3rd Annual Report

CARE

Coordinated Accelerator Research in Europe

Integrating Activity

implemented as

Integrated Infrastructure Initiative

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Project Co-ordinator: Roy ALEKSAN

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In memory of the late Francesco Ruggiero, coordinator of the HHH Activity.

A. ACTIVITY REPORT

1. PROGRESS REPORT

1.1 Summary of the activities and major achievements

The CARE project includes three networking activities ELAN, BENE, HHH, and four joint research activities SRF, PHIN, HIPPI and NED. The third year of the project has permitted the following major achievements.

1.1.1 Networking Activities

CARE Management Activity

- Edition of the first CARE annual report (June 2006)
- Table of the CARE deliverables regularly updated on the CARE web site
- Organisation of the CARE general meeting CARE06 (INFN-Frascati, November 2006)

N1 Electron Linear Accelerator Network (ELAN)

- Preparation for an ILC European contract and for Integrated Activities within FP7
- Support of first international ILC school in Japan

N2 Beams in Europe for Neutrinos Experiment (BENE)

- The BENE Midterm Interim Scientific Report was published in final form: a detailed outline and a plea for a timely R&D program
- Completion of the International Scoping Study and clear indication towards next step towards in depth International Design Studi(es).

N3 High Energy High Intensity Hadron Beams (HHH)

- Novel scenarios for the upgrade of the LHC interaction regions were developed along with new sets of beam parameters, which are better tailored to a higher-luminosity LHC.
- In 2006, a first test of crystal reflection in the SPS North Area with a 400-GeV proton beam demonstrated more than 95% extraction efficiency, which opens up a new perspective for the upgrade of the LHC collimator system.

1.1.2 Joint Research Activities

JRA1 Superconducting Radio Frequency (SRF)

- Based on the experience of hydroforming of Niobium cavities, several single-cell cavities and the first three large grain nine-cell cavities worldwide have been fabricated from large grain niobium, achieving the accelerating gradients of 41 MV/m for single-cell and 30 MV/m for the three nine-cell cavities (WP3).
- On the basis of metallographic investigations and electron beam welding tests on niobium single crystals, a prototype single crystal single-cell cavity was fabricated and achieved an accelerating gradient of 37.5 MV/m (WP3).
- Using the dc field emission scanning microscope it was shown that standard electro-polished high-pressure-water rinsed Nb samples avoid field emission (FE) up to surface fields of 120 MV/m (WP6).
- Piezo-tuners have demonstrated the compensation of the cavity detuning up to 25 MV/m accelerating field (WP8, WP10).

- A BPM prototype with a new signal processing electronics has been qualified with beam in a warm section of the FLASH (TTF) accelerator achieving a 4 µm resolution (WP11).

JRA2 Charge Production in Photo-Injectors (PHIN)

- Production of photocathode with quantum efficiency above CTF3 specifications (WP2).
- Electron beam spectrometer (0- 300 MeV) has been used to measure electron beam produced in the new "two colliding pulse" regime (WP2).
- CTF3 laser amplifiers full power tested at RAL (WP3).
- First production of low emittance electron beam with square laser pulse in the SPARC RF gun; production of "comb shape" laser pulse with phase mask pulse shaping (WP3).
- Photocathode preparation chamber, transfer and storage system installed and tested in the new clean room. All parts of SRF gun cryomodule assembled and tested including all vacuum and diagnostics components (WP4).

JRA3 High Intensity Pulsed Proton Injector (HIPPI)

- RF measurements on the CCDTL prototype (WP2).
- First cold measurement results from the CH prototype (WP3).
- The completion of the CHOPPER A hardware including vacuum tests and electrical measurements. The chopper structure is validated (WP4).

JRA4 Next European Dipole (NED)

- Commissioning of double-bath cryostat manufactured under the supervision of Wroclaw University (WP2)
- Characterization tests of first 1.25-mm-diameter wire produced by SMI showed record critical current density of 2500 A/mm^2 at 4.2 K and 12 T (WP3).
- Development of a Finite Element model to simulate cabling degradation (WP3).
- Production and characterization of first polyimide-sized, glass fibre tape (WP4).

1.2 MANAGEMENT ACTIVITY

- The 2006 instalment received from the EC has been distributed to the CARE contrators.
- The CARE Web site http://care.lal.in2p3.fr/ has been regularly updated (CNRS-Orsay).
- The official table of the CARE deliverables has been regularly updated on the CARE Web site at http://care.lal.in2p3.fr/Deliverables .
- The CARE Publication Database has been maintained and updated (CEA).
- Release of two intermediate activity reports per activities, available from the CARE web site http://care.lal.in2p3.fr/Quaterly/NA/ and http://care.lal.in2p3.fr/Quaterly/JRA/ .
- The following table lists all the management meetings as well as the general annual meeting CARE 06 organised by the management team.
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Date	Title/subject of meeting	Location	Number of attendees	Website address
11 April 2006	CARE Steering Committee and Dissemination Board	Paris	10	http://care.lal.in2p3.fr/CAREmeetings/Management/Steering/Schedule/
13-14 September 2006	CARE Steering Committee and Dissemination Board	CERN	15	http://care.lal.in2p3.fr/CAREmeetings/Management/Steering/Schedule/
15-17 November 2006	General meeting CARE'06	Frascati	125	http://www.lnf.infn.it/conference/care06/index.htm
16 November 2006	CARE Steering Committee and Dissemination Board	Frascati	16	http://care.lal.in2p3.fr/CAREmeetings/Management/Steering/Schedule/
17 November 2006	CARE Governing Board	Frascati	20	http://care.lal.in2p3.fr/CAREmeetings/Management/Governing/Schedule/

1.3 NETWORKING ACTIVITIES (other than Management)

1.3.1 N1: Electron Linear Accelerator Network (ELAN)

ELAN is the CARE network for Electron Linear Accelerators. It comprises 11 countries plus CERN. The list of participants and their implication in the ELAN Work Packages (**C**: Coordination, X: Participation) is given in the table below. The overall management is done by CNRS-Orsay and CERN.

Number	Participant	WP1 LTECNC	WP2 LTECSC	WP3 BDYN	WP4 INSTR	WP5 ANAD
1	**CEA**		X	X	X	
3	**CNRS**	X	X	X	X	X
	CNRS-		X	X		
	CNRS-					X
	CNRS-					X
	CNRS-	X			X	
	CNRS-LOA	X			X	X
	CNRS-					X
	CNRS-	X				
5	**DESY**		X	X	X	
7	**FZJ**				X	
8	**FZR**		X		X	
10	**INFN**	X	X		X	
	INFN-LNF	X			X	
	INFN-LNL		X			
	INFN-Mi		X			
	INFN-Na		X			
	INFN-Ro2		X			
11	**TEU**				X	
12	**TUL**		X			
13	**IPJ**		X			
14	**WUT-ISE**		X			
16	**CSIC**		X	X		
	CIEMAT		X			
	LEII		X			
17	**CERN**	X		X	X	
19	**PSI**				X	
20	**CCLRC**	X	X	X	X	X
21	**ICL**			X	X	X
22	**UMA**			X	X	

There are also associates:

Participant number	Organisation (name, city, country)	Short name	Associated to
1	Center for the Advancement of Natural Discoveries using Light Emission, Yerevan , Armenia	CANDLE	CERN
2	Technion – Israel Institute of Technology, Tel-Aviv, Israel	Technion-IIT	CERN
3	Stanford Linear Accelerator Center, Stanford, USA	SLAC	CERN
4	Krakow University of Technology, (Institute of Applied Mechanics), Krakow, Poland	CUT	CERN

N1.1 MEETINGS

Annual ELAN meeting in Orsay

This meeting was organized in sequence with the EUROTEV and EUROLEAP meetings to maximize the connections between the communities involved and to reduce travel expenses. There were 85 participants in total. The meeting lasted 3 days. On the first morning, May 15, there were the following talks: http://ilcagenda.cern.ch/conferenceTimeTable.py?confId=293

- Laser plasma accelerators: achievements and plans, Brigitte Cros (*LPGP/Orsay*)
- Progress and plans on warm cavity technology, Sergio Calatroni (*CERN*)
- Summary of the workshop on polarized positron source based on Compton back scattering, Louis Rinolfi (*CERN*)
- An SC RF Facility at CERN? Lutz Lilje (*DESY*)
- Achievements and plans for Instrumentation and Beam Dynamics Daniel Schulte (*CERN*)

In the afternoon a discussion took place on the preparation of FP7:

- New Informations Francois Richard (*LAL*)
- Infrastructures for R&D on SC available at CERN Sergio Calatroni (*CERN*)
- Possible synergy with R&D for protons Jean-Pierre Delahaye (*CERN*)
- The ELI proposal Victor Malka (*LOA*)
- Questions and issues on an new IS for SCRF Lutz Lilje (*DESY*)
- Proposals for JRA Francois Richard (*LAL*)

Discussions were centred on a possible construction of a new infrastructure for SCRF at CERN by re-using and upgrading the complex which already exists.
A specialized working party took place afterwards involving experts from the major players in SCRF technology after which a document was written (ELAN Document-2006-04).
There were 4 Parallel ELAN sessions for half a day.
The EUROLEAP kick-off meeting took place on May 16 while EUROTEV met in parallel.

CARE Annual Meeting in FRASCATI

During this meeting, ELAN has organized detailed presentations of the plans for FP7 for what concerns the Integrated Activities. These talks can be found in:
http://esgard.lal.in2p3.fr/Project/Activities/Current/Networking/N2/ELAN/Meeting/ELAN-CARE06/index.php

There were:

- A general presentation on Research Infrastructures in FP7 by G. Guignard (CERN)

- A presentation on SCRF activities in Europe and plans for FP7 by O. Napoly (Dapnia)
- Novel acceleration systems and preparation for bids by G. Guignard (CERN)

A large part of the meeting was devoted to discussions.

N1.2 Publications

The list of ELAN-Documents can be found in the ELAN database:
http://esgard.lal.in2p3.fr/Project/Activities/Current/Networking/N2/ELAN/Documents/

N1.3 Web sites

The central ELAN web page http://care.lal.in2p3.fr/Networking/N2/ELAN/ and the web pages of the 5 work packages have been regularly updated.

N1.4 Activities of ELAN in 2006

This year has been very active in various sectors connected to ELAN priorities.
The 3 work package leaders on Beam Dynamics (BDYN), Instrumentation (INSTR) and SC technology (LTECSC) had contributions directly embedded in the Global Design Effort (GDE) for the ILC project. The coordinator has been involved in reinforcing the connection between the GDE and the community of particle physicists through organizing common workshops (e.g. the ECFA/GDE workshop in Valencia) with debates resulting in crucial choices for the parameters of this machine. ELAN resources were instrumental in helping the various ILC workshops. Also, the first international ILC School, which has been held in Japan in 2006, has been supported by ELAN, providing a lecturer on beam dynamics.

The CLIC R&D is centered on the CT3 facility and aims at a proof of feasibility in 2010. There was active participation of the Normal Conducting Technology working package (LTECNC) through workshops supported by ELAN with emphasis on possible synergies with the ILC project. Examples of this are:

- Preparation of an experiment at KEK on micrometer beams
- Beam Dynamics
- Laser technology to produce polarized positron beams

Concerning the CLIC-CTF technology, a topical workshop on High-gradient RF was held on the development results for high-gradient RF structures and high-power specific phenomena. Another workshop dealt with the use of Compton back-scattering for the production of polarized positrons.

For what concerns laser-plasma electron accelerators (work package ANAD), the ELAN convener had the responsibility of launching Euro-LEAP the newly approved NEST contract. This happened during the ELAN yearly meeting at Orsay where intense discussions took place to define the strategy of these rapidly progressing techniques.

ELAN took an active part in initiating the preparation for FP7:
1/ we take part to an initiative to reinforce the European contribution to ILC through a newly born tool created to support the preparatory phase of large international projects supported by ESFRI
2/ we also take part through ESGARD to the coordination of the various proposals of Integrated Activities (IA) for R&D. Three working groups were created to cover the topics on high-energy, high-intensity proton beams, on SCRF technology and on novel acceleration systems. ELAN takes part in the last two.

N1.5 Overall Progress of Work Packages

Work Package 1: Normal Conducting Linac Technology (LTECNC)

	Title	Original end date	Estimated Status	Revised end date
WP1	**Normal Conducting Linac Technology**			
1.3	Proceedings CTF3 workshop	Dec. 2006		Beginning of 2007
	Review of structure prototype Results	March 2006	ELAN/Doc-06-15	

Work Package 2: Super Conducting Linac Technology (LTECSC)

	Title	Original end date	Estimated Status	Revised end date
WP2	**Superconducting Linac Technology**			
	Data Base for SCRF	July. 2006	Integration into ILC GDE activities started	End 2007

Work Package 3: Beam Dynamics (BDYN)

	Title	Original end date	Estimated Status	Revised end date
WP3	**Beam Dynamics**			
	Workshop to coordinate Further R&D	June 2006	ELAN-Doc-06-11	

Work Package 4: Instrumentation (INSTR)

	Title	Original end date	Estimated Status	Revised end date
WP4	**Instrumentation**			
	Review progress on diagnosticS	Jun. 2006	ELAN-Doc-06-11	

Work Package 5: Advanced and Novel Accelerator Development (ANAD)

	Title	Original end date	Estimated Status	Revised end date
WP5	**Advanced and Novel Accelerator Development**			
	Evaluate existing laser guiding Techniques	feb. 2006	ELAN-Doc-06-13	
	Identify optical diagnostics	June 2006	In progress	March 2007
	Build database of plasma accelerators	Nov. 2006	Postponed	End 2007

N1.6 Significant Achievements

- Preparation for an ILC European contract within FP7
- Support of 12 workshops on innovative linac technologies
- Helping the synergy between ILC and CLIC (positrons)
- Encouraging connections between laser-plasma acceleration and standard techniques
- Preparatory work for Integrated Activities within FP7
- Release of 17 documents in the ELAN web-base which describe in detail some of the contributions achieved under ELAN
- Support of first international ILC school in Japan

N1.7 List of all deliverables during the reporting period

Data base on diagnostics performance in WP4 from CCLRC and UMA.
There is now a web page connected to the ILC-GDE:
http://www.pp.rhul.ac.uk/~blair/ELAN/INSTR/ELAN_INSTR_home.htm

N1.8 List of major meetings organized under ELAN during the reporting period

2006		
ILC-LET Workshop	08 - 11 February	CERN
LCWS2006 International Linear Collider Workshop GDE Meeting	09 - 13 March 09 - 11 March	Bangalore, India
Compton Posipol Workshop 2006	26 - 28 April	CERN
XFEL Workshop organized by EIFast	09 - 10 May	DESY, Hamburg
Electron Accelerator R&D for the Energy Frontier	15 - 17 May	Orsay, France
ILC School	19 - 27 May	Sokendai, Hayama, Japan
VLCW06 Vancouver Linear Collider Workshop	19 - 22 July	Vancouver, British Columbia, Canada
HG2006 Workshop on High Gradient RF and breakdown studies	25 - 27 September	CERN
International Workshop on "Thin films applied to Superconducting RF: Pushing the limits of RF Superconductivity"	09 - 12 October	Legnaro National Laboratories INFN (Padua) Italy
Mini Workshop 19 october 20 october Design and Technical Challenges of the ILC Small Angle Interaction Regions"	19 October 20 October	LAL Orsay CEA-Saclay
International Linear Collider (ILC) Workshop ILC-ECFA and GDE Joint Meeting	06 - 10 November	Valencia, Spain
CARE06	15 - 17 November	Frascati, Italy

1.3.2 N2: Beams in Europe for Neutrino Experiments (BENE)

BENE is the CARE network for Beams for European Neutrino Experiments. It comprises 13 countries. The table of the participants and their implication in the BENE Work Packages is given in the table below. The overall management is done by INFN-Na.

Participant number	Participant	PHYSICS	DRIVER	TARGET	COLLECTOR	NOVEL NEUTRINO BEAMS
1	**CEA**	X	**C**	X	X	**C**
2	**UCLN**	X				X
3	**CNRS**	X			X	X
	CNRS-Orsay	X			X	X
	CNRS-LPNHE	X			X	
	CNRS-CENBG	X				
	CNRS-IPNL	X			X	
	CNRS-LPSC					**Cb**
	CNRS-IReS	X			**C**	
4	**GSI**					X
7	**FZJ**		X	X		
8	**TUM**	X				X
10	**INFN**	**C**	X	X	X	X
	INFN-LNF	X				X
	INFN-Ba	X				X
	INFN-Ge					X
	INFN-GS	X				
	INFN-LNL	X	X			X
	INFN-Mi	X				X
	INFN-Na	X				X
	INFN-Pa	**C**				X
	INFN-Pi	X				
	INFN-Tr	X				X
	INFN-Ro3	X				X
	INFN-To	X				
16	**CSIC**	X				
	UBa	X				
	IFIC	X				
	UAM	**C**				
17	**CERN**	X	X	X	X	**Cc**
18	**UNI-GE**	X		X	X	X
19	**PSI**			X		
20	**CCLCR**	X	X	**C**	X	X
	CCLRC-RAL	X	X	**C**	X	X
21	**ICL**	X		X		**Ca**

In 2006, we finally welcome a new Deputy Coordinator (S. Pascoli, from Univ. of Durham) who accepted the job in December. New WP coordinators have taken up the DRIVER (M. Zito), TARGET (C. Densham) and COLLECTOR (M. Dracos) WP. A new PHYSICS co-coordinator was drafted (A. Donini).

During 2006, the BENE[1] Network has

1) **Welcome first operation of the CNGS in August:** while BENE looks forward to more ambitious future facilities, it is well aware that these can only be rooted in the expertise that has produced the CNGS and its predecessors, the WANF and the PS neutrino beams. Exploration of the upgrade paths to maximal CNGS performance remains BENE immediate priority.

2) **Submitted its recommendations to the CERN Council Strategy Group**.
BENE prepared a comprehensive report electronically submitted by Jan 31st," for the preparatory Open Symposium of the CERN Council Strategy Group in Orsay. It is an outline and a plea for a timely R&D program in the accelerator (and detector) neutrino sector.
Before this, members of BENE were present in the task forces that CERN set up to look into its options for proton accelerator of the future (PAF) and into the physics opportunities of those future proton accelerators (POFPA), with the decisive task of designing the best possible proton complex capable of best serving LHC and its upgrades, an ambitious neutrino program, some frontier aspects of kaon, muon and other fixed target physics, the nuclear physics of radioactive ion beams and possibly more.
A. Blondel, a senior member of BENE, organized the neutrino session in Orsay. M. Mezzetto, BENE PHYSICS coordinator, was secretary. P. Huber and A. Cervera gave the theoretical and experimental talk, respectively. This was a success, according to neutral observers, it showed that the European accelerator neutrino community has the physics case, the enthusiasm, the organization and, we trust, also the technical competence, necessary to make a new accelerator neutrino complex, built with a decisive EU contribution, conceivable. Many interventions of BENE members underlined different crucial tasks ahead of us. The conclusions of the session were voiced by the BENE coordinator**: a timely R&D program should not be procrastinated**.

3) **Produced Networking Activity Midterm Scientific Report** (CERN 2006-05, CARE 2006-009-BENE, ECFA 06/242) evolved from the electronic report for Orsay. It summarizes the state of advancement of our initiative, reviewing progress and proposing a preliminary road map towards a new European accelerator neutrino facility to be built in the coming decade.

4) **Contributed to the syllabus of the International Scoping Study (ISS), the one-year study on Neutrino Factories and Superbeams** launched at the BENE edition of Nufact05 in Frascati in June 2005 and completed in Aug 2006 at NuFact06. The **concluding recommendation** of the ISS was to proceed now to a few few-years **International Design Studies**: presumably an IDS on neutrino factories, one on betabeams, and one for each superbeam option presently envisaged. The final report of the ISS is expected in Jan 2007 and IDSs should now be promoted. The Study has

[1] BENE's mandate is that to promote clear awareness, in our particle physics peer community, a) the physics interest of superior accelerator neutrino beams (Superbeams, Betabeams, Neutrino Factories) b) the promising on-going developments of accelerator technology that will make them possible c) the opportunities that exist to plan, fund, and realize, on a realistic time scale, a much enhanced European accelerator neutrino complex.

been organized jointly by the Neutrino Factory and Muon collider collaboration in the US, the Japanese NuFactJ collaboration and our ECFA BENE Network for future neutrino beams in Europe, where it was hosted at CCRLC laboratories by the UK neutrino factory collaboration that has promoted it first. Important contributions have also come from India (INO), Russia, Poland and Bulgaria. The coordinator of BENE, one representative of the US-MC (S. Geer), NuFACTJ (Y. Kuno) and UKNF (K. Peach) were asked to overview the study. Their proposal to have 3 sub-studies coordinated by Yori Nagashima (Physics Group), Mike Zisman (Accelerator Group), Alain Blondel (Detector Group) was accepted. Overall leader of the ISS is Peter Dornan (UK). The ***Physics*** group has been revisiting the reach of future accelerator neutrino beams. Neutrino factories and superbeams are compared to each other and to neutrino betabeams The ISS boosted the work on comparison between facilities constructing more reliable, though not yet final, comparison yardsticks. It reviewed the deep underlying physics motivations for a precision neutrino facility and the value of measurements within and beyond the minimal 3 neutrino scenario. It also explored the synergy between precision physics with slow muons and neutrino factories. Member of the BENE network played leading roles in the ISS Physics Study. Five members of the eleven in the ISS Physics Council were drawn from BENE with M. Mezzetto (Padua) on both the Physics and Detector councils to form a link between the two working groups. Two of the four Physics subgroup conveners were members of the BENE network (Theory Subgroup convener, S. King, Southampton, and Experimental Subgroup convener K. Long, IC London). Significant portions of the theoretical and phenomenological sections of the ISS report are being provided by BENE members. The comparison of the performance of the various proposed facilities received substantial input from the Munich, Madrid and Valencia groups. The outcome of the study is that the Neutrino Factory offers the best sensitivity over a large region of the parameter space, the beta-beam being a competitive option for intermediate values of the small mixing angle θ_{13}. At large values of θ_{13} super-beams, beta-beams and the Neutrino Factory give comparable performance. The ***Accelerator*** Group has been revisiting the components of the accelerator chain, proton drivers, target and collection systems (common to Factories and Superbeams) and ionization cooling, acceleration and storage of muons (specific of Factories). It established a coherent set of baseline parameters and options for the various components of a neutrino factory capable of 10^{21} muon per year per decay straight section with the desired angular divergence. Some preliminary studies of a MMW superbeam were also started. A first list of important R&D items, being prepared, will be included in the Accelerator section of the ISS Report. All convenors of the BENE WP's contributed to this work and are now writing portions of the Report. EU contributions are however still far from having the necessary impact. We hope that can come in the context of the IDS and the FP7 initiatives (see below), with a more resolute involvement of CERN experts. The *Detector* Group revisited the outstanding issues involved in the realization of neutrino detectors of adequate mass and performance for each of the three beam options. It rejuvenated simulation and study of neutrino factory detectors and established "baselines" (detectors that can be built, with reasonable first estimates of performance and cost) and "optimistic baselines" (detectors with potentially better performance, but feasibility and affordability still to be ascertained). A first list of important R&D items, being prepared, will be included in the Detector section of the ISS Report. Main editors (and Group convenors) are A. Blondel and P. Soler that have raised help from a large number of BENE colleagues. Finally, a collaboration of the physics and detector groups addressed the systematic issues of experimental nature (matter effects,

uncertainties of neutrino cross sections, flux control etc..) The ISS has thus proven a valuable tool and reached quite a few goals. It also emphasized areas where we need however to score better results:
1) raising funds for the studies and
2) rallying more coherently the entire community of experimental physicists presently operating or preparing experiments on accelerator neutrino beams

5) **Contributed to the NuFact06 Workshop and to the formulation of the proposal for the evolution of the ISS** that emerged there**.** The NuFact Workshop is the yearly international forum of a world-wide collaboration of several regional communities and has gained importance over the years, as can also be judged from the number of accompanying satellite events.. A large BENE delegation was present to both meetings, presenting the work of one year in about 1/3 of the talks given in all parallel and plenary sessions of the workshop. More than ever, for the scope of presenting and evaluating the ISS, NuFact06 provided the most advanced possible review today of the potential of both conventional and novel neutrino facilities. The most promising physics result emerged was probably a scheme proposed by C. Rubbia for enhanced production of parent ions for betabeams.

6) **Brought about,** as in each previous year, **the approval of R&D programs,** notably this year in the sector of particle acceleration by FFAG, securing **the funding of the EMMA** project in the UK **and of the RACCAM project** in France. This is taking off fairly well in Jan 2006 on scaling FFAG and magnet prototyping, which will also concern the type of FFAG needed in Japan for their NuFact acceleration scheme and for the KURRI high power p beams**.**

7) **Has been and is now even more preparing very actively the proposals for the IDSs and for several possible FP7 programs .** We are following closely the guidance of the ESGARD in this domain and reporting regularly to ECFA, last on Nov 30. Open meetings of the BENE Steering Group (SG) were held at CERN on this subject on July 4, on October 25, at BENE06 on Nov 14 and during CARE06 on Nov.15-17. We are preparing a coherent set of multiple FP7 initiatives: to apply for Design Study funds in the first FP7 call and for a number of indispensable JRA's within either a Neutrino I3 or larger scope I3s for the second FP7 call, to explore one or more "ERC" projects at the frontiers of science and to address other EC programs that are also being investigated. This is the most recent and advanced document produced on this subject.

There were a few key events this year for BENE. **One** has no doubt been the special session of **CERN Council on July 14 in Lisbon**. This approved a document outlining a **Strategy for European particle physics**. Council emphasized early in the document "the *vital need to strengthen the advanced accelerator R&D programme*", stating that "*a coordinated programme should be intensified, to develop the CLIC technology and high performance magnets for future accelerators, and to play a significant role in the study and development of a high-intensity neutrino facility*", adding finally that "*studies of the scientific case for future neutrino facilities and the R&D into associated technologies are required to be in a position to define the optimal neutrino programme based on the information available in around 2012; Council will play an active role in promoting a coordinated European participation in a global neutrino programme*".
It seems therefore that the BENE strategy, including its attention to international collaborations in a truly global context, **was recognized by Council**. We look now forward to

deploy the strongest possible effort to contribute to the establishment of such a coordinated European participation to a structured European and International R&D program. The task is that of assembling a large and solid collaboration of laboratory and university teams supported by all the European agencies willing to contribute funds and human resources to our sector. This EU collaboration would participate to a global effort, clustering around a small but freshly re-motivated CERN task force and heading resolutely towards securing crucial FP7 EC funds.

More generally, the process started by BENE with the "Physics with a multi MegaWatt proton source" Workshop at CERN, in May 2004, described in the 1st CARE/BENE annual report, has continued. It was much reinforced by the SPSC recommendations, following our participation to its strategic meeting in Villars in September 2004, by the start of a BetaBeam Design Study in January 2005 and by the completion of the ISS in 2006. ECFA support has also been warm and constant. This continuity of strategy and initiative has taken us to the present time that seems be preparing important decisions on R&D support. Council has now all the elements to take them, possibly soon in 2007.

A **second key event** of the year has been then at Univ. of California, Irvine 21-23 and 24-30 August, with **the fourth meeting of the ISS and NuFact06**, the 8th International Workshop on Neutrino Factory, Superbeam & Betabeam. The main conclusions reached at NuFact06 (and the ISS meeting that preceded it) were summarized in a document http://www.hep.ph.ic.ac.uk/~longkr/tmp/ISS_Doc4-v06_28-8_2006.pdf proposed by the Programme Committee of the ISS, that NuFact06 discussed and endorsed in a dedicated session. In view of the fact that"*Conceptual Design Report (CDR) for the considered facilities should* be available *around 2012*" with "*Interim Design Reports available around 2010"* it states *"that full international design studies (IDS's) of the super-beam, betabeam and neutrino factories are needed*" and that these "*design studies would each be initiated by those seeking to propose a particular option and would be carried in parallel. The teams carrying out the studies would be encouraged to work together on areas of common interest. The detector requirements for the betabeam and superbeam are very similar as are the multi megawatt proton driver and target for the neutrino factory and Superbeam*". It recommends too that a "*physics working group continues the work of evaluation of performance and comparison that was initiated by the ISS"* and suggests that the*"regional oversight bodies could provide a degree of coordination***".** The next ISS/IDS meeting will be at CERN in February, most likely on Feb 19-21. It will start defining the ways of the transition from ISS to IDS's.
The results of the ISS clearly emphasise the need for a coordinated programme of R&D and design work. Resources to support this programme will be sought from all EU particle physics funding agencies and from Framework Programme 7.
A third event was the **NNN06 Workshop on Next Nucleon decay & Neutrino** detector in Seattle, USA, Sep 21-23, that reviewed the physics case and the technical challenges of these very large mass detectors and further structured the international collaboration towards their realization.

The two NuFact and NNN workshop series remain the yearly international forums of the two physics options that BENE tries to promote. These two main physics strategies that have been consolidating over the last few years are:

1 use of the high neutrino rate (>10^{20}/year) and **energy** (10-50 GeV) promised by the **Neutrino Factory**, in conjunction with a detector of large but not huge mass (50-100 Kt), necessarily magnetic (a dense magnetized iron detector, or, possibly, Li-Argon in mag field), a few 1000 Km away.

2 use of the **low**er neutrino rate (10^{18-19}/year) and **energy** (sub-GeV) offered by a **Betabeam**, in conjunction with a low density detector of very large mass () and volume, non **magnetic** (a 0.5-1 Mt Water Cerenkov detector, or possibly, again 100 Kt Li-Argon), a few 100 Km away. This is the same detector needed to extend the search for nucleon instability, supernovae and other astrophysical phenomena.

The statements of our last yearly report and, more extensively, of our Midterm Report, have been confirmed by the ISS: the two options have comparable merits. The second option appears to have somewhat lower performance, for neutrino oscillation physics, but offers also a synergy with other fundamental sectors of physics, as detection of super-nova, atmospheric or solar neutrinos and proton lifetime.

These preliminary conclusions, particularly after the work of the ISS Physics group, are now based on much better agreed yardsticks. They must still however undergo sharper and sharper scrutiny.

The two strategies are also, to large extent, complementary. Both are and must be pushed very actively. We are confident that international collaboration can bring about, in due time, both type of facilities and we should seriously aim at hosting one of them in Europe.

NB It should be**, however**, kept in mind that more recently proposed, **intermediate solutions with higher energy** and higher rate **betabeams**, very attractive though possibly more difficult, **deserve** indeed continued **attention**.

Superbeams are less performing, per se. But they do offer a technical synergy with Neutrino Factories and a scientific synergy with Betabeams. Their realization should be possible early on the path leading to either of the two others. So they **are likely to be integrated in both strategies** and be available for physics at a rather early stage.

A superbeam facility technically largely coincides with the front end of a Factory. High power is the crucial keyword. If one solves the technical challenges presented by a several MegaWatt class proton driver and target and collection system, on the way to build a factory, a superbeam facility will be available essentially for free and usable in conjunction with a large volume detector built for astroparticle physics.

A betabeam and superbeam can instead use together this same detector and their combination has some truely unique features. The oscillation signal is $\nu_e \rightarrow \nu_\mu$ in the first, $\nu_\mu \rightarrow \nu_e$. in the second, so that one calibrates the signal (and the background) of the other. T-reversal and CPT asymmetries, probably not accessible to a factory, can be measured.

Neutrino Betabeams are the subject of a complete 4 years Design Study that was approved in 2004, will last from 2005 to 2008 and produce a Conceptual Design Report (CDR) by early or mid 2009.

Neutrino Factory and Superbeam need to advance to a similar status with FP7. One can thus understand the push to propose a longer and more in depth, effort, possibly under more than one FP7 program, so to have a CDR ready by 2012 or so in this sector too.

A proposal for a new superior neutrino facility will become thus possible, based on the final CDRs, at about the right time for new major investments in particle physics. When presumably LHC expenditures will be completed, its first results available and a decision on the ILC taken.

In this general process, of course, our NA has been consistently supporting and reviewing the on going R&D projects HARP, MUSCAT, MUCOOL, HIPPI, MICE, MERIT, and the beta-beam Design Study. Much scientific, technical and organizational work in these Collaborations has been done by BENE members.

N2.1 Meetings

The major events organized or co-organized by BENE in 2006 were:

1) After the first meeting at CERN Sep 22-24, 2005, **the second meeting of the ISS in KEK, Tsukuba, Jan 23-25.** It was a good success with over 60 people with parallel group meetings of the three working groups, accelerator, detector and physics, and joint plenary meetings Details can be found on the transparencies, available from the ISS website,

2) The **third meeting of the ISS at RAL 25-27 Apr.,** again a good success with over 70 people Again meetings of the three working groups and joint plenary meetings Transparencies, available from the ISS website,

3) **The 1st BENE plenary meeting Apr 28 at RAL**. This was a special shorter meeting of one day dedicated to the exam of FP7 options. The chair of ESFRI, J. Wood, addressed BENE there. A complete review of BENE FP7 options was the main theme.

4) One Open meeting of the BENE Steering Group (SG) was held on the preparation of FP7 proposals on July 4 at CERN. It proved to be a useful tool.

5) The fourth meeting of the ISS at UC Irvine, Aug 21-23, that drew the conclusions of this first phase, largely described above

6) **The NuFact06 International Workshop, the 8th International Workshop on Neutrino Factories, Suprbeams & Betabeams**, still in Irvine Aug 24-30, 2006.
Also this year, **the 5th NuFact06 International Summer School** on Neutrino Factories & Superbeams & Betabeams took place in Irvine next to the workshop. First introduced in 2002 by the EU component (not yet known as BENE) the School is now well established. The aim of the school is to provide young particle physicists with an introduction to both particle and accelerator physics aspects of conventional and novel neutrino beams. The long-term goal of this series is to lay the foundation for a large international group of scientists with the diverse skills essential to secure the future of accelerator neutrino experiments. An essential task indeed, for BENE. We had many EU lecturers as usual, a few EU students attended, most being of course Americans, this year.
Plans are already being made to host again the NuFact08 workshop and school in Europe, after NuFact07 in Japan.

7) The **NNN06 Workshop on Next Nucleon decay & Neutrino** detector in Seattle, Sep 21-23. This is the 5th edition of this international Workshop, organized with decisive contributions of groups working in BENE. The concept of a large Megaton water detector has emerged independently in the 3 regions, under the name of Hyper-Kamiokande in Japan, of UNO in the USA, MEMPHYS in the Western Alps in Europe, where the Li-Argon option is also well alive. The three designs have much in common, the collaborations have significant

overlap and work in very close cooperation, with the aim of realizing commonly one such detector in the region that will offer the best and earliest opportunity. Cooperation was further strengthened in Seattle.

8) A second Open BENE SG Oct 25; we progressed on the formulation of our FP7 proposals, in view of the the outcome of the ESGARD and CARE meetings in September and once again of CERN Council in October.

9) A regular week of meetings of BENE related work packages, study groups and R&D projects (BENE06) took place during and immediately before CARE06 in Frascati. We had parallel meetings of several WPs. Then a plenary session of all accelerator WP together, where the themes of each of them (DRIVER, TARGET, COLLECTOR, MUFRONT, MUEND and BETABEAM) and those specific of the HARP, MICE, MERIT and other R&D experiments will each covered by a few hours of presentations and discussion. A plenary session of the PHYSICS WP followed. Finally, discussion took place on the evolution from the ISS to the IDSs and on the IDSs relation with the FP7 commitments that we hope to take. Last, the agenda of BENE in 2007 was finalized.

At the WP level, only rarely dedicated meeting were held, in addition to the CARE06 meetings and the many meetings of the ISS. Phone-meeting are instead common practice by now to prepare the major events.

The PHYSICS WP met in both Physics and Detector groups of the ISS at the KEK meeting of the ISS in January, at the Joint BENE/ISS meeting at RAL 24-29 April, at the Irvine meeting of the ISS in August, in the ISS Physics Group meetings in Boston (6-10 Mar) and Valencia 3-6 July, 2006, in the ISS Detector meeting at CERN July 3-5, 2006 and during CARE06 in Frascati.

The accelerator WP's (DRIVER, TARGET, COLLECTOR., MuFRONT, MuEND) met in in the specific sessions of the Accelerator group of the ISS at the KEK meeting of the ISS in January, at the Joint BENE/ISS meeting at RAL 24-29 April, at the Irvine meeting of the ISS in August, at a dedicated Accelerator Group meeting July 26–28, 2006 at Princeton University and finally at CARE06.

In the COLLECTOR WP additional travel was necessary for some meetings with institutes (outside of our field) and private companies to define the horn pulse generator.

MuEND participated to FFAG06, BNL, April, where F. Méot was rapporteur of "Muon acceleration" session and to the EMMA team meeting, RAL, 22 April. EMMA aims at a first European electron model of a linear non-scaling FFAG. EMMA proto-collaboration phone meetings also take place with periodicity of 2-3 week since more than a year, involving BENE people, US, TRIUMF and Japan

The members of the BETABEAM WP reported, to all meetings of BENE interest listed above, the progress of their work package in the Eurisol Design Study that has its own regular schedule of meetings.

In addition, BENE has been present to all major neutrino events in the year. In 2006 we will mention only two most important and representative events, the International Neutrino Conference NU2006 in Santa Fe in June and the ICHEP Conference in Moscow, all attended by a significant BENE delegation with speakers in several sessions and/or panel discussions.

BENE has also made reports at regular ECFA meetings in the year. It also keeps regular contact with the Chairs of the CERN scientific committees (SPSC, SPC) and the CERN Directorate.

N2.2 Publications

The main publication of the year is of course the Scientific Midterm Report mentioned above.

An overview of BENE documents and publications can be found in:
http://bene.web.cern.ch/bene/publications/
From there one can link to the documents created by each work package. They are structured in the same way as it is proposed for the general CARE publication policy, i.e. CARE-Note/Report/Conf/Pub/Document.
Regular update of the database of publications by the work package convenors and the BENE deputy coordinator has been hindered by the lack of a deputy coordinator. It should now soon finally be resuming in earnest.

N2.3 Web Sites

The BENE Main Web Page has been improved and refurbished at http://bene.web.cern.ch/bene/.

It displays the general plan of BENE activities for about 1 year ahead. Basic informations are kept up to date. BENE federates several pre-existing working groups and relies on their several pre-existing Web sites
http://muonstoragerings.web.cern.ch/muonstoragerings/Welcome.html
http://nfwg.home.cern.ch/nfwg/nufactwg/nufactwg.html
http://beta-beam.web.cern.ch/beta-beam/

The process of re-organization into a unitary site, in tune with the BENE federative process, continues. In each BENE WP Web page, the fraction of the material relevant to the scope of WP is being reorganized in a coherent set of links.

The Mailing List of members, bene@cern.ch, has been further extended. In addition there exist mailing lists of each work packages. (hep-mgt-betabeam@cern.ch, hep-mgt-bene-collector@cern.ch, hep-mgt-bene-drivers@cern.ch, hep-mgt-bene-muend@cern.ch, hep-mgt-bene-mufront@cern.ch, hep-mgt-bene-physics@cern.ch, hep-mgt-bene-target@cern.ch).
Other lists of more loosely connected colleagues are also maintained.

N2.4 Activities of BENE in 2006

BENE's further acceleration of initiative in 2006 is driven by the work of its Steering Committee that has created the necessary networking tools for this and organized the main meetings and the other events. Regular phone-conferences are the main tool of coordination in the interval between meetings. Closed or Open meeting of the SG in person occur then at each of the major events that BENE supports.

The BENE SG was the core of the editorial board of the Midterm Report. Its main long term task is presently to identify and formulate content and ways of proposals for a larger, stronger, well coordinated R&D program. Including proposals for FP7 funds.

The preparation of FP7 proposals is now becoming one of the highest priority of the SG and each WP.

The following text and five tables highlight the progress of work done by each work package by listing the lowest level subtasks of the BENE detailed implementation plan. No major deviations are reported, with one notable exception in the driver sector (see below).

WP1 (PHYSICS) The comparison of different facilities is now close to its final version, from the Physics point of view. Several presentations have been made at the Nufact 06 workshop about this topic. The main unknown now are the input fluxes and the cost and timescales of the different facilities. Beta Beam studies focused on a new, improved description of Beta Beam experiments and investigates the physics reach with different ions than the baseline He6 and Ne18. Nufact studies focused on a better description of the Magnetic Detector, optimized to the Neutrino Factory needs, and on a discussion of the optimization of the possible different options about baselines, muon stored energies and experimental measures. Also the SPL SuperBeam description has been updated and a comprehensive study of combined capabilities of long baseline neutrinos with atmospheric neutrinos published. A study of the design and physics performances of a megaton class water Cherenkov detector, Memphys, under the Frejus, has been published. The comparison of different facilities is now close to its final version, from the Physics point of view. Several presentations have been made at the Nufact 06 workshop about this topic and since then a big effort has been developed to collect and rationalize the terms of comparison of different facilities. A long report is almost ready.

In the latest BENE meeting of November 14-17, the Physics groups discussed the issue of neutrino cross sections at low energies, a critical aspect of neutrino super beams and beta beam, the comparison of superbeam experiments like Nova and the Brookhaven wide band beam, and the importance of large statistics atmospheric neutrino samples in future analysis of neutrino oscillations. A long discussion was held on the topic of possible upgrades of the CNGS neutrino beam, specially focused on the intensity upgrades of the SPS. The comparison of options will remain the core activity of the WP.

WP2 (DRIVER) has continued its comparative study of M-Watt proton driver designs. An important element in this comparison is the recently published (CERN 2006-006) CDR of a SC proton linac (SPL) of higher energy (3.5 GeV), stimulated by this WP. This design study complies with the parameters optimization for physics needs for a Megaton-class detector at Fréjus but could also support an upgrade in order to be the proton driver of a neutrino factory.

The WP is also looking carefully at the Fermilab option of a still higher energy linac (8 GeV). It was less effective, so far, in stimulating more systematic studies of the Rapid Cycling Synchrotron option, where only slower efforts are being deployed by European (and non-European) labs and funding agencies. Finally, it is starting looking into the exciting recent idea of using Fixed Field Alternating Gradient (FFAG) machines also as MWatt p-drivers. An innovative pumplet lattice is now part of the UK FFAG design.
It is also clear that the CERN PAF and POFPA task forces have enlarged this debate out to a much larger forum and consequently re-scheduled decisions on a longer time scale.
The discussion and comparison of these options is thus being enlarged in consultations with other communities of potential users of the proton driver. The WP will closely follow the works of CERN PAF task force as the choice of the appropriate proton driver is a corner stone of the future of particle physics in Europe.
Two topics of interest of this WP, namely,

the prospects for intense H- sources and high power injectors

the HIPPI results on fast choppers and accelerating structure

are and will continue to be closely followed by the WP. An example of the progress in this field is provided by the efforts deployed in UK towards a Front End Test Stand (FETS). In this framework relevant R/D is ongoing in the domain of the ion source and the chopper, a crucial element in the proton driver. For this last point it is worthwhile underlining the synergies with the CERN studies which are being properly exploited in the frame of the HIPPI JRA.

The last part of the year has been devoted to the early stage of the preparation of the FP7 proposal for the design study. In this context, new energies from RAL and Saclay have been attracted to the BENE framework. Clearly the design study will provide an excellent focussing point for the studies related to the proton driver, especially if the common aspects between different facilities are recognized and the WP structure is carefully devised to fully integrate these synergies. Concerning the FP7 plans, special attention needs to be paid to the coordination of the design study activity and the R/D effort in the IA.s.

WP3 (TARGET). The status of the target WP studies are summarized below:

a) Liquid Metal Jet (Free Mercury) Targets

A free mercury jet is the current solution favoured by the ISS for a neutrino factory target, as it is hoped to minimise problems of shock, radiation damage and cooling. Problems with the generation of radioactive mercury have lead to discussions at NuFact06 on the use of a liquid lead-bismuth eutectic as an alternative. There are also expected to be severe problems associated with the target station window. High velocity micro-jets of liquid metal induced by the proton beam are believed to be suppressed by the capture solenoid. Many of the technical questions regarding the liquid metal jet will be addressed by the MERIT experiment at CERN. The construction of this experiment is nearing completion and will be run early in 2007. The 15 Tesla pulsed capture solenoid has been successfully tested and the MERIT experiment consequently promises significant additional progress for WP4 (COLLECTOR).

b) Solid Targets

A solid refractory metal target is the back-up solution to liquid metals, with radiatively cooled tungsten as the leading contender. A number of experiments on thermal shock in tantalum and tungsten have started at RAL. These tests use a pulsed power supply to generate thermal and lorentz force induced shock waves in thin wires that replicate those generated in a neutrino factory target material by the pulsed proton beam. Life tests indicate that tantalum is too weak at temperatures of 1800 - 2000 K to withstand more than a few hundred thousand beam pulses. However tungsten shows considerable promise and a number of specimens have withstood >10 million pulses at 2000 K. These results indicate that if an engineering solution can be developed to circulate 500 bars through the beam and solenoid, then a 4 MW tungsten target material could run for 10 years.

In the UK, the Universities and CCLRC (RAL) are applying for further funding (led by Ken Long). This includes a critical application for continued funding of the solid target work, which has already shown that thermal shock should not be a problem in tungsten. Work on an engineered design for the targets and target station is an important part of this proposal towards a practical solid target system and is a key part of the next work programme.

c) Fluidised bed target

A new idea was presented at BENE06 to use a fluidised bed target. The ratinale behind this is that a fluidised bed of tungsten granules can in principle combine many of the advantages of a solid target with those of a liquid target, without many of their respective difficulties. However it does present new technical difficulties and these would need to be examined and addressed before it can become a serious contender.

The WP has been, in the last part of the year, focussing more and more on the preparation of the FP7 design study proposal.

WP4 (COLLECTOR) The process of reorganization of the WP under the new IN2P3 leadership (of Strasbourg that has replaced LAL) is now completed. WP4 aims at connecting more solidly with the CERN group that has once more with the CNGS been reviving the brilliant European tradition and know-how (Van der Meer) in the sector of magnetic horns. This appears essential in order to establish a steady rate of progress and a larger European

effort. As stated in previous reports, pre-BENE work had produced an initial design of a collection system based on a magnetic horn, a horn prototype optimized for a Neutrino Factory, and a series of feasibility tests. LAL, did a redesign to fulfil the superbeam requirements. During this last period, more weight has been put on the design of the superbeam horn power supply able to send 350 kA pulses at 50 Hz. This design is under study with the help of institutes and private companies specialized in pulsed high magnetic fields and high current pulsers. Progress is under way also in the area target integration and simulation of relevant effects and comparison with existing devices.
Like BENE in general, this WP has been, in the last part of the year, focussing more and more on the preparation of the FP7 design study proposal.

The main achievements of the 3 components of **WP5** (NOVEL NEUTRINO BEAMS)

a) WP5a (MUFRONT) Progress in the design and specification of the Neutrino Factory muon front-end was made during the ISS. The ISS baseline calls for an ionisation cooling channel in which lithium-hydride absorbers are interspersed with RF cavities in a solenoidal transport lattice. The proof-of-principle of the ionisation cooling technique will be provided by the international Muon Ionisation Cooling Experiment (MICE) which is being prepared at the Rutherford Appleton Laboratory. Over the reporting period, significant progress has been made in the preparation of infrastructure required in the MICE Hall. In addition, the pion-production target has been successfully tested in the ISIS proton beam. Construction of beam-line components and refurbishment of the magnets required for the beam line (from RAL and PSI) is ongoing. The design of the particle identification system (time-of-flight counters, a Cherenkov detector, and a calorimeter) has been finalised. The spectrometer solenoids as well as the scintillating-fibre trackers for the experiment are in construction. It is anticipated that the experiment will enter its first data taking phase in the autumn of 2007. Work has continued on the study of novel cooling- and phase-rotation schemes based on non-scaling FFAGs. European physicists have given presentations on the experiment at a number of international meetings and workshops including the International Neutrino Factory, beta-beam, and super-beam Workshop (NuFact06), which took place in Irvine, Caifornia, in August. WP5a has been, in the last part of the year, focussing more and more on the preparation of the FP7 design study proposal.

b) WP5b (MUEND): Design study actvities for 2006 have concerned the muon FFAG accelerators and its electron model EMMA, and the two possible geometries for the muon storage ring, triangle and bow-tie. In this frame, new types of proton driver lattice designs, of the FFAG type, have been devised (see WP2 above). Investigations on scaling FFAG methods in muon beam cooling have been launched at the Imperial College, London, in collaboration with BNL and the muon beam capture and damping PRISM project (Osaka University). The "harmonic number jump" method is resurrected in the frame of fast FFAG acceleration, as a possible way of combining scaling FFAGs and high frequency RF. These studies have been performed in collaboration with the ISS accelerator working group. They have been subject to contributions to FFAG-2006 (BNL), EPAC06, NuFact06, FFAG06 (Kyoto), the EU Cyclotron Conference (Nice). The construction of EMMA by CCLRC at Daresbury, next to the 4th generation energy-recovery light source, has been launched, following the announcement, in December, of its funding by UK BASTOC, with money to arrive in March. The EMMA collaboration will involve scientists from CARE/BENE, BNL, FERMILAB, KEK, KURRI, LPSC-Grenoble. Given the construction, WP5b's involvement in EMMA should increase.

WP5b is active in the French RACCAM FFAG project, now planning a collaboration to the 180 MeV upgrade of the 65 MeV medical beam at the MEDICYC cancer treatment clinic, in Nice, France. This should result in an enhancement of WP5b's implications in that proton scaling FFAG prototyping.

The LPSC, Grenoble, team in WP5b is now preparing the FFAG-2007 workshop, to be held 12-17 April 2007.

WP5b is defining now the Accelerator and Storage Ring WPs of the FP7 NuFact-BetaBeam-SuperBeam Design Study proposal (coordinator R. Edgecock, RAL) planned for submission in May 2007 (see Appendix). WP5b is also fostering a EUROFFAG JRA proposal (coordinator F. Méot, LPSC), discussions are going on concerning its integration within the “New acceleration methods” IA proposal (in preparation with coordinator E. Jensen, CERN) in view of 2008's bids (see proposal in Appendix).

WP5c (BETABEAM): The beta-beam BENE WP serves as a link between the on-going design study of a beta-beam facility within EURISOL DS and the neutrino physics community. The design study is making good progress and the BENE community has been updated on a regular basis through the BENE meeting on this progress. The main areas of progress this year, in addition to the one on general design, have been: 1) collimation studies for absorption of ion losses and recognition of the interest of a new PS 2) decay ring optics design and optimization 3) design of large aperture dipoles for the decay ring 4) introduction of a low energy ion accumulator and cooling ring promising recovery of part of the presently missing production rate for neon parents. In return, the BENE Betabeam team has assured talks on neutrino physics and informative talks on other alternatives for generating neutrino beams at the regular EURISOL meetings. In the EURISOL town meeting in November 2006 the task contributed with two talks, one on neutrino physics in general and one on the conclusions of the ISS study. The EURISOL International Advisory Panel stressed that both talks were very important as they assure that the design studies beta-beam task is well integrated in the field of neutrino beams. The lectures on general accelerator physics and beta-beams at the Nufact summer school at UCLA/UCI in California were also delivered by the BENE beta-beam task. The possible continuation of the design study has been discussed at the BENE meetings. Main issues which are not within the scope of the current design study but which should be addressed within any future work is a high gamma beta-beam, a high Q-value beta-beam and new scenarios for production and bunching of isotopes. The new ideas presented by Prof. Carlo Rubbia on a high Q value beta-beam with production of the ions in a small storage ring with ionization cooling is a very interesting option and should be considered for any future beta-beam studies. The web site for the beta-beam at http://cern.ch/beta-beam is documenting the progress within the design study and gives reference to new published work.

N2.5 Overall Progress of Work Packages

Work Package 1: PHYSICS.

	Title	Original begin date (Annex 1)	Original end date (Annex1)	Estimated Status	Revised end date
WP1	**PHYSICS**				
1.1	Improvement of the WP Web Site	Jan. 2006	Mar 2005	95%	Continuously improving
1.2	WP Spring Meeting	Mar 2006	Mar 2006	100 %	held jointly with ISS
1.3	Close in on physics analysis, motivate IDS	Jan 2006	Jun 2006	100%	presented at Nufact06 IDS promoted
1.4	WP Summer Meeting	Aug 2006	Aug 2006	100 %	joint with ISS & NuFacto6
1.5	WP Fall Meeting	Nov 2006	Nov 2006	100 %	
1.6	Physics section of ISS Report	Sep2006	Dec 2006	90%	March 2007

Work Package 2: DRIVER

	Title	Original begin date (Annex 1)	Original end date (Annex1)	Estimated Status	Revised end date
WP2	**DRIVER**				
2.1	Improvement of the WP Web Site	Jan 2006	Mar. 2006	95%	Continuously improving
2.2	Finalize criteria of SPL vs RCS comparison	Jan 2006	Mar. 2006	20% It is going to take longer!!	Larger picture emerging, CERN debate wide open
2.3	Identify R&D beyond HIPPI, motivate IDS	Jan 2006	Mar. 2006	100 %	presented at Nufact06 IDS promoted
2.4	WP Spring Meeting	Mar 2006	Mar 2006	100 %	held jointly with ISS
2.5	WP Summer Meeting	Aug 2006	Aug 2006	100 %	joint with ISS & NuFacto6
2.6	WP Fall Meeting	Nov 2006	Nov 2006	100 %	
2.7	Driver section of ISS Report	Sep2006	Dec 2006	90%	March 2007

Work Package 3: TARGET

	Title	Original begin date (Annex 1)	Original end date (Annex1)	Estimated Status	Revised end date
WP3	**TARGET**				
3.1	Improvement of the WP Web Site	Jan 2006	Mar. 2006	95%	Continuously improving
3.2	Close in on hi power target choice, motivate IDS (R&D beyond MERIT)	Jan 2006	Mar. 2006	100 %	presented at Nufact06 IDS promoted
3.3	WP Spring Meeting	Mar 2006	Mar 2006	100 %	held jointly with ISS
3.4	WP Summer Meeting	Aug 2006	Aug 2006	100 %	joint with ISS & NuFact06
3.5	WP Fall Meeting	Nov 2006	Nov 2006	100 %	
3.6	Target section of ISS Report	Sep2006	Dec 2006	90%	March 2007

Work Package 4: COLLECTOR

	Title	Original begin date (Annex 1)	Original end date (Annex1)	Estimated Status	Revised end date
WP4	**COLLECTOR**				
4.1	Improvement of the WP Web Site	Jan 2006	Mar. 2006	95%	Continuously improving
4.2	Close in on collector choices, motivate IDS and other R&D	Jan 2006	Mar. 2006	100 %	presented at Nufact06 IDS promoted
4.3	WP Spring Meeting	Mar 2006	Mar 2006	100 %	held jointly with ISS
4.4	WP Summer Meeting	Aug 2006	Aug 2006	100 %	joint with ISS & NuFact06
4.5	WP Fall Meeting	Nov 2006	Nov 2006	100 %	
4.6	Collector section of ISS Report	Sep2006	Dec 2006	90%	March 2007

Work Package 5: NOVEL NEUTRINO BEAMS

	Title	Original begin date (Annex 1)	Original end date (Annex1)	Estimated Status	Revised end date
WP5	**NOVEL NEUTRINO BEAMS**				
5.1	Improvement of the WP Web Site for the three areas of interest of the WP	Jan 2006	Mar. 2006	95%	Continuously improving
5.2	Review of existing designs for NuFact and Betabeams, motivate ISS	Jan 2006	Mar. 2006	100 %	presented at Nufact06 IDS promoted
5.3	WP Spring Meeting	Mar 2006	Mar 2006	100 %	held jointly with ISS
5.4	WP Summer Meeting	Aug 2006	Aug 2006	100 %	joint with ISS & NuFact06
5.5	WP Fall Meeting	Nov 2006	Nov 2006	100 %	
5.6	WP sections of ISS Report	Sep2006	Dec 2006	90%	March 2007

N2.6 Significant Achievements

- Recognition from CERN Council of the importance of promoting a coordinate European participation in a global neutrino programme".
- The BENE Midterm Interim Scientific Report was published in final form: a detailed outline, and a plea, for a timely R&D program
- Completion of the International Scoping Study and clear indication towards next step, namely complete in depth International Design Studies.
- Timely progress on the preparation of FP7 Design Study proposal, whose content will also determine our contributions to the International Design Studies.

N2.7 List of all deliverables during the reporting period

Deliverable/ Milestone No	Deliverable/Milestone Name	Workpackage /Task No	Lead Contractor(s)	Planned (in months)	Achieved (in months)
D	**Final Publication of Interim (Midterm) Scientific Report**	All WPs	INFN-Na,	23	29
D	**Promotion of International Design Studies on Neutrino Factories, Superbeams, Betabeams**	All WPs	CCLRC, ICL, INFN-Na, Uni-Ge	30	32
D	**Draft of FP/ Design Proposal, to be delivered by month 41**	All WPs	CCLRC, IN2P3 CERN	30	36

N2.8 List of major meetings organized under BENE during the reporting period

Date	Title/subject	Location	Number of participants	Web Site Address
Jan 23-25	2nd meeting of the ISS	KEK	65	http://www-kuno.phys.sci.osakau.ac.jp/%7Eyoshida/ISS/index.html
Apr 24-27	3rd meeting of the ISS	RAL	70	http://www.hep.ph.ic.ac.uk/iss/iss-plenary-meetings/iss-benemain.html
Apr 28	BENE day	RAL	60	http://bene.web.cern.ch/bene/060428Agenda.htm
4-Jul	Open meeting of the BENE Steering Group	CERN	30	http://bene.web.cern.ch/bene/060704Agenda.htm
21-23 Aug	4th meeting of the ISS	Irvine	60	http://nufact06.physics.uci.edu/ISS/Program/Default.aspx
24-30 Aug	8th NuFact06 Workshop	Irvine	120	http://nufact06.physics.uci.edu/
21-23 Sep	NNNO6	Seattle	74	http://neutrino.phys.washington.edu/nnn06/
Oct 25	Open meeting of the BENE Steering Group	CERN	30	http://bene.web.cern.ch/bene/061025OpenBENESG.htm
Nov 14-17	BENE06/CAREO6	Frascati	40 150	http://bene.web.cern.ch/bene/BENE meeting at CARE06.htm

1.3.3 N3: High-Energy High-Intensity Hadron Beams (HHH)

HHH is the Care network for High Energy High Intensity Hadron Beams. It comprises 8 countries plus CERN. The list of participants and their implication in the HHH Work Packages (**C:** Coordination, X : participation) is given in the table below. The overall management is done by CERN.

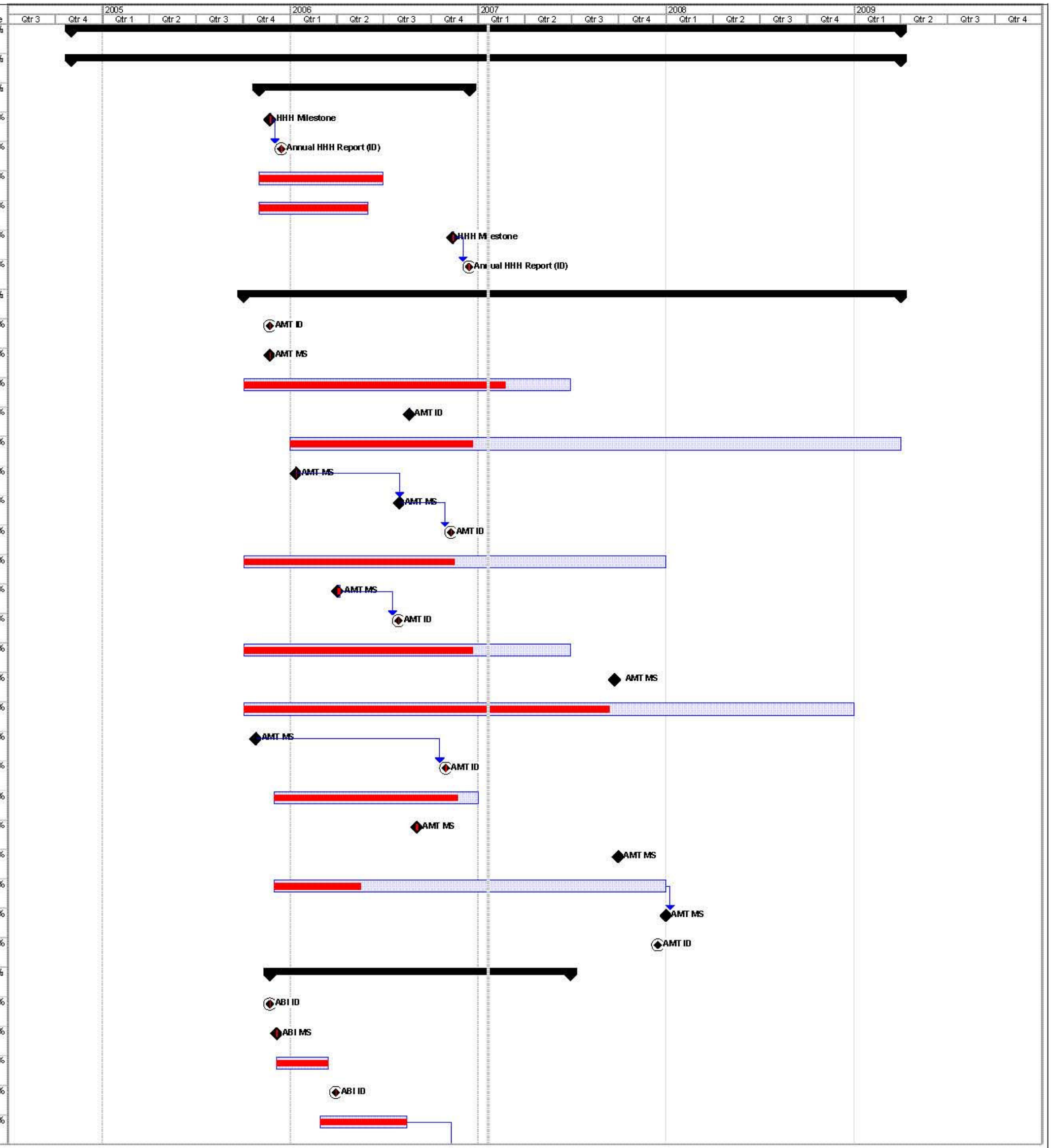
Number	Participant	WP1 AMT	WP2 ABI	WP3 APD
1	**CEA**	X		
4	**GSI**	X	X	X
6	**DESY**		**C**	X
10	**INFN**	X		X
	INFN-Ge	X		
	INFN-LNF			X
	INFN-Mi	X		
	INFN-Na			X
	INFN-Sal			X
11	**TEU**	X		
15	**WUT**	X		
16	**CSIC**			X
	CIEMAT	X		
	LEII			X
17	**CERN**	**C**	**C**	**C**
19	**PSI**		X	
20	**CCLRC**	X		

In 2006 the networking activity of CARE-HHH remained focussed on the upgrade of the FAIR project at GSI and of the LHC accelerator complex at CERN.

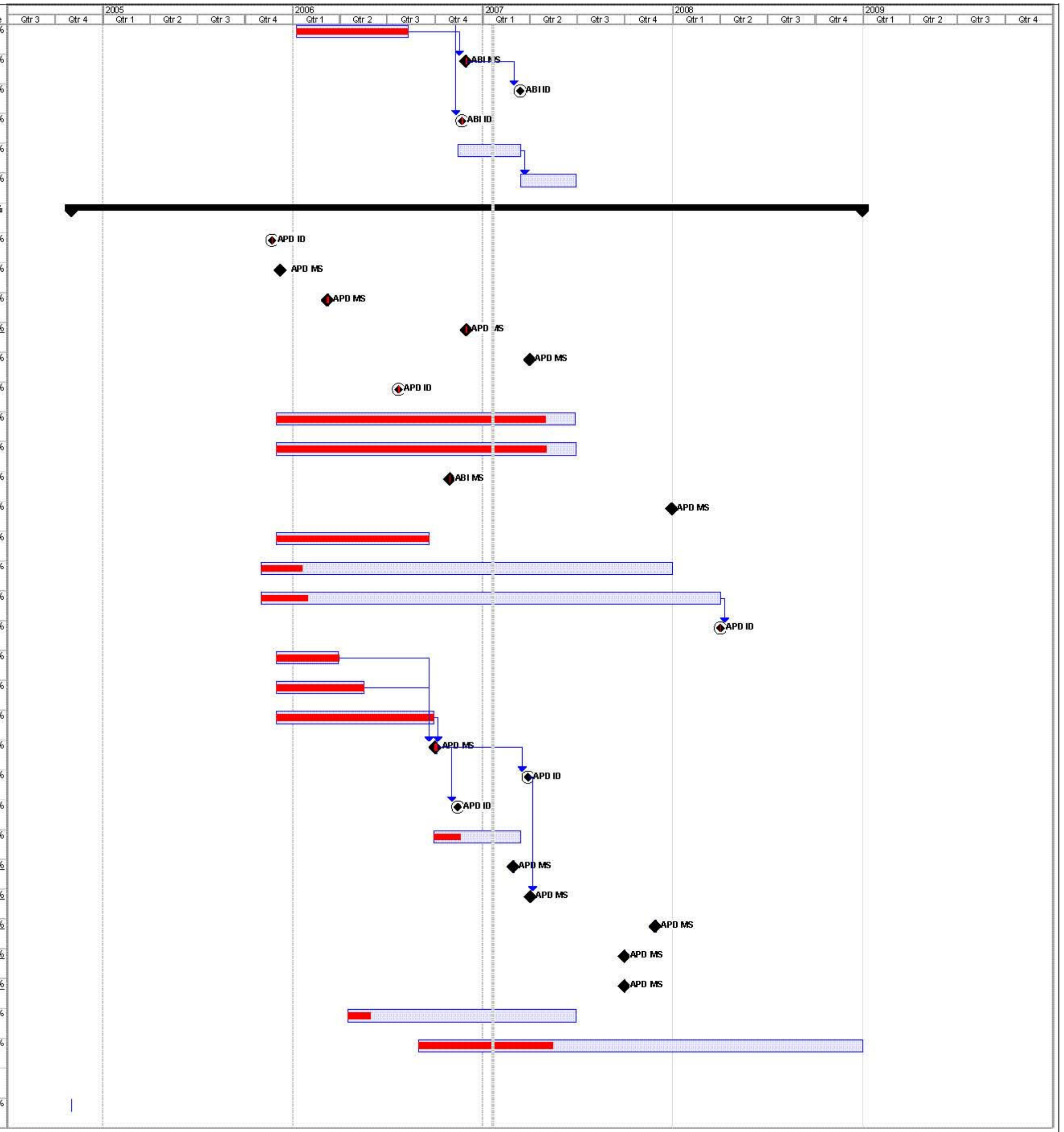
N3.1 Overall Progress of the Activity

The overall progress of the HHH activity is described in the following Gantt chart.

ID	Task Name	% Complete
1	**N3: HHH Networking Activities**	**51%**
2	**All Work Packages**	**51%**
3	**Network coordination, dissemination, and outreach**	**100%**
4	MS: Annual HHH meeting	100%
5	***ID: HHH Annual Report 2005***	100%
6	Reinforce connections between Labs and Universities in all WP's	100%
7	Revisit priorities for all WP, update HHH web site	100%
8	MS: Annual HHH meeting	100%
9	***ID: HHH Annual Report 2006***	100%
10	**WP1 Accelerator Magnet Technology (AMT)**	**48%**
11	***ID: Interim report on AMT activities and reporting at the general CARE meeting***	100%
12	MS: General AMT meeting	100%
13	Coordinate conductor development and tests	80%
14	***ID: Proceedings of AMT min-workshop on Beam Generated Heat Load & Magnet Quench Level***	100%
15	Development of Web based database for SC Cables and Magnets	30%
16	MS: First specific meeting on database	100%
17	MS: Second specific meeting on database	100%
18	***ID: Preliminary report on Web based database structure***	100%
19	Codes and models for design, stability and protection studies for AMT1 and AMT4	50%
20	MS: AMT workshop on Accelerator Magnet Design and Optimization (WAMDO)	100%
21	***ID: Proceedings of AMT WAMDO workshop***	98%
22	Comparison of different IR options (AMT4) and steering of LARP magnet developments	70%
23	MS: AMT workshop on Coil Insulation & Impregnation Techniques (THERMOMAG)	0%
24	Studies of pulsed SC magnets for GSI and LHC injectors	60%
25	MS: AMT workshop on SC Pulsed Magnets for Accelerators (ECOMAG-05)	100%
26	***ID: Proceedings of the AMT workshop ECOMAG-05***	100%
27	Comparative studies of alternatives using low field magnets for AMT2 and AMT3	90%
28	MS: AMT workshop on LF magnets (LER)	100%
29	MS: AMT workshop on HF magnets	0%
30	Determination of scaling law for magnet and cryogenic cost for AMT5	22%
31	MS: Preliminary report on scaling law for magnet and cryogenic cost (roadmap)	0%
32	***ID: Interim report on AMT activities and reporting at the general CARE meeting***	0%
33	**WP2 Accelerator Beam Instrumentation (ABI)**	**68%**
34	***ID: Interim report on ABI activities and reporting at the general CARE meeting***	100%
35	MS: 3rd ABI topical workshop on Remote diagnostics and maintenance of beam instrumentation	100%
36	Definition of possible new milestones	100%
37	***ID: Proceedings of the 3rd ABI topical workshop***	100%
38	Contribution to US-LARP activities/events and possible synergy with HHH WP1-WP3	100%



ID	Task Name	% Complete
39	Study of further beam instrumentation challenges for LHC commissioning and upgrade	100%
40	MS: 4th ABI topical workshop on Simulation of BPM FEE & Sp. Mech. Designs	100%
41	*ID: Proceedings of the 4th ABI topical workshop*	0%
42	*ID: Interim report on ABI activities and reporting at the general CARE meeting*	100%
43	Definition of possible new milestones	0%
44	Contribution to beam measurements and preparation for LHC commissioning	0%
45	**WP3 Accelerator Physics and Synchrotron Design (APD)**	**47%**
46	*ID: Interim report on APD activities and reporting at the general CARE meeting*	100%
47	MS: 2nd APD mini-workshop on Crystal Collimation	100%
48	MS: 3rd APD mini-workshop on Crystal Collimation	100%
49	MS: 4th APD mini-workshop on Crystal Collimation	100%
50	MS: 5th APD mini-workshop on Crystal Collimation	0%
51	*ID: Proceedings of the 2nd APD topical workshop (LUMI-05)*	100%
52	Further development of the APD Web Site: maintain beam dynamics codes repository	90%
53	Compare and further document benchmarked codes and alternative IR optics	90%
54	MS: Creation of a web reference for alternative IR optics	100%
55	MS: Creation of a web reference for synchrotron optics	0%
56	Assessment of alternative optics designs for IR layout	100%
57	Assessment of alternative optics designs for booster synchrotrons	10%
58	Assessment of impedance budget for booster synchrotrons	10%
59	*ID: First structured list of intensity limits for booster synchrotrons and LHC*	20%
60	Beam dynamics studies and experiments to validate different options (APD1-2, APD6-7)	100%
61	Studies relevant for APD3, APD4 and APD5, contribution to US-LARP events	100%
62	Determination of a roadmap for Synchrotron and IR designs	100%
63	MS: 3rd APD topical workshop on Fast Synchrotrons and IR design	100%
64	*ID: Proceedings of the 3rd APD topical workshop (LUMI-06)*	0%
65	*ID: Interim report on APD activities and reporting at the general CARE meeting*	0%
66	Definition of possible new milestones	30%
67	MS: APD Mini-Workshop on Technological Solutions for E-Cloud	0%
68	MS: CARE-APD CERN-GSI Working Meeting on Collective Effects in HI Beams	0%
69	MS: CARE-APD Mini-Workshop on LHC IR Upgrade	0%
70	MS: CARE-APD Mini-Workshop on LHC Beam Performance Upgrade	0%
71	MS: CARE-APD Mini-Workshop on Injector Upgrade	0%
72	Preparation of beam measurements for SPS+LARP HI tests and LHC commissioning	10%
73	Possible SPS tests on Crystal Collimation	30%
74		
75		0%



Networking aspects: Two specific HHH working groups created in 2005 continued to be active in 2006. The first, which addresses issues such as accelerator physics and machine-detector interface aspects related to the upgrade of the LHC Interaction Regions, was strengthened and involved representatives of all the LHC detectors. The second, which investigates an appropriate R&D programme for AC superconducting magnets in view of the upgrade of the LHC injector complex and of FAIR at GSI, was slowed down due to the longer time-scale of the involved programmes. A networking support for crystal channeling and crystal collimation started at the end of 2005 and continued all through 2006, providing a forum of discussion to which many associated institutes in Russia and US, such as IHEP, PNPI, JINR and FNAL, could contribute. A small working group on crab cavities for the LHC upgrade was launched in 2006.

Deliverables: The web based database for SC Cables and Magnets has well advanced in the frame of WP1 (AMT). Benchmarking parameters, examples and overview tables were added to the accelerator physics code repository of WP3 (APD). Work on a structured list of intensity limitations has begun in WP3 (APD).

Events: A total of 5 workshops were organized, two in the frame of WP1 (AMT), one in the frame of WP2 (ABI), and two in the frame of WP3 (APD). The participation was large. It included not only representatives from several European HHH partner laboratories, but also from European industry, from Japan, and in particular a strong presence from the US-LARP. In addition, a CARE-HHH bilateral GSI-CERN meeting was organized in the frame of WP3 (APD).

Dissemination and outreach: The effort for dissemination of information was further intensified. Numerous invited talks were delivered, mostly by the HHH coordinators, which illustrated the HHH activity for various CERN committees, to the LHC experiments, at universities, and at workshops or conferences organized by other institutions. Thirty new publications were issued, almost all of which are already stored in the CARE database. The HHH web site was continually updated.

Exchanges and educational aspects: Three US accelerator specialists received support for attending HHH workshops in the frame of WP3 (APD). A visit to CERN by one EU junior scientist active on HHH issues from the University of Sannio, Benevento, Italy, was supported, also in the frame of WP3 (APD). Two EU summer students, one master degree EU student, and five EU doctoral students were active at CERN on issues related to WP1 and 3 (AMT and APD), namely IR upgrade, wire compensation, optics for new injector synchrotrons, and web databases. The first US-LARP Toohig fellow was hosted at CERN for a period of six months. In the frame of WP2 (ABI), the CERN –DESY collaboration was strengthened: M. Werner of DESY visited CERN for an expert audit of the LHC machine protection system; the FMCM (Fast Magnet Current Monitor) developed at DESY has become an integral part of the LHC machine protection system, and more than 20 units will be produced in order to monitor the stability of the supply current of key warm magnets in the LHC; the LHC BLM system is under test in HERA with remote control from CERN; quench levels at HERA were newly calculated and associated analyses of beam induced quenches at HERA were presented at HB2006. Triggered by the 3rd WP2 (ABI) workshop (addressing GAN, MVL, VII, diagnostics work packages), a first experiment to test remote communication between office or home and a team in the tunnel was successfully performed at DESY. WP2 spin-off in the US included the LHC @ FNAL control room project, and the new initiative "LAFS" (LHC application Fermilab software), which is developing essential add-ons to the LHC control system, e.g., RBAC = Role Based access.

Overall CARE-HHH Network activities in 2006 in chronological sequence:

- **09-13 January 2006 (APD):** T. Demma from Sannio University (Italy) visited CERN in the frame of the HHH collaboration on novel approaches to modeling the electron cloud build up in the LHC and its upgrade.
- **13 January (AMT)**: 1st specific meeting on database for s.c. cables and magnets was held at CERN; definition of the database main elements; definition of the objects to collect; definition of strategy for cooperation with other laboratories.
- **01 February 2006 (AMT):** A special AT/MAS Magnet Seminar was organized at CERN. The **talk** "Test Results on the Model Nb3Sn Dipole TAMU2" was presented by P. McIntyre to an audience of about 30 experts.
- **07-10 March 2006 (APD):** The International Workshop on Recent Progress on Induction Acceleration RPIA2006 KEK, Tsukuba., was attended by 45 world experts, including 2 members of CERN. Discussions focused on LHC upgrade, pulsed beam-beam compensators for LHC, and stronger kickers for upgraded injectors. The main topics related to HHH were:
  - Possible Uses of Rapid Switching Devices and Induction RF for an LHC Upgrade,
  - LHC Long-Range Beam-Beam Compensation with DC and Pulsed Wires,
  - Assessment of the LHC pulsed wire lens from the current Pulse Power Technology Point of View
- **09-10 March 2006 (APD):** CARE-HHH-APD mini-Workshop on *Crystal Channeling*, CERN, Geneva, Switzerland. Discussion on beam experiments, crystal production, and research programm. About 20 participants. Topics included:
  - Plans for crystal collimation,
  - SPS H8 beam facility for crystal validation,
  - Beam characteristics in H8
- **23 March 2006 (AMT/APD):** A special AT/MAS Magnet Seminar was organized at CERN. The talk about "Studies of Low Crossing Angle Bumps for the LHC Luminosity Upgrade" was presented by G. Sterbini to an audience of about 20 experts.
- **30-31 March 2006 (APD):** CARE-HHH-APD CERN-GSI bi-lateral working meeting on *Collective Effects–Coordination of Theory and Experiments*, GSI, Darmstadt, Germany. Five participants from CERN attended. The main topics were:
  - Space-charge and electron-cloud effects in simulations and experiments
  - Landau damping
  - Resistive-wall and kicker impedances
  - TMC instability
  - Code benchmarking
- **March 2006 (ABI)**: the proceedings of the 3rd topical ABI workshop have been completed and made available for publication in the CARE Conference series, see: http://adweb.desy.de/mdi/CARE/Hirschberg/Proceedings of the 3rd CARE.pdf
- **03-06 April 2006 (AMD):** CARE-HHH-AMT Workshop on *Accelerator Magnet Design and Optimization* (WAMDO), CERN, Geneva, Switzerland. The discussion covered the following topics:
  - Beam optics and layout for the luminosity upgrade
  - High field superconductors.
  - Design tools, potential and limitations

- Magnet design
- Design issues of cycled magnets
- New concepts and perspectives

- **11 April 2006 (coordination):** CARE Joint Steering Committee and Dissemination Board Meeting, LPNHE, Paris. Walter Scandale presented the HHH status report.
- **26-28 April 2006 (coordination):** H. Schmickler represented HHH at the US-LARP Collaboration Meeting, LBNL, USA.
- **10 May 2006 (dissemination):** At the 55th meeting of the LHC Technical Committee (LTC), W. Scandale presented options for the LHC IR upgrade.
- **29 May - 2 June 2006 (dissemination):** Advanced ICFA Workshop on High Brightness Hadron Beams (HB2006), KEK, Tsukuba. Discussions on high brightness hadron beams, code benchmarking, collective effects, machine protection, and electron cloud. Topics relevant to HHH included:
  - LHC Upgrade Options and CARE-HHH Activities,
  - Electron-Cloud Benchmarking & CARE-HHH Codes
  - Fast Beam Losses
- **9 June 2006 (dissemination):** J.-P. Koutchouk discussed the "Low Crossing Angle **Scheme** for the LHC Luminosity Upgrade" at the 1st LHC Upgrade Machine Experiment Interface Meeting.
- **21 June 2006 (APD):** At the 58. meeting of the LHC Technical Committee (LTC), W. **Scandale** presented a proposal for crystal collimation experiments at the SPS.
- **26-30 June 2006 (dissemination):** HHH contributed 14 talks and papers to EPAC'06, Edinburgh, including an invited overview presentation by W. Scandale on "LHC Luminosity and Energy Upgrades", and one by A. Faus-Golfe on "Non-linear Collimation in Linear and Circular Colliders".
- **03-07 July 2006 (dissemination):** At the International Conference on Charged and Neutral Particles Channeling Phenomena "Channeling 2006", W. Scandale reviewed prospects of channelling for hadron-beam collimation in front of some 77 scientists.
- **July 2006 (APD)**: the proceedings of the workshop LHC-LUMI-05 have been completed and made available for publication as CARE and CERN Yellow Report, see: http://care-hhh.web.cern.ch/CARE-HHH/LUMI-05/Proceedings/proceedings_lumi05.htm.
- **27 July 2006 (APD):** In the frame of a CERN AB Seminar, E. Benedetto explained the emittance growth induced by the electron cloud in CERN proton rings to about 50 specialists.
- **27 July 2006 (APD):** A small working group on crab cavities for the LHC upgrade was **launched** and met for the first time. It comprises about 6 members, from HHH and US-LARP. Further meetings followed on 11 August, 19 September, and 12 October; see http://cern-ab-bblr.web.cern.ch/cern%2Dab%2Dbblr/Crab%20Cavity/crabcavity.htm
- **July 2006 (AMT)**: a summary of the 2005 AMT mini-workshop on beam generated heat load and magnet quench levels have been completed and made available as CARE Note, see: http://care-hhh.web.cern.ch/CARE-HHH/CARE-HHH-AMT/CARE-Note-2006-013-HHH.doc
- **August (AMT)**: The proceedings of the March-2006 WAMDO workshop have been completed and made available for publication as CARE document CARE-Conf-06-049-HHH.
- **2 August (AMT)**: 2nd specific meeting on database for s.c. cables and magnets was held at CERN; the website was presented (sdb.web.cern.ch), an expanded set of ~100 objects to

collect was defined; the data about web survey were analyzed; the structure of the database was defined.

- **1 September 2006 (dissemination):** W. Scandale presented an "Overview of LHC **Upgrade** Scenarios" and G. Sterbini "Parameters for an Early Beam Separation Scheme" at the 2nd LHC Upgrade Machine Experiment Interface Meeting.
- **27 September 2006 (dissemination):** F. Zimmermann gave a seminar on "R&D for Future Accelerators" at the University of Pisa.
- **1 October 2006 (dissemination):** F. Zimmermann presented the "Machine Plans for the LHC Upgrade" at the ATLAS Upgrade Workshop http://indico.cern.ch/conferenceDisplay.py?confId=a063024
- **6 October 2006 (dissemination):** W. Scandale and F. Zimmermann reviewed the extent of **the** "luminous region, collisions with displaced beams, and the feasibility of 50 ns bunch spacing," while J.-P. Koutchouk investigated the "parameter space for the luminosity upgrade" at the 3rd LHC Upgrade Machine Experiment Interface Meeting.
- **11-12 October 2006 (AMT):** CARE-HHH-AMT: LER - Workshop on the Low Energy Ring study, CERN, Geneva, 11-12 October 2006. CERN contributions: attendance to the workshop of about 30 CERN staff contributing to the general discussion with 5 of them acting as 'devil's advocates' for technically difficult items.
- **16-20 October 2006 (APD):** CARE-HHH-APD Workshop *Towards a Roadmap for the Upgrade of the LHC and GSI Accelerator Complex* (LHC-LUMI-06), IFIC, Valencia, Spain, 16-20 October 2006. About 70 participants from CARE-HHH, US-LARP, and KEK. Main topics included:
  - IR upgrade and ranking of options,
  - Injector upgrade,
  - Intensity limitations
- **25-27 October 2006 (coordination):** H. Schmickler represented HHH at the US-LARP Collaboration Meeting 7, Port Jefferson, USA.
- **October (AMT)**: The proceedings of the 2005 ECOMAG workshop have been completed and made available for publication as CARE document, see: http://care-hhh.web.cern.ch/CARE-HHH/CARE-HHH-AMT/ECOMAG05 Proceedings.pdf
- **15 – 17 November (coordination)**: CARE'06 Annual Meeting, INFN-LNF, the presentations included on overview of HHH activities in 2006, first results from crystal collimation experiments at the SPS, calculations of energy deposition in the final quadrupoles near the interaction point, plans for FP7 proposal,
- **21 November (APD)**: PAF/POFPA Meeting at CERN; F. Zimmermann and W. Scandale **discussed** "Accelerators Options for the LHC Luminosity Upgrade". The conclusion of this discussion is that the option with 12.5 ns bunch spacing is de-emphasized. Also the experimenets expressed a preference for the scenario with 50 ns spacing as compared to that with 25 ns.
- **28 November (APD)**: W. Scandale presents the H8-RD22 Experiment to test Crystal Collimation for the LHC to a group of experts at the INFN CSN1 Meeting, Frascati.
- **30 November – 1 December 2006 (ABI)**: 4th CARE-HHH-ABI workshop on *Simulation of BPM Front-End Electronics and Special Mechanical Designs* Lüneburg, Germany. Topics are BPM technology and modern design tools. A total of about 27 participants attended, coming from CERN, DESY, GSI, CEA, RAL, FNAL, Globes Electronics and Kyocera.

N3.2 Overall progress of Work Packages

The following table highlights the progress of work planned in the year 2006 by listing the lowest level subtasks of the HHH detailed implementation plan.

WBS #	Title	Original begin date (Annex 1)	Original end date (annex1)	Estimated Status	Revised end date
General	MS: annual HHH meeting				
	HHH coordination meeting (ID8)	T4-2006	T4-2006	100 %	On time: T4-2006
WP1-AMT	Coordinate conductor development and tests	T4-2005	T2-2007	80 %	Delayed to: T2-2007
	ID: Proceedings of AMT mini-workshop on Beam Generated Heat and Magnet Quench Level	T4-2005	T1-2006	100 %	Delayed to: T3-2006
	Web based database for SC Cables and Magnets	T3-2004	T4-2006	30 %	Delayed to T2-2007
	MS: specific meeting on database	T2-2005	T2-2005	100 %	Delayed to T1-2006
	ID: first report on web based database	T2-2005	T2-2005	100 %	Delayed to T4-2006
	Catalogue of numerical codes for AMT1 and AMT4	T1-2004	T4-2005	50 %	Delayed to T4-2007
	Comparison of codes for AMT1 and AMT4	T1-2004	T2-2004	50 %	Delayed to T4-2007
	Identifications of main limiting issues	T2-2004	T4-2004	50 %	Delayed to T4-2007
	MS: AMT workshop on Accelerator Magnet Design and Optimization (WAMDO)	T2-2006	T2-2006	100%	On time: T2-2006
	ID: Proceedings of AMT WAMDO workshop	T3-2006	T3-2006	100%	Delayed to T3-2006
	Comparison of different IR options (AMT4) and steering of LARP magnet developments	T4-2005	T2-2007	70%	Delayed to: T2-2007
	MS: AMT workshop on Coil Manufacturing Optimization	T1-2006	T1-2006	0%	Suspended
	Studies of pulsed SC magnets for GSI and LHC injectors	T4-2005	T2-2007	60%	Delayed to: T4-2008
	ID: Proceedings of the	T1-2006	T1-2006	100%	Delayed to:

	AMT workshop ECOMAG-05				T4-2006
	Comparative studies of alternatives using low field magnets for AMT2 and AMT3	T3-2004	T4-2004	90 %	Delayed to T1-2007
	Determination of scaling law for magnets and cryogenic cost for AMT5	T4-2004	T2-2006	22 %	Delayed to T1-2008
	MS: preliminary report on scaling law for magnets and cryogenic cost for AMT5	T2-2006	T2-2006	0%	Delayed to: T1-2008
WP2-ABI	Definition of possible new milestones	T4-2005	T1-2006	100 %	On time: T1-2006
	ID: proceedings of the third ABI workshop	T1-2006	T1-2006	100 %	On time: T1-2006
	Contribution to US-LARP activities/events and possible synergy with HHH WP1-WP3	T1-2006	T3-2006	100%	On time: T3-2006
	Study of further beam instrumentation challenges for LHC commissioning and upgrade	T1-2006	T3-2006	100%	On time: T3-2006
WP3-APD	MS: 2nd APD mini-workshop on Crystal Collimation	T4-2005	T1-2006	100%	Delayed to: T1-2006
	ID: Proceedings of the 2nd APD topical workshop (LUMI-05)	T1-2004	T2-2004	100%	Delayed to T3-2006
	Further development of the APD Web Site: maintain beam dynamics codes repository	T1-2005	T2-2006	100%	On time: T2-2006
	Compare and further document benchmarked codes and alternative IR optics	T1-2005	T2-2006	100 %	On time: T2-2006
	MS: Creation of a web reference for alternative IR optics	T2-2006	T2-2006	100 %	Delayed to T4-2006
	MS: Creation of a web reference for alternative synchrotron optics	T2-2006	T2-2006	0 %	Delayed to T4-2007
	Assessment of alternative optics	T4-2005	T3-2006	100 %	Delayed to T3-2006

	designs for IR layout				
	Assessment of alternative optics designs for booster synchrotrons	T4-2005	T3-2006	10 %	Delayed to T4-2007
	Assessment of impedance budget for booster synchrotrons	T4-2005	T3-2006	10 %	Delayed to T2-2008
	ID: First structured list of intensity limits for booster synchrotrons and LHC	T2-2006	T2-2006	20 %	Delayed to T2-2008
	Beam dynamics studies and experiments to validate different options (APD1-2, APD6-7)	T4-2004	T1-2006	100 %	On time: T1-2006
	Studies relevant for APD3, APD4 and APD5, contribution to US-LARP events	T4-2005	T2-2006	100%	On time: T2-2006
	Determination of a roadmap for Synchrotron and IR designs	T4-2005	T3-2006	100%	On time: T3-2006
	Preparation of beam measurements for SPS+LARP high intensity tests and LHC commissioning	T2-2006	T2-2007	10%	On time: T2-2007

N3.3 Significant Achievements

- Novel scenarios for the upgrade of the LHC interaction regions were developed along with new sets of beam parameters, which are better tailored to a higher-luminosity LHC. Plans and studies for supporting upgrades of the CERN accelerator complex greatly evolved in parallel.
- The exchange between the LHC accelerator and the LHC experiments was intensified in order to better understand the feasibility of integrating slim magnetic elements deep inside the detectors and the pertinent constraints. Simulations of energy deposition in the IR magnets of the upgraded LHC were performed by European institutes. A small working group on LHC crab cavities was established.
- In 2006, a first successful test of crystal reflection in the SPS North Area with a 400-GeV proton beam demonstrated an extremely high effective field together with more than 95% extraction efficiency, which opens up a completely new perspective for the upgrade of the LHC collimator system.
- A continued intense effort for the dissemination of information has included several invited talks at major conferences, e.g., EPAC, or workshops, as well as university seminars. Five HHH workshops plus a CERN-GSI bilateral meeting were organized in 2006. CARE-HHH and US-LARP activities were successfully re-aligned.
- A first version of the HHH web based database for SC Cables and Magnets has been published, while numerous benchmarking parameters, examples and overview tables were added to the Accelerator Physics Code Repository. Work on a structured list of intensity limitations has begun.

N3.4 List of all milestones and deliverables (D) during the reporting period

WBS #	Title	Due date in Annex 1	Status	Revised delivery date
General				
8	MS: annual HHH meeting	T4-2006	100%	T4-2006
WP1-AMT				
15	ID: Proceedings of AMT mini-workshop on Beam Generated Heat and Magnet Quench Level	T2-2006	100%	T3-2006
16	MS: specific meeting on database	T2-2005	100%	T1-2006
18	ID: first report on web based database	T2-2005	100 %	T4-2006
20	MS: AMT workshop on Accelerator Magnet Design and Optimization (WAMDO)	T2-2006	100%	T2-2006
21	ID: Proceedings of AMT WAMDO workshop	T3-2006	100%	T3-2006
23	MS: AMT workshop on Coil Manufacturing Optimization	T1-2006	0%	Suspended
26	ID: Proceedings of the AMT workshop ECOMAG-05	T1-2006	100%	T4-2006
28	MS: Possible AMT workshop on HF magnets	T3-2006	100%	T4-2006
29	MS: Possible AMT workshop on LF magnets	T3-2006	0%	T4-2007
31	MS: preliminary report on scaling law for magnets and cryogenic cost for AMT5	T2-2006	0%	T1-2008
32	ID: Interim report on AMT activities and reporting at the general CARE meeting	T4-2006	100%	T4-2006
WP2-ABI				
37	ID: Proceedings of the 3rd ABI topical workshop	T1-2006	100 %	T1-2006
41	ID: Proceedings of the 4th ABI topical workshop	T1-2007	0 %	T1-2007
W3-APD				
47	MS: 2nd APD mini-workshop on Crystal Collimation	T4-2005	100 %	T4-2005
48	MS: 3rd APD mini-workshop on Crystal Collimation	T1-2006	100 %	T1-2006

51	ID: Proceedings of the 2nd APD topical workshop (LUMI-05)	T1-2006	100%	T3-2006
54	MS: Creation of a web reference for alternative IR optics	T2-2006	100 %	T4-2006
55	MS: Creation of a web reference for alternative synchrotron optics	T2-2006	0 %	T4-2007
59	ID: First structured list of intensity limits for booster synchrotrons and LHC	T2-2006	20 %	T2-2008
63	MS: 3rd APD topical workshop on Fast Synchrotrons and IR design	T4-2006	100%	T4-2006
64	ID: Proceedings of the 3rd APD topical workshop	T4-2006	20%	T1-2007
65	ID: Interim report on APD activities and reporting at the general CARE meeting	T4-2006	100%	T4-2006

NOTE : The workshop on Coil Manufacturing Optimization was postponed to September 2007 for better organization and preparation. The schedule for the derivation of scaling laws for magnet and cryogenic cost has been extended, due to lack of resources. The development of the database for s.c. magnets and cables, which was slow in previous years, has made good progress in 2006. This task is almost 50% completed. The APD web reference for synchrotron optics and the structured list of intensity limitations for the booster synchrotrons have both been slower than expected. The delay was primarily caused by the reorganization of the injector upgrade studies inside CERN, and by inconsistent internal schedules and priorities.

N3.5 List of major meetings organized under HHH during the reporting period

Date	Title/subject	location	Main organizer	Number of participants	Comments and Web site
9-13 Jan	Visit T. Demma / U. Sannio	CERN (CH)	HHH-APD coordinators	4	Discussion on electron cloud simulations
1 Feb	AT/MAS Seminar by P. McIntyre	CERN (CH)	AT/MAS	About 30?	Test Results on the Model Nb3Sn Dipole TAMU2, http://care-hhh.web.cern.ch/CARE-HHH/Literature
7-10 Mar	RPIA2006	KEK (J)	KEK	45	Discussion on LHC upgrade, pulsed beam-beam compensators & stronger kickers; http://conference.kek.jp/rpia2006

9-10 Mar	mini-workshop on crystal channelling	CERN (CH)	HHH and HHH-APD coordinators	About 20	Discussion on beam experiments, crystal production, and research programm http://indico.cern.ch/conferenceDisplay.py?confId=1183
23 Mar	AT/MAS Seminar by G. Sterbini	CERN (CH)	AT/MAS	About 20?	Studies on Low Crossing Angle Bumps for the LHC Luminosity Upgrade; http://cern-ab-bblr.web.cern.ch/cern-ab-bblr/D0-Dipole/Sterbini.ppt
30-31 Mar	working meeting on Collective Effects	GSI (D)	HHH & HHH-APD coordinators	5	Collective Effects–Coordination of Theory and Experiments http://care-hhh.web.cern.ch/care-hhh/Collective-Effects-GSI-March-2006
3-6 Apr	WAMDO workshop	CERN (CH)	HHH-AMT coordinators	About 140	Accelerator Magnet Design and Optimization http://wamdo-2006.web.cern.ch/wamdo-2006
11 April	CARE coordination meeting	Paris	Care coordinator	10	
26-28 Apr	US-LARP collaboration mtg.	Berkeley (USA)	US-LARP coordinators	About 50	Project status, new project proposals and financial issues; http://uslarp.lbl.gov/workshops/060424/
10 May	55. LHC Technical Committee LTC	CERN (CH)	LTC coordinators	About 25	Options for the LHC IR upgrade; http://edms.cern.ch/lhc_proj/plsql/lhcp.page?p_number=7700
29 May – 2 Jun	HB2006	KEK (J)	KEK, JAEA, ICFA	130	Discussions on high brightness hadron beams, code benchmarking, collective effects, machine protection, electron cloud, etc.; http://hb2006.kek.jp/
21 Jun	58. LHC Technical Committee LTC	CERN (CH)	LTC coordinators	About 25	Proposal for Crystal Collimation Studies; http://edms.cern.ch/lhc_proj/plsql/lhcp.page?p_number=7700
26-30 Jun	EPAC06	Edinburgh (UK)	EPS-AG	About 1200	Several invited plus numerous contributed presentations from CARE-HHH; http://epac06.org/
3-7 Jul	Channeling 2006	LNF (I)	INFN, IPCF, Hadron Physics I3, HHH-APD	77	Review prospects of channelling for collimation http://www.lnf.infn.it/conference/channeling2006/
27 Jul	AB Seminar by E. Benedetto	CERN (CH)	AB-seminar-coordinator	About 50	Emittance growth induced by electron cloud in CERN proton rings http://ab-seminar.web.cern.ch/AB-seminar/meeting/ABsem270706.html

27 Jul	1st CC group meeting	CERN (CH)	HHH-APD coordinators	4	Challenges of LHC crab cavities, draft optics, beam dynamics with crab rf, and rf technology; http://cern-ab-bblr.web.cern.ch/cern-ab-bblr/Crab-Cavity/crabcavity.htm
11 Aug	2nd CC group meeting	CERN (CH)	HHH-APD coordinators	3	Draft design and parameters of LHC crab cavity; number of crab cavities, simulation studies and tools; http://cern-ab-bblr.web.cern.ch/cern-ab-bblr/Crab-Cavity/crabcavity.htm
19 September	3rd CC group meeting	CERN (CH)	HHH-APD coordinators	4	Optics with 8 mrad crossing angle, baseline crab cavity design, orbit and tune shift for pair of global crab cavities, alternative cavity shapes, crab rf noise; http://cern-ab-bblr.web.cern.ch/cern-ab-bblr/Crab-Cavity/crabcavity.htm
1 October	LHC Upgrade Workshop	CERN (CH)	ATLAS upgrade coordinator	About 150	Machine and detector Plans for the LHC upgrade http://indico.cern.ch/conferenceDisplay.py?confId=a063024
12 October	4th CC group meeting	CERN (CH)	HHH-APD coordinators	5	Luminosity scope, parameters, options, technological issues; http://cern-ab-bblr.web.cern.ch/cern-ab-bblr/Crab-Cavity/crabcavity.htm
11-12 October	AMT LER workshop	CERN (CH)	HHH-AMT coordinators & US-LARP	About 50	Pipetron Ring as 1-TeV Injector in the LHC Tunnel; Fast switching dipoles http://ler06.web.cern.ch/LER06
16-20 October	APD LHC-LUMI-06 workshop	Valencia (E)	HHH-APD and HHH coordinators	About 70	IR upgrade, Injector upgrade, Ranking, Intensity limitations http://care-hhh.web.cern.ch/care-hhh/LUMI-06/default.html
15-17 November	CARE'06	Frascati (I)	CARE Coordinators	About 100	Crystal collimation, HHH activities, energy deposition around IP, FPP7 proposals, http://www.lnf.infn.it/conference/care06/prog.htm
29 Nov – 1 Dec	4th ABI topical workshop	Luneburg (D)	HHH-ABI coordinators	27	BPM technology and modern design tools http://adweb.desy.de/mdi/CARE/Lueneburg/ABI-Lueneburg.htm

1.4 JOINT RESEARCH ACTIVITIES

1.4.1 JRA1: Superconducting Radio Frequency (SRF)

The list of participants and their implication in the SRF Work Packages (**C**: Coordination, X: Participation) is given in the table below. The overall management is done by DESY and CNRS-Orsay.

Number	Participant	WP1 M&C	WP2 ISCF	WP3 SCP	WP4 TFCP	WP5 SP	WP6 MA	WP7 COUP	WP8 TUN	WP9 LLRF	WP10 CIT	WP11 BD	Person-months
1	**CEA**					X			X		**C**	X	114.19
3	**CNRS**	**C**						**C**	X		X		117.4
	CNRS-IPNO								X				4.4
	CNRS-LAL	**C**						**C**	X		X		113
6	**DESY**	**C**	X	**C**		**C**	X			**C**			224 (48)
10	**INFN**		**C**	X	X	X	**C**		X			**C**	118.5 (65.5)
	INFN-LNF											**C**	24.5 (10.5)
	INFN-LNL		X	X		X	**C**						24 (12)
	INFN-Mi		**C**						X				40 (19)
	INFN-Ro2				X								30 (24)
12	**TUL**								**C**	X			97 (40)
13	**IPJ**		X		**C**								83 (12.4)
14	**WUT-ISE**									X			19.03 (9.12)
19	**PSI**									X			14

The aim of the JRA on Superconducting RF Technology is to improve the quality and performance of the superconducting test accelerator TTF (Tesla Test Facility), a unique test facility to explore the operating conditions of a high gradient superconducting accelerator, at DESY.
The ultimate objectives of this research activity are

- to increase the accelerating gradient from 25 to 35 MV/m and
- to increase the quality factor from 5×10^9 to 2×10^{10},
- to improve the reliability, operating performance and availability of the superconducting accelerating system,
- to achieve a cost reduction of the SRF cavities and their associated components.

Change of WP or Task leaders.

Dr. P. Strzyzewski from Soltan Institute replaces task leader Dr. J. Langner (WP4.1) who died after a shot but severe illness. We will keep him in our memory as a very competent, highly motivated and friendly colleague
Dr. A. Matheisen replaces WP leader L.Lilje who has to manage increasing work load for ILC.
Mr. N. Steinhau-Kühl replaces Dr. A. Matheisen as Task leader in WP5.2.
Mr. F. Eouzénou replaced Dr. C. Antoine as task leader in WP5.1 because of her leave of absence to FNAL.

Great progress has been made by the group of W. Singer (WP3.2) in fabrication of cavities from large grain and even single crystal Niobium sheets. Excellent results were reported in his highlight talk at the CARE06 annual meeting at CERN. Based on these results it can be expected to fabricate high gradient and high Q (low RF loss) cavities at reduced material and processing costs. The progress of this work follows the experience of intensive material studies for hydroforming of Niobium cavities. Because of the enormous impact of single grain cavity production a new subtask in WP3.2 about further work on single grain cavity production will be defined early 2007.

JRA1.1 Work Package 1: Management and Communication

JRA1.1.1 Use and Dissemination of knowledge

Communication is an important aspect of the JRA-SRF, both between participating institutes as well as with external institutes who share our interest in high gradient, low loss superconducting cavities. Contributions from JRA-SRF members were given to several conferences and meetings, the major ones being as follows:

- The IEEE-SPIE ELHEP.ISE XVII SYMPOSIUM 2006 (Warsaw, PL)
- The IEEE-SPIE WILGA Conference of Electronics for HEP (Wilga, PL)
- The Int. Conf. on Metallurgical Coatings and Thin Films (San Diego, USA)
- The NSTI Nanotechnology Conference and Trade Show 2006 (Boston, USA)
- The European Particle Accelerator Conference 2006 (Edinburgh, GB)
- The Int. Conf. on Mixed Design of Integrated Circuits and Systems (Gdynia, PL)
- The Multiconference CryoPrague 2006 (Prague, Czech Rep.)
- The Int. Conf. on Charged and Neutral Particles Channeling Phenomena 2006 (Frascati, Italy)
- The 2006 Linear Accelerator Conference (Knoxville, USA)
- The 2nd Int. Con. on Radiation Physics and Modifications of Materials (Tomsk, Russia)
- The 22nd Int. Symp. on Discharges and Electrical Insulation in Vacuum (Matsue, Japan)
- The TESLA Technology Collaboration Meeting (KEK-Tsukuba, Japan)
- The Int. Workshop on Thin Film (Legnaro, Italy)
- Several GDE/ILC meetings

Papers and talks were also presented at TESLA Technology Collaboration meetings in this reporting year as well as at the annual CARE meeting held at Frascati in November

The impressive progress made in WP3 (Cavity production) and WP6 (Material Analysis) was presented as highlight talks at the CARE 06 annual meeting. The presentations can be found on the meeting WEB site.

JRA1.1.2 Meetings

Annual SRF Meeting

In addition to the above conferences and several telephone meetings, the SRF JRA held their dedicated annual meeting the day before and during the annual CARE06 meeting at Frascati. This meeting included an entire review of all work-packages and tasks therein. It was the opportunity for the external scientific advisory committee to review the program of work. Their findings can be found later within this report. What was clear from the Frascati meeting is that, despite some delay in certain milestones / deliverables, the project has made enormous progress in the last twelve months. The technical summaries to be found in later sections bears witness to this.

The strong connection between the R&D activities in JRA-SRF and the European X-FEL, the International Linear Collider activities and the TTC (TESLA technology Collaboration) community continues. It seems likely that many of the results of the work from SRF will have a major impact on these projects and collaboration

JRA1.2 Work Package 2: Improved Standard Cavity Fabrication

JRA1.2.1 Reliability analysis

The activities relative to the reliability analysis have been summarized in a dedicated paper and poster presentation at the 2006 European Particle Accelerator Conference. The paper is entitled: "Performance Limitations of TTF Cavities in Accelerator Operation and their Relation to the Assembly Process" [1].

JRA1.2.2 Improved component design

During this period, the activity has been focused on three different items;

- experimental tests and analysis of cold flanges
- stiffening studies (end-dish shape etc.)
- e-beam welding.

Cold flanges: Experimental tests and analysis

The work relative to the cold connection flanges has been completed. We have performed new experimental tests (at room temperature and at liquid nitrogen temperature) and compared our FE model results with experimental measurements performed on the TESLA-like beam-line connections [2].
The whole activity has been dedicated to an in-depth study of the sealing mechanism, measuring the flattening of several gaskets as a function of the applied load. With these new data we have obtained information relative to the pressure needed to obtain tight seals for both of the gasket families we have studied (Al5754 and Al6060 alloys).
Cryogenic temperature tests have been performed in order to study the seal behavior after being subjected to several thermal cycles, and to identify possible long term and fatigue problems. The typical procedure consisted of 20 thermal cycles between room and LN_2 temperature, applied to a joint closed with a tightening torque of 25 Nm. It was directly immersed in liquid nitrogen and left to cool for 10 minutes. The joint was leak checked every cycle, both at cryogenic and at room temperature. The connection performed well and the measured leak rate was always less than $1 \cdot 10^{-10}$ mbar·l/s. In order to evaluate the criticality of the tightening procedure, a test was performed also on a joint closed with a lower torque, near to the required value for leak-tight seal generation. In this case the joint, tightened to 12 Nm, (about one half of the typical value used for the TTF beam-line flanges), also remained leak tight after one thermal cycle in LN_2, thus demonstrating the reliability of this joint.
As presented in the CARE-Note-2006-002-SRF an FE model for the analysis of beam-line connection flanges has been developed and its results were compared with the experimental data obtained. The availability of the mechanical characteristics of the Al5754 and Al6060 alloys (experimentally measured on specimens machined from the same alloy batch used for the gasket, Fig. JRA1.2.1) allowed us to successfully complete the comparison between the FE model results and the experimental measurements performed at room temperature (Fig. JRA1.2.2).

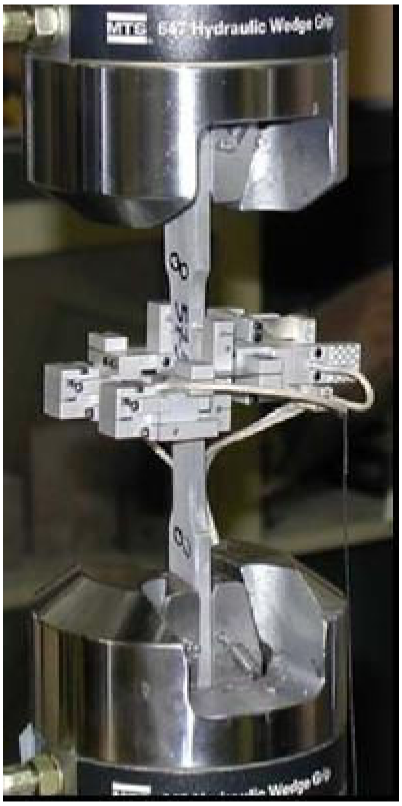


Figure JRA1.2.1: Experimental tensile tests on an Al specimen alloy.

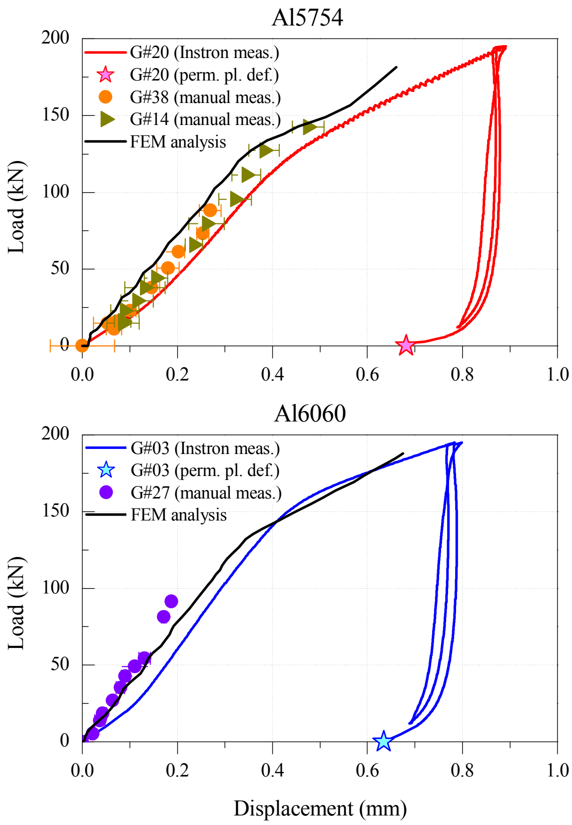


Figure JRA1.2.2: Flange compression curves for the two Al alloys compared with the FEM analysis: the good agreement of the model with the measurements is clearly visible.

<u>Stiffening studies (end dish shape etc.)</u>

Minimal modifications have been realized on the existing cavity for the blade-tuner tests.
The coaxial tuner that will be used to meet the requirements for the ILC cavity, together with the reduction of the overall cavity length and the cost reduction request for mass production, has forced a review of the layout of the He-tank structure and the end dishes.
The adopted strategy is based on the analysis of different solutions developed for SC cavities in several laboratories. In particular, we are critically analyzing the TESLA, SNS, KEK and TRASCO-ADS solutions. For each solution, we have evaluated performance, weaknesses, construction problems and costs.
As an example, Fig. JRA1.2.3 and Fig. JRA1.2.4 show the FE analysis of the end dish configuration used for the blade-tuner test.
In order to achieve better results a different geometry has to be adopted. The solutions that we are investigating are similar to the ones we have chosen for the 700 MHz proton cavities, (see Fig. JRA1.2.5). This choice allows one to obtain a higher stiffness while saving the possibility to accommodate the helium tank length with the total length of the cavity during the final assembly.

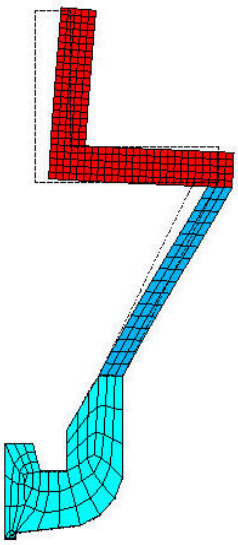


Figure JRA1.2.3: deformed mesh of the end dish - tuner side.

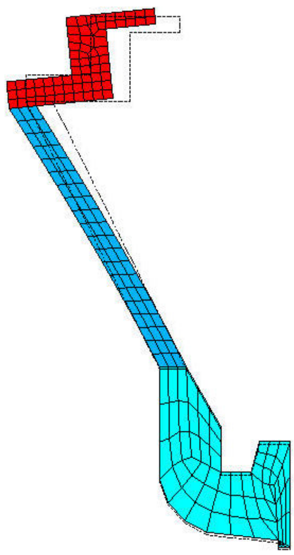


Figure JRA1.2.4: deformed mesh of the end dish - coupler side.

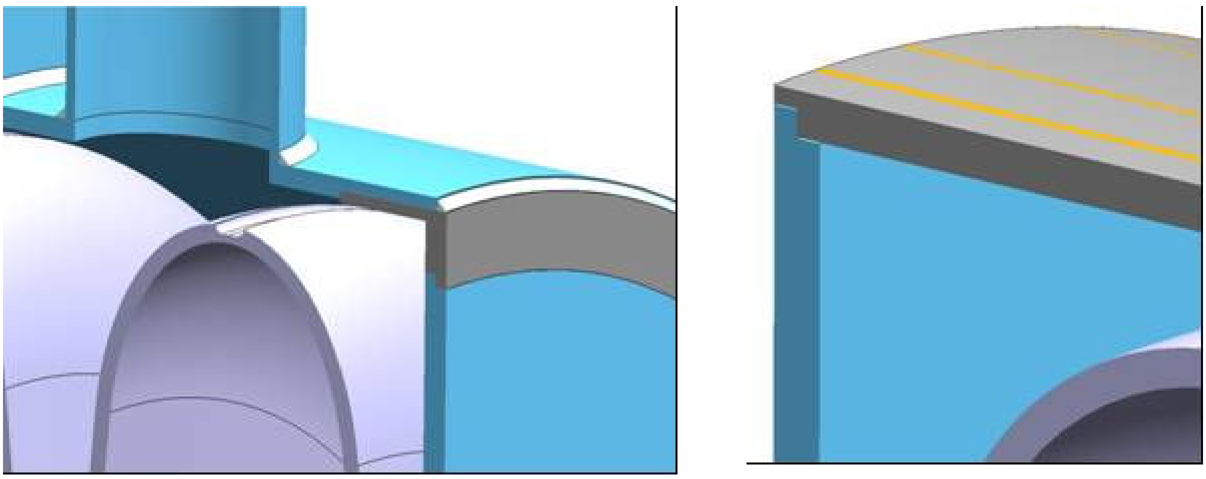


Figure JRA1.2.5: Schematic of proposed helium tank – end dish stiffer connections

e-beam welding

A listing of the main parameters relative to the welding machine is in progress. Papers relative to the welding mechanism, on topics such as energy dissipation, electron scattering, etc., have been collected.
Moreover, we have analyzed the possibility to join dissimilar materials such as niobium and stainless steel [3,4] through a thin Vanadium interlayer: this might allow a significant cost reduction in the production of SC cavities. In Fig. JRA1.2.6 the phase diagram of some Vanadium alloys (Nb-V, Fe-V) is shown together with the Nb-Ti phase diagram.

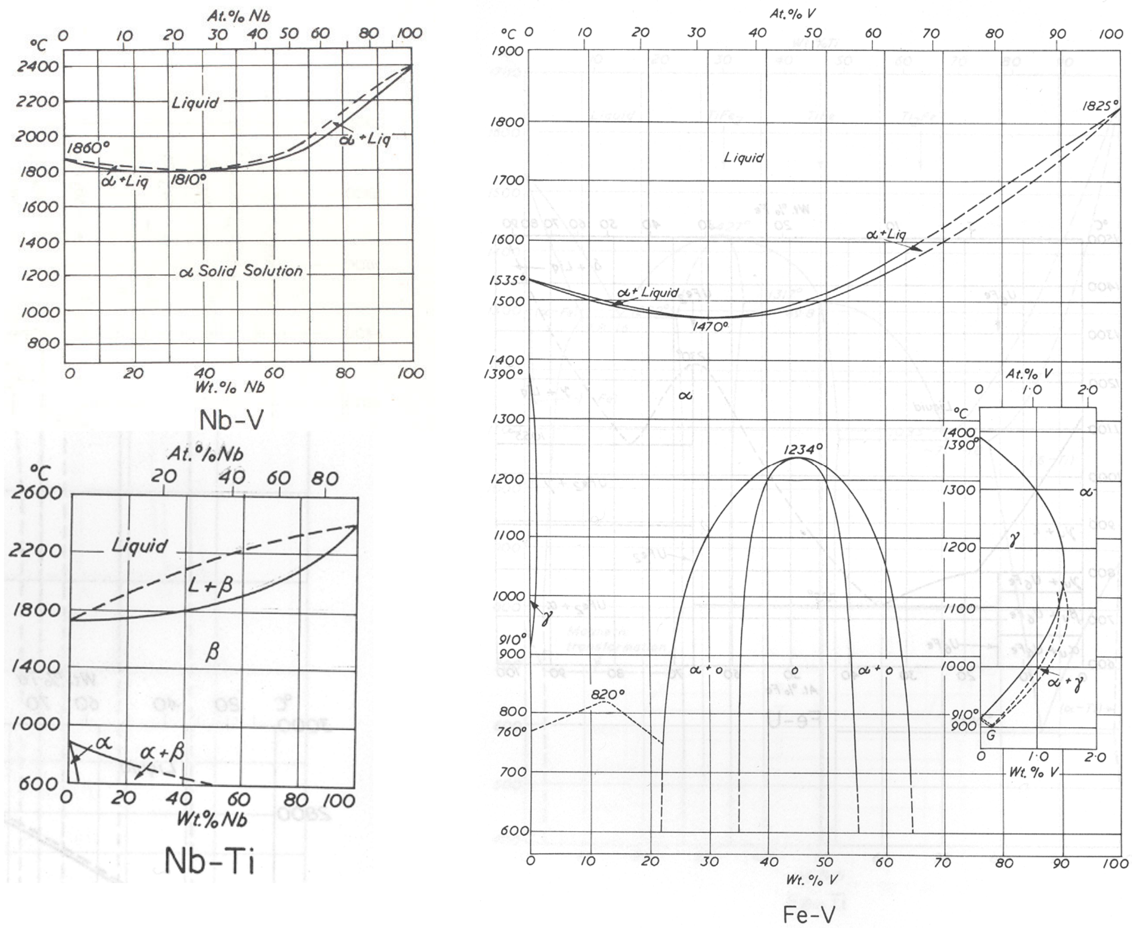


Figure JRA1.2.6: Phase diagrams of some vanadium alloys and Nb-Ti.

References

[1] L. Lilje, “Performance limitations of TESLA cavities in the FLASH accelerator and their relation to the assembly process”, proceeding EPAC’06, Edinburgh, UK.

[2] L. Monaco, P. Michelato, C. Pagani, N. Panzeri, “Experimental and theoretical analysis of the TESLA-like SRF cavity flanges”, proceeding EPAC’06, Edinburgh, UK.

[3] N. P. Krutogolov, V. V. Diachenko, et al. “Defocused electron beam welding of Nb alloys and Stainless Steel”, Industrial Welding, 4, 1980, p. 14.

[4] V. A. Veinik, V. V. Diachenko, et al. “Electron beam welding of Nb alloys and Stainless Steel through a Vanadium layer”, Industrial Welding, 5, 1973, p. 16.

JRA1.2.3 EB welding

During a three week shut down of the electro beam-welding machine, we dismounted the old mechanical rotation drive and installed the new stage and box for the UHV-motor.

Figure JRA1.2.7: Motor box and current supply with Kapton© isolation

With the new support and rotation drive it is possible to change the working angle of the motor or the stage.

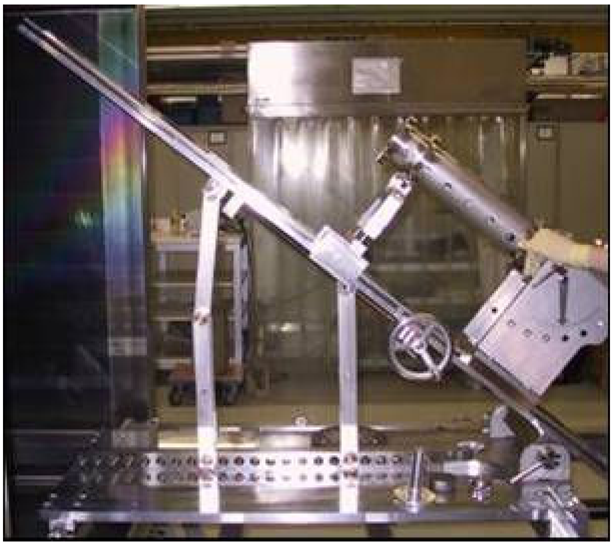


Figure JRA1.2.8: Stage at a 38° angle

The installation of the motion-drive for the y-axis has been prepared. It will be completed next month.

In order to manage new welding jobs, such as the neck of the nine-cell-cavity, we built a new universal support with wide rollers. A mandrel adjusts the axis-centre-distance of the rollers. Therefore, we can weld work pieces with different diameters without constructing a new welding fixation.

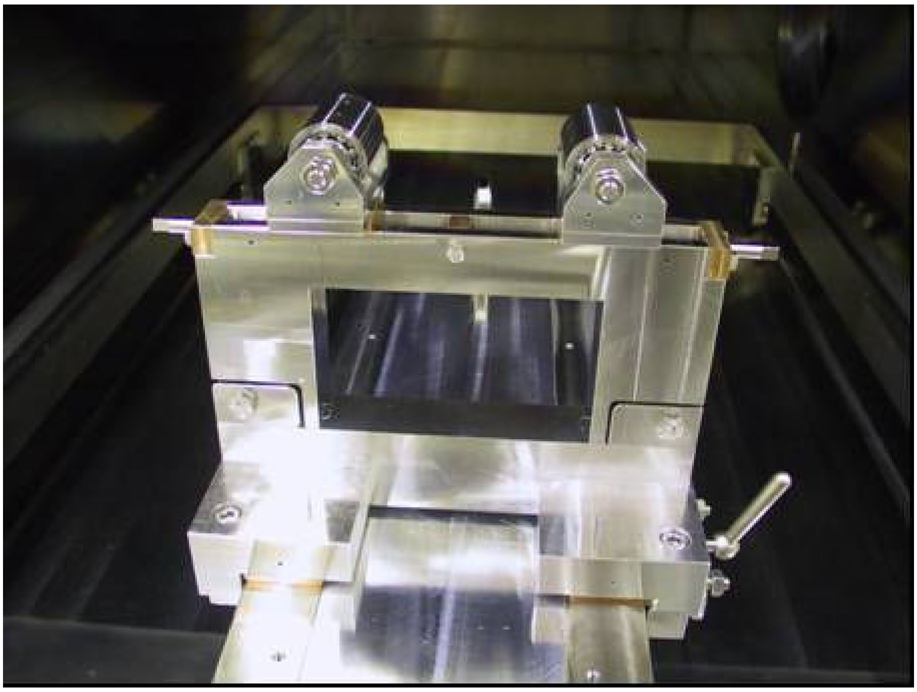
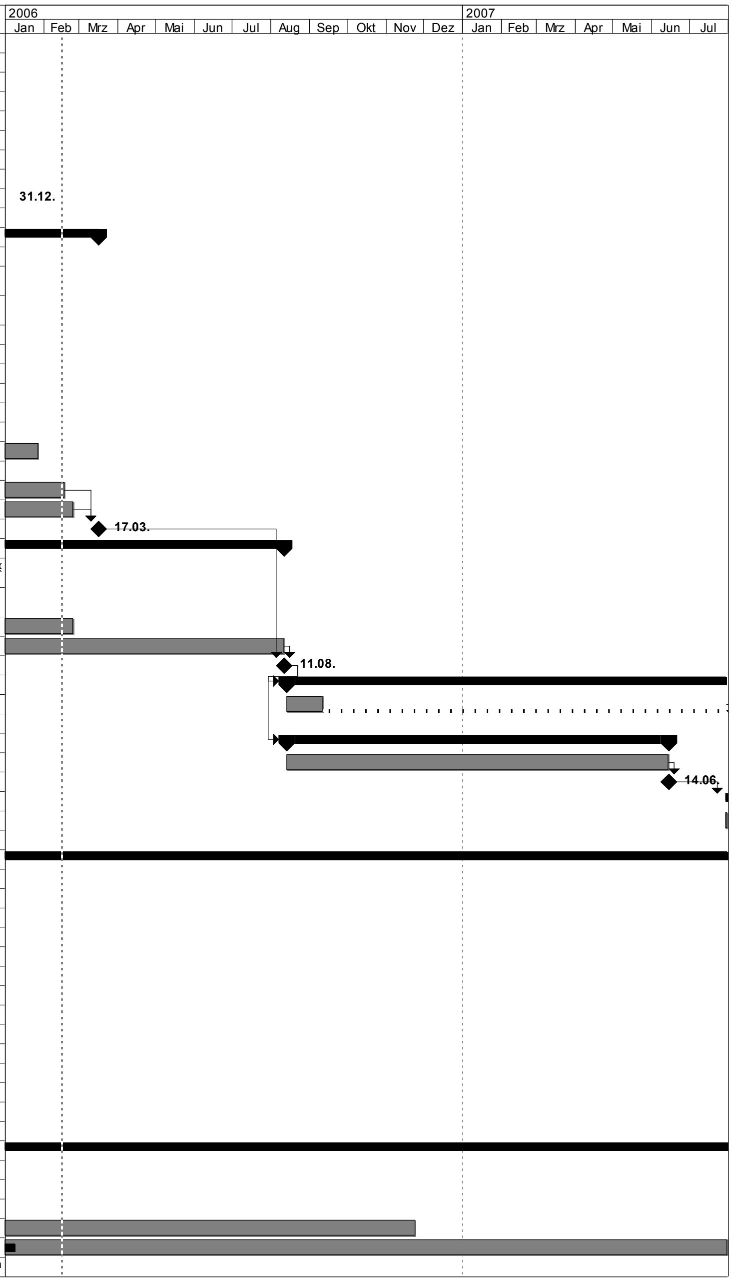


Figure JRA1.2.9: Front side of the new universal welding support

JRA1.2.4 Overall Progress of Work Package 2

N°	Task Name
2	**WP 2 IMPROVED STANDARD CAVITY FABRICATION**
2.1	**Reliability Analysis**
2.1.1	Review of data bank: cavity fabrication
2.1.2	Review of data bank :cavity treatment
2.1.3	Review of data bank: cavity VT performance
2.1.4	Review of data bank: string assembly
2.1.5	Review of data bank: string performance
2.1.6	Establish correlations
2.1.7	**Final report on reliability issue**
2.2	**Improved component design**
2.2.1	**Documentation retrieving**
2.2.1.1	Start up meetings
2.2.1.2	Access and study of Jlab, DESY, LLAN, KEK experience
2.2.1.3	**Summary report on the status of the art on ancillaries**
2.2.1.4	Sealing material and shape design
2.2.1.5	Flange preliminary design
2.2.1.6	Material and geometric compatibility
2.2.1.7	Final assembly design
2.2.1.8	End plate preliminary design
2.2.1.9	**Report about new design for components**
2.2.1.10	Stiffness optimization
2.2.1.11	Manufacturing procedure analysis
2.2.1.12	Final assembly design
2.2.1.13	Other ancillaries design
2.2.1.14	**Final Report for new components**
2.2.2	**Review of criticality in welding procedures**
2.2.2.1	Review of available parameters on vendor welding machine
2.2.2.2	Definition of prototype requirements for tests
2.2.2.3	Welding test on specimens
2.2.2.4	Analysis of the results
2.2.2.5	**Report about welding parameters**
2.2.3	**Finalize new component design**
2.2.3.1	Do drawings
2.2.3.2	**New components design finished**
2.2.4	**Finalize new cavity design**
2.2.4.1	Make drawings
2.2.4.2	**New cavity design finished**
2.2.5	**Fabrication of new cavity**
2.2.5.1	Fabrication
2.2.5.2	New cavity finished
2.3	**EB welding**
2.3.1	**Design tooling**
2.3.1.1	Tools for flange welding
2.3.1.2	Tools for pipe welding
2.3.1.3	Tools for stiffening rings
2.3.1.4	Tools for single cell welding
2.3.1.5	Tools for 9-cells
2.3.1.6	**Tools design finished**
2.3.2	**Tools production**
2.3.2.1	Tools for flange welding
2.3.2.2	Tools for pipe welding
2.3.2.3	Tools for stiffening rings
2.3.2.4	Tools for single cell welding
2.3.2.5	Tools for 9-cells
2.3.2.6	**Tools fabrication finished**
2.3.3	**Welding**
2.3.3.1	Commissioning welding machine
2.3.3.2	Test welding
2.3.3.3	**Start production welding of components**
2.3.3.4	Single cell welding
2.3.3.5	Multicell welding
2.3.3.6	**Welding of prototypes of components finish**



JRA1.3 Work Package 3: Seamless Cavity Production

JRA1.3.1: Seamless cavities by spinning

Spinning is a low-cost production method of forming axially symmetrical hollow parts of almost any shape. It is a point deformation process by which a metal disk, or a cylindrical pre-formed hollow component is plastically deformed by the axial or radial motions of a tool or rollers acting on a work piece clamped against a rotating chuck. A characteristic of this process is that the movement of tools onto a rotating piece acts upon a very localized area where plastic flow takes place. Spinning belongs to the tension-compression forming process since tangential compressive and radial tensile stresses are generated in the deformation zone just as in deep drawing. At LNL spinning has been applied for the construction of seamless TESLA-shape cavity prototypes. The technique primarily consists of a rotary-point method of extruding metal, pressing it against a mandrel rotated by the headstock of a lathe. A metal disk is first spun into a truncated-conical shape onto a pre-form. Subsequently the final shape is obtained by spinning the material from the external side, onto a mandrel that exactly reproduces the shape of the cavity interior. Hence the truncated cone piece is spun against the mandrel. The cut-off and the half-shell being closer to the truncated cone basis are the first to be obtained. Subsequently the manufactured piece is spun at the level of the equator looking for the closest fit of the metal to the mandrel. The material after the equator that has still to be spun has a conical shape. By the same method the material of such a region is made to flow under the external roller creating the second half shell and the second cut-off. The mandrel is made collapsible so it can be extracted from the cavity after forming. By this process the metal is made to flow under plastic deformation in a bi-dimensional space. In this way, a rather high percentage reduction can be achieved without any buckling or cracking. This method found for the forming of mono-cells has been successfully applied in an iterative way for the construction of seamless multi-cells. No matter the number of cells, no intermediate annealing is needed.

Spinning a multi-cell cavity directly from a 3 mm thick 1 meter diameter niobium blank is certainly impressive but is, however, impractical for industrial production. Hence the procedure has been engineered by first producing seamless tubes then by subsequently spinning the cavity. When spinning a multi-cell from a tube, the spinning procedure is the same for every cell. Moreover spinning from a tube, rather than directly from a blank, ensures a much better wall thickness uniformity for the spun cavity. Niobium seamless tubes are however not commercial, so we have been simultaneously developing three different methods: forward flow turning and deep-drawing, both direct and reversal.

<u>Fabrication of the spinning machine</u>

Fig. JRA1.3.1 shows the spinning lathe used before starting the CARE project. The lathe turret supporting the rollers moved along an axis of about 45 degrees with respect to the spinning axis. Since the shear force was applied onto the spun piece by the roller only when this moves forward, the necking process worked only for a half cell.

Figure JRA1.3.1: The spinning lathe used for the fabrication of seamless cavity prototypes. The lathe had only one turret which held the rollers.

In other words, the main problem is the following: the revolving turret supporting rollers can move back and forward along a direction that is approximately 45 degrees from the cavity axis. It moves forward in order to have rollers applying a radial force to the tube that must be plastically deformed. It moves backward in order to retract the roller after the deformation in order to shift to another point. During this latter operation, the pressure is released and there is not any possibility to apply a plastic deformation. Due to the peculiar shape of the cavity in each dumb-bell, the actual machine can spin only the half cell that is encountered along the roller's rectilinear path. In order to spin the other half-cell, the cavity must be dismounted from the lathe together with the internal mandrel. The whole thing is turned through 180 degrees, the half-cell that was previously untouched by the roller becomes the part that must be plastically deformed. This operation is at the moment iterated several times up to the moment when the full dumb-bell is finished. This operation is rather laborious, time consuming, and is rather risky. Not only for the piece, which can be damaged during the operations of dismounting from lathe headstock, turning and remounting, but also because the collapsible mandrel can move from the correct position. Further, the lathe is not long enough for the nine-cell spinning and the pressure between headstock and tailstock is insufficient. Due to this limit, which is normally found on all spinning lathes that we know of, the cavity needs to be dismounted from the lathe headstock, tilted and remounted several times for each necking operation. This means wasting time, not only because of the time lost for dismounting the cavity and turning it on the lathe, but mainly because each time the cavity is dismounted and mounted from the lathe headstock, the cavity rotation axis must be aligned each time from the beginning.

The fabrication time will be strongly reduced by adding a second turret working in the opposite direction to the standard one. As shown in Fig. JRA1.3.2, the turret has been designed, fabricated and added to the lathe. In this configuration the cavity remains mounted onto the lathe during the whole spinning operation (apart from when the internal collapsible die is dismounted), while the operator moves around the lathe depending on the half cell he has to spin. This makes the spinning procedure shorter in time, less expensive and therefore easier to industrialize.

The spinning machine for producing seamless multi-cell resonators starting from a tube has been finished and it is currently working. The research activity on spinning is executed in an external firm that already owns a lathe currently used for spinning resonators.

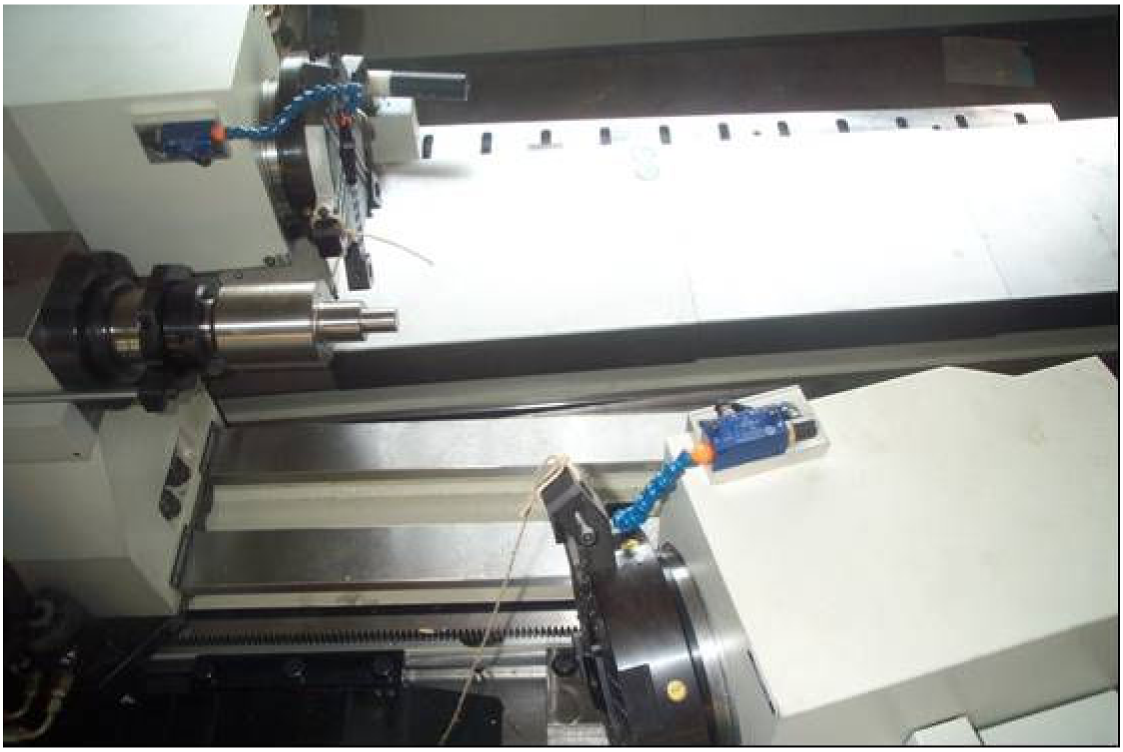


Figure JRA1.3.2: The new spinning lathe with two turrets which hold the rollers. In this configuration, the rollers can work in opposite direction.

The previous machine however was also not powerful enough for the spinning operation. Therefore we adapted the already existing machine, designing some modified parts to add to it. All the work done is reported below and fully respected the milestone deadline:

- The new turret has been added and it works in the opposite direction and on the other side of the already existing one.
- The hydraulic plant was implemented and valves were added, for achieving a pressure of 120 bar.
- Since the increase in pressure was too large for the existing headstock configuration, and since the maximum rotation speed was 2000 rpm, the bearings supporting the headstock were changed adopting forced lubrication bearings with the related pump and ancillaries.
- The headstock was consequently lengthed by 100 mm and was designed for more robust construction.
- The lathe base and carriage appears more solid in the new design. The lathe-basement was lengthened by 200 mm.
- The lathe tailstock was also enforced in order to support the higher pressure applied between headstock and tailstock when spinning the part.
- A new motor of 18 KW power, an output speed of 8000/min and a speed reducer of 1:4 was also mounted.

Evaluation of spinning parameters

In standard operation the material wall thickness at the iris, at the end of the necking operation, could be lower than the initial tube thickness. This is actually possible in the double turret configuration, but it requires careful control of the roller working pressures, of the spinning angular velocity, of the roller feed speed and finally of the pressure between headstock and tailstock.

Figure JRA1.3.3: Phase of the double turret necking process during the spinning parameter definition action.

The definition of spinning parameters must be twofold: first the piece must not crack or wrinkle, then the material must be spun in order to get a uniform wall thickness. Basically the tendency to wrinkle is dependent on the relationship between metal thickness and the area of the blank which, to be formed, is not clamped. Also material strength has a direct effect on the limits to tangential loading: a thin, large diameter blank will certainly require more intermediate steps than a smaller diameter, thick blank. The critical parameter is however the ratio **(v/ω)** between the feed speed **v** and the angular speed of the rotating part **ω**. Increasing **v** or decreasing **ω** will favour wrinkles appearing. For a given material and assigned cinematic conditions, lowering the angle between the lathe axis and the mandrel surface or increasing the roller nose radius will also provide a higher wrinkle probability. Subsequently radial cracks can form in the outermost portion of the work-piece at the end of the process when wrinkles are removed by continued spinning

In order to determine the required spinning parameters we worked with copper tubes. Once the parameters were determined we switched to niobium tubes. This allowed us to determine the parameters in an economic fashion. Many process variables have to be considered when spinning, in order to achieve the required shape, dimensional accuracy, surface finish and wall thickness profile and tolerances. On the basis of our experience, the parameters recognized to govern the final result can be seen in the work-piece parameters, material parameters, tooling parameters, machine parameters and process parameters. In particular for the work-piece parameters it is mainly important to control the blank diameter and thickness and the shape and size of the final piece to spin. For the material parameters it is important to control the material flow curve; the anisotropy; the compressive modulus and the compressive yield strength. For the tooling parameters it is important to control the shape, size and finishing of the mandrel, diameter, nose radius and shoulder radius of the roller, type and quantity of lubricant. More than the final mandrel, however, the series of the pre-mandrels needed for keeping a uniform wall thickness are important. For the machine parameter it is important to control the positional accuracy; machine rigidity, operational distance between headstock and tailstock and the maximum radius of acceptable blank. For the process parameters the number of rollers, the roller feed speed, the angular speed of the rotation chuck, the forming force (tangential, axial and radial components) and the blank support force are important.

JRA1.3.2: Seamless cavity production by hydroforming

Numerical simulation of the necking process

The numerical simulation was done using the finite element code ANSYS. The real geometry of the tubes after end reduction was taken into account.

A comparison of the measured and simulated wall thickness after the necking process is shown in Fig. JRA1.3.4. The comparison was made for Cu tubes with markers Rohr8 - Rohr13. For the comparison the tube thicknesses were normalized to 4mm.

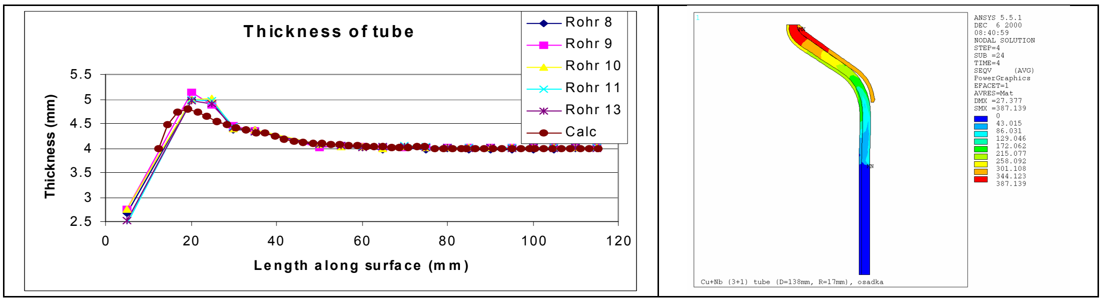


Figure JRA1.3.4: Comparison of simulated and experimental wall thicknesses after necking.

The thickness of wall, obtained from simulation agrees with the experiment. The thickening of the tube region between the iris and the equator is in accordance with the measured dimensions of tubes with reduced ends.

<u>Numerical simulation of hydroforming process</u>

During the simulation of the hydro-forming process, the tube form and stress distribution after necking were taken into account. Applied loads (pressure and displacement) from real experiments on Rohr13 where used. The results are compared in Fig. JRA1.3.5. The agreement with experimental data seems acceptable.

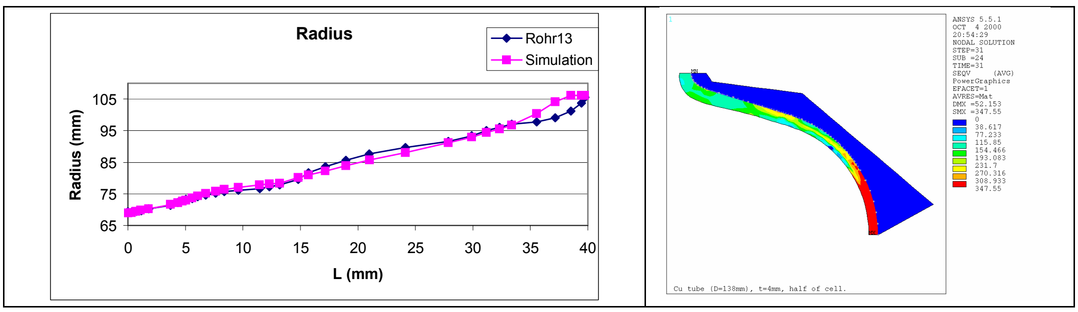


Figure JRA1.3.5: Simulation of radius growth during hydro-forming in comparison with experiment

<u>Experiments on tube necking at the iris</u>

The necking experiments were performed on copper as well as on niobium tubes in order to optimize the necking parameters. The machine can be seen in Figure JRA1.3.6.

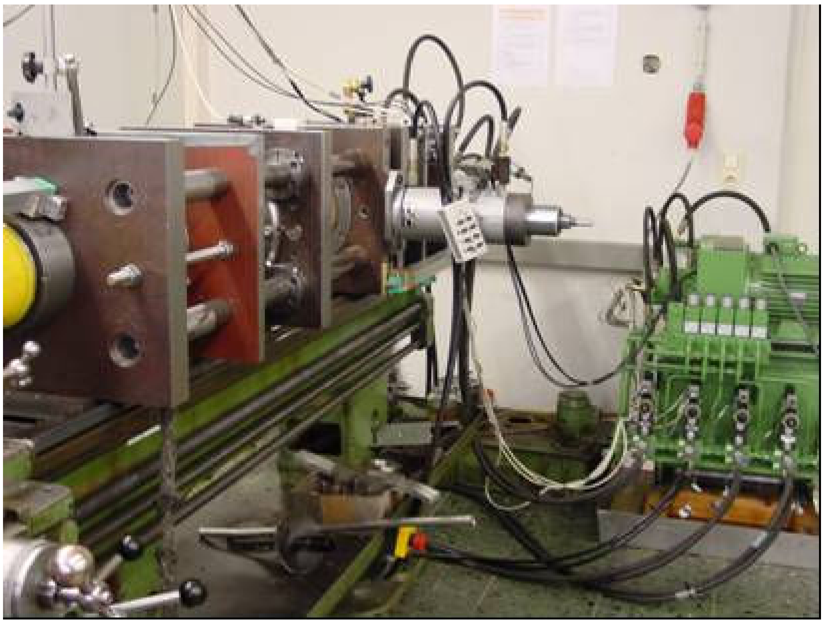


Figure JRA1.3.6: View of the tube necking machine

A combination of radial and axial movements allows one to improve the uniformity of the circumferential wall thickness at the iris area without a noticeable reduction of the wall thickness. One example of the necking can be seen in Fig. JRA1.3.7.

Figure JRA1.3.7: Example necking of the niobium three cell unit.

Hydro-forming of three cell units and fabrication of a seamless cavity

After successfully necking six 3-cell cell units for two 9-cell cavities, cavities have been fabricated by hydro-forming from earlier produced seamless tubes of dimensions: internal diameter of 150 mm, wall thickness 3 mm of bulk niobium (Fig. JRA1.3.8). The expansion of the tube diameter at the equator area (hydro-forming) is done by simultaneous application of internal pressure and of axial displacement. A definite relation between the applied internal pressure against axial displacement (path of the expansion) is fulfilled. The rough value of the pressure was derived from numerical simulations and further corrected on the basis of hydroforming experiments. The hydroforming is done on the hydroforming machine (Fig.JRA1.3.9) in two stages in order to achieve the correct shape, rather uniform wall thickness of the complete cavity and to suppress instabilities during the tube expansion.

Figure JRA1.3.8: Hydro-formed three cell units

Figure JRA1.3.9: View of the hydroforming machine

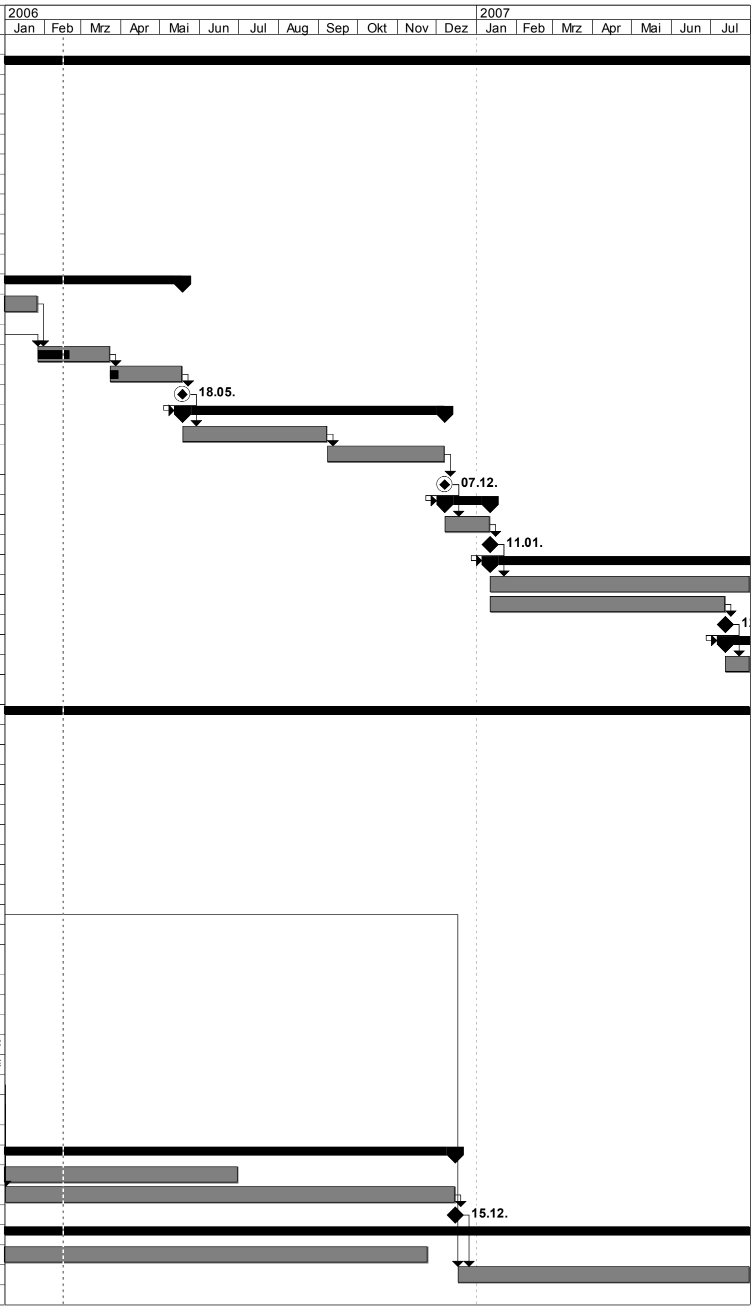
An order for fabrication of a 1.3 GHz nine-cell seamless resonator (without equator welds) has been placed with industry.
Fabrication includes the following steps:

- Fabrication of the long and short end groups connected with the three cell units
- Machining, preparation and welding of the three units together to form a 9 cell cavity (two iris welds are done from outside)
- Machining, preparation and welding on of the stiffening rings

Delivery of the seamless resonator is expected for the beginning of 2007.

JRA1.3.3 Overall Progress of Work Package 3

N°	Task Name
3	**WP3 SEAMLESS CAVITY PRODUCTION**
3.1	**Seamless by spinning**
3.1.1	**Design spinning machine**
3.1.1.1	Drawings of the matrices
3.1.1.2	Drawings of the support system
3.1.1.3	**Drawings of spinning machine finished**
3.1.2	**Fabrication of spinning machine**
3.1.2.1	Fabrication of machine parts
3.1.2.2	Software for the machine
3.1.2.3	Assembly of machine
3.1.2.4	Commissioning of the machine
3.1.2.5	**Spinning machine ready**
3.1.3	**Evaluation of spinning parameters**
3.1.3.1	Drawings of the support system and turning mechanism
3.1.3.2	Drawings of the necking mechanism
3.1.3.3	Fabrication of the tube necking machine
3.1.3.4	Commissioning of the machine
3.1.3.5	**Spinning parameters defined**
3.1.4	**Spinning of 1-celll cavities**
3.1.4.1	Material and fabrication of bulk Nb test tubes
3.1.4.2	Material and fabrication of bimetallic NbCu test tubes
3.1.4.3	**1-cell spinning parameters defined**
3.1.5	**Extension of spinning apparatus to multicells**
3.1.5.1	Computer simulation of the necking
3.1.5.2	**Start of Multi-cell spinning**
3.1.6	**Spinning of multi-cell cavities cavities**
3.1.6.1	Computer simulation of the spinning
3.1.6.2	Spinning of bulk Nb 9-cell cavities
3.1.6.3	**Parameters of multi-cell spinning defined**
3.1.7	**Series production of multi-cell cavities**
3.1.7.1	Spinning
3.1.7.2	**Multi-cell cavities finished**
3.2	**Seamless by hydroforming**
3.2.1	**Design hydro forming machine**
3.2.1.1	Drawings of the matrices
3.2.1.2	Drawings of the support system
3.2.1.3	**Drawings matrix & support finished**
3.2.2	**Construction of hydro forming machine**
3.2.2.1	Hydraulic for machine
3.2.2.2	Software for the machine
3.2.2.3	Machine fabrication
3.2.2.4	Commissioning of the machine
3.2.2.5	**Hydro forming machine ready**
3.2.3	**Construction of tube necking machine**
3.2.3.1	Drawings of the support system and turning mechanism
3.2.3.2	Drawings of the necking mechanism
3.2.3.3	Fabrication of the tube necking machine
3.2.3.4	Software for the tube necking machine
3.2.3.5	**Construction tube necking machine finished**
3.2.4	**Development of seamless tubes for 9-cell cavitie**
3.2.4.1	Material and fabrication of bulk Nb test tubes
3.2.4.2	Material and fabrication of bimetallic NbCu test tubes
3.2.4.3	**Seamless tubes ready**
3.2.5	**Development of tube necking**
3.2.5.1	Computer simulation of the necking
3.2.5.2	Experiments on tube necking at iris
3.2.5.3	**Tube necking machine operational**
3.2.6	**Hydro forming of seamless cavities**
3.2.6.1	Computer simulation of the hydro forming
3.2.6.2	Hydro forming of bulk Nb 9-cell cavities
3.2.6.3	**Hydro formed 9-cell cavities ready**



JRA1.4 Work Package 4: Thin Film Cavity Production

JRA1.4.1 Linear arc cathode coating

Status of activities

The task 4.1 has been focused on the development of a UHV arc system with the linear (cylindrical) cathode configuration. A general view of the UHV linear-arc system, which has been slightly modified during operational tests, is presented in Fig. JRA1.4.1.

Figure JRA1.4.1. UHV linear-arc facility operated at the IPJ in Swierk, Poland.

Modifications of the UHV linear-arc facility

During 2006, studies of the arc-current reduction and stabilization were continued with the use of a stainless-steel chamber of shape and dimensions similar to the single TESLA RF-cell. This chamber was equipped with two flanges, used as connections with the UHV pumping stand (at the bottom) and a magnet driving system (at the top), and four radial diagnostic ports in the central symmetry plane of the cell.

The prototype version of the pure-Nb cylindrical cathode was 32 mm in diameter. Taking into account the micro-droplet filter, that cathode could not be used within the original TESLA cavity. Therefore, two new pure-Nb tubes of 24 mm in diameter (with walls of 3 mm in thickness) were ordered. The first tube of about 50 cm in length was designed for coating a single RF cavity, while the second one of about 120 cm in length was designed for future experiments with a multi-cell structure. The first modified cylindrical cathode (described in the WP4 Quarter Report 1-2006) has already been exploited.

In order to facilitate biasing of samples, a so-called keying module was designed and constructed at IPJ, as described in the WP4 Quarter Report 1-2006. It can transform a DC input signal into pulsed output signals of amplitude variable from -800 V to 0, with a frequency setting within the range of 0-100 kHz. The module has already been delivered to the Tor Vergata laboratory in order to perform tests within a UHV planar-arc facility. An identical module will be constructed for the UHV linear-arc facility, if results of the current tests are positive.

Coating of single cells

Tests on the coating of single cells within the UHV linear-arc facility have been postponed because the collaborating laboratories (INFN-Legnaro and DESY) were unable to deliver the TESLA-type copper cavities in 2006. According to information announced during the CARE Annual Meeting 2006, the original TESLA-type copper cavities should be delivered in the first quarter of 2007. Therefore, it has been proposed to delay the coating of a single-cell without a micro-droplet filter until March 31, 2007 at the earliest, while the realization of the whole task (4.1.1.7) should be prolonged to at least June 30, 2007.

Taking into account the positive results of the previous tests on the coating of model TESLA–type copper cavities (described in WP4 Annual Report 2005) and the modifications of the UHV linear-arc facility it is estimated that 80% of the whole task has already been achieved, but its complete realization depends also on other sub-tasks, and particularly on the design and application of a micro-droplet filter (see below).

Design and construction of a micro-droplet filter

A micro-droplet filter is needed in order to eliminate micro-droplets emitted from the cathode surface. Such a filter must of course be adapted to the cylindrical configuration. A prototype of the cylindrical micro-droplet filter was constructed in 2005. After tests, it was decided to design and manufacture two versions of the modified filter. The first version consisted of a concentric set-up of thin Cu-tubes carrying magnetizing currents and a flow of cooling-water. Computations of the magnetic field distribution were performed in order to optimize the filter configuration and thermal loads (due to the magnetizing current and arc-plasma) were estimated in order to determine the appropriate construction, as shown in Fig.JRA1.4.2.

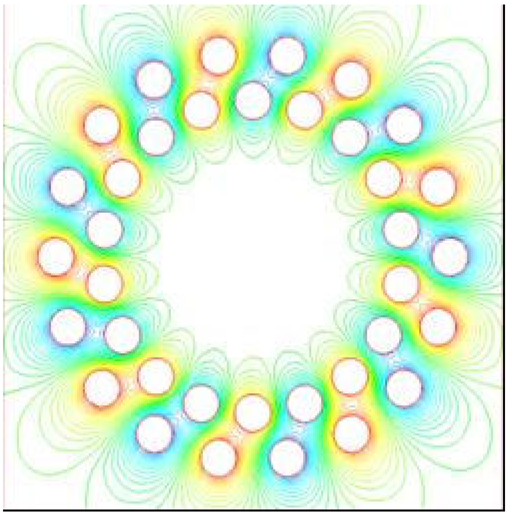



Figure JRA1.4.2: Distribution of magnetic field lines in the cross-section of the considered micro-droplet filter, and a general view of that filter prepared for the installation.

A second version of the micro-droplet filter was also designed. It consists of a cylindrical Venetian-blind system without any magnetizing current. It was equipped with a solid copper flange with connections for the water cooling, as shown in Fig.JRA1.4.3

Figure JRA1.4.3: View of the cylindrical Venetian-type micro-droplet filter.

Both filters were manufactured (see Figs JRA1.4.2 and JRA1.4.3) according to the up-dated time-schedule of the project. They were installed within the model TESLA-type cavity and tested during typical UHV arc discharges in two successive experiments. At arc currents of about 60 A they could withstand 2-minute operation cycles, as reported at an International Congress in Tomsk (Sept.2006) and the International Workshop in Legnaro (Oct. 2006). Hence, the milestone "Micro-droplet filter ready" (task 4.1.1.7.3) was achieved according to the time-schedule.

Studies of samples coated within experimental chambers of the TESLA-type

In order to investigate characteristics of thin Nb-films deposited by means of the UHV linear-arc facility, use was made of several sapphire samples, which were placed in the diagnostic port of this facility. The deposition processes were performed under very clear and controlled vacuum conditions, but without any micro-droplet filter. Since the samples were mounted on the grounded support, no additional bias was applied. The Nb-coated sapphire samples were investigated in other laboratories in order to get SEM images, micro-droplet populations, RRR values and SIMS profiles.

The SEM pictures of the Nb layers deposited without any micro-droplet filter showed a relatively large population of micro-droplets, as shown in Fig.JRA1.4.4.

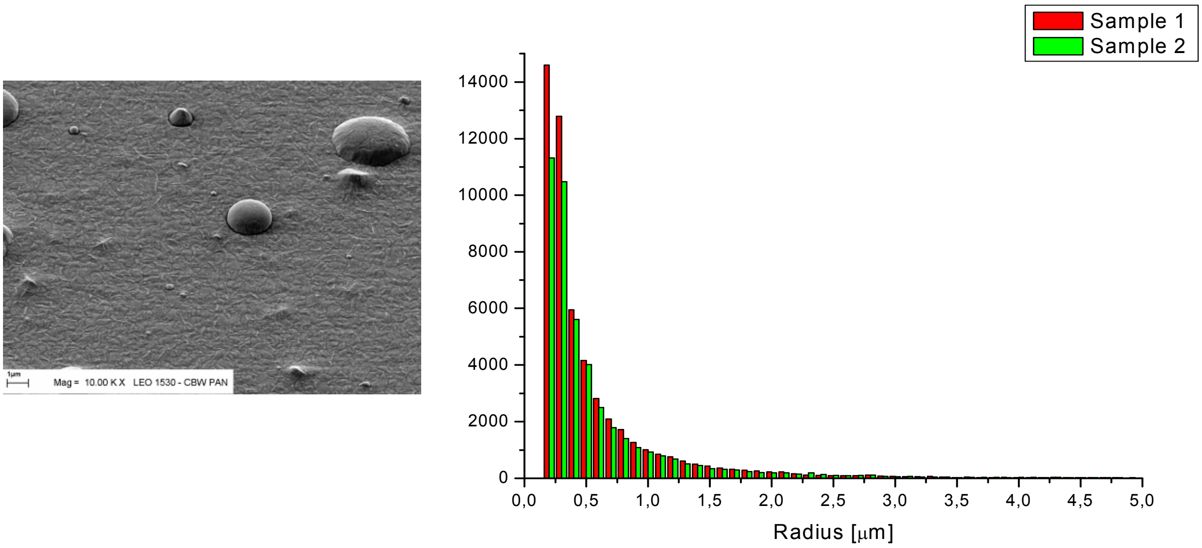


Figure JRA1.4.4: SEM picture of an unfiltered sample and the population of the deposited microdroplets.

Measurements performed at the Tor Vergata laboratory showed that the unfiltered Nb layers have low RRR values (from 5 to 25), which is explained by the influence of numerous micro-droplets. Better results (RRR up to 48) were obtained for the biased (-70 V) samples, but this procedure cannot be used when entire TESLA cavities are coated. Therefore, the application of a cylindrical micro-droplet filter seems to be necessary.

To study the chemical composition of the deposited layers, use was made of the SIMS technique. Preliminary measurements were performed with an O_2+ ion-gun and time-of-flight (ToF) mass analyzer, but the O_2+ ions caused the formation of an additional NbO mixture, as shown in Fig.JRA1.4.5.A Therefore, the next SIMS measurements were carried out with non-reactive gas (Ar) ions. As a result, the oxygen contamination was considerably reduced, as shown in Fig.JRA1.4.5B.

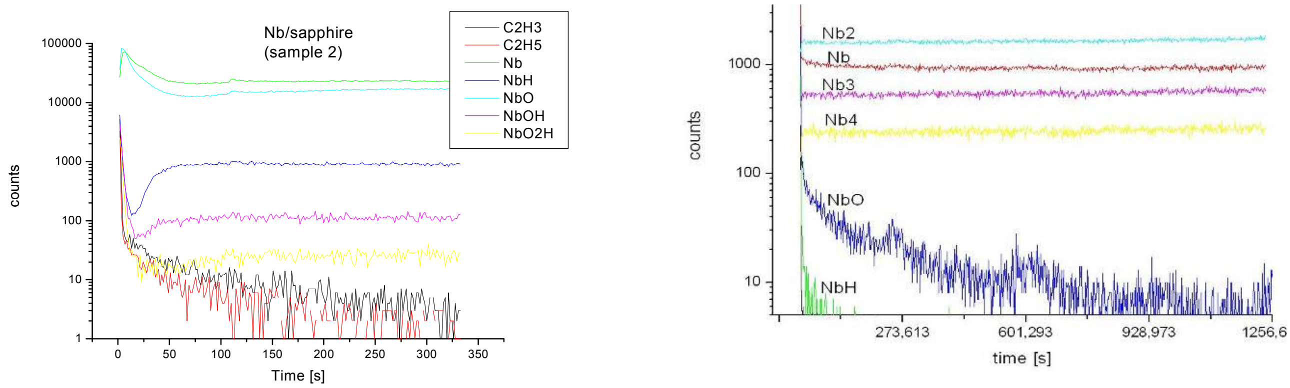


Figure JRA1.4.5 (A,B): SIMS profiles of the Nb films deposited without any microdroplet filter, which were recorded with the use of the oxygen ions (on the left) and argon ions (on the right).

Study of samples coated with the use of a microdroplet filter

In order to prepare for coating of a single cell with micro-droplet filtering (task 4.1.1.7.3) some sapphire substrates were placed outside the Venetian-type filter (see Fig. 4.1.3) and were coated at an arc current of 55 A during 25 minutes. The deposited Nb-film thickness was about 1.5 μm. The obtained Nb-layers were characterized by the surface distribution of micro-droplets, as shown in Fig. JRA1.4.6.

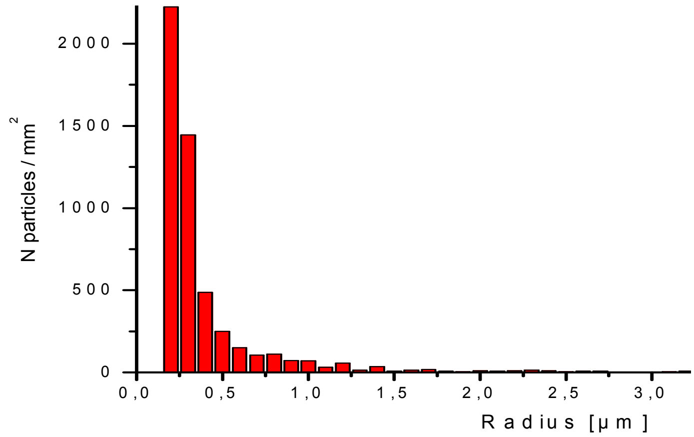


Figure JRA1.4.6: Micro-droplet distribution upon the filtered Nb-layer.

The amount of the deposited micro-droplets was strongly reduced in comparison to the layer deposited without filtering (see Fig.JRA1.4.4), and about 90% of the micro-droplets have diameters lower than 0.5 μm. The RRR values of these samples are still under investigation at other laboratories.

UHV arc deposition of pure Pb-layers for photo-cathodes

In addition to the planned tasks, the IPJ team has also performed several depositions of pure Pb-layers, which are investigated as potential photo-cathodes for new electron injectors. The preliminary results were presented at EPAC-2006 in Edinburgh (June 2006), the international conference in Alushta (Sept. 2006) and the International Workshop in Legnaro (Oct. 2006), as discussed above.

JRA1.4.2 Planar-Arc Cathode Coating Status of activities

Task 4.2 is focused on the development of a UHV arc system with the planar (truncated cone) cathode configuration, the optimization of micro-droplet filters, and characterization of samples coated under different conditions.

Design and tests of a new T-type filter

The modeling of magnetic field distributions within different filters, which were performed in the collaboration with the IPJ team (as reported in previous Quarterly Reports), has shown that additional correction coils are needed in order to optimize the plasma transmission. In order to improve the filter efficiency a new vacuum planar-arc device with a T-type magnetic filter was assembled and put into operation. The system was equipped with external coils, used for the deflection and guidance of the arc column, as shown in Fig. JRA1.4.7.

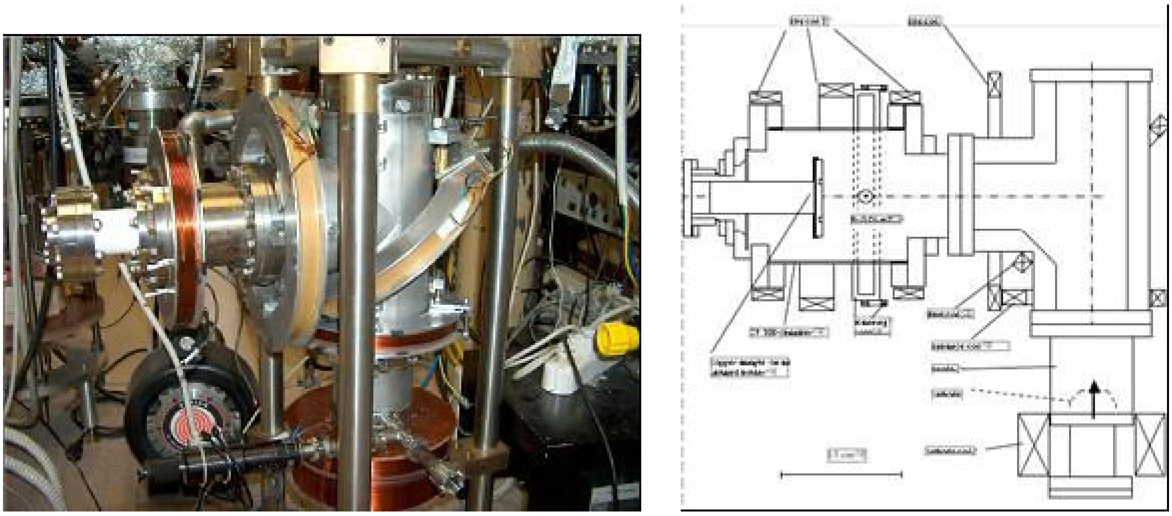


Figure JRA1.4.7: Schematic of a T-type filter connected with a planar-arc chamber designed for larger samples and a picture of the system during assembly.

At the typical operating conditions (i.e. arc current of 110 A, and bias voltage - 80 V) the ion current to a large (71 cm^2) sample holder reached 0.5 A. The average ion current density was about 7-8 mA/cm^2, i.e. it was twice as high as that obtained in the 90^0-L filter system used previously.

Improvements of the magnetic field configuration within a cavity-like chamber

Considerable progress has been achieved in controlling arc-plasma dynamics inside a mock RF cavity, which was equipped with insulated collectors to measure the ion current in various parts of its upper half. Two additional magnetic coils, similar to those used in the T-filter system, were mounted on the cavity-like chamber, as shown in Fig. JRA1.4.8.

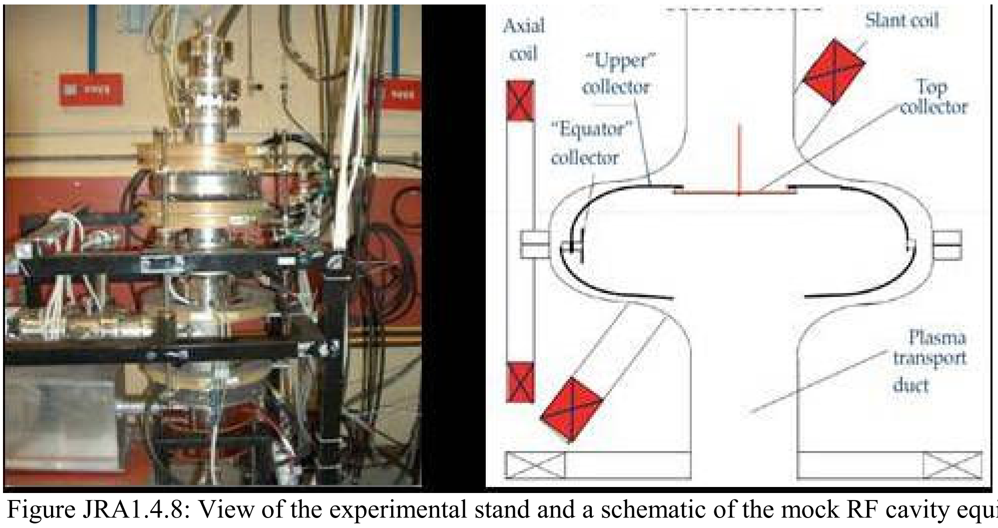


Figure JRA1.4.8: View of the experimental stand and a schematic of the mock RF cavity equipped with insulated collectors and additional coils used to control plasma flow.

The "slanted" coil, which could generate up to 9 mT magnetic field on the axis, was inclined by approximately 45°, while the second "axial" coil was mounted with its axis oriented in the cavity equatorial plane. It enabled the deflection of the arc-discharge column to be varied considerably. During experiments the collectors were biased (to -80V) separately, and the ion currents delivered to each of them were measured as a function of the magnetizing current (I_{sl}) of the slanted coil, as shown in Fig.JRA1.4.9.

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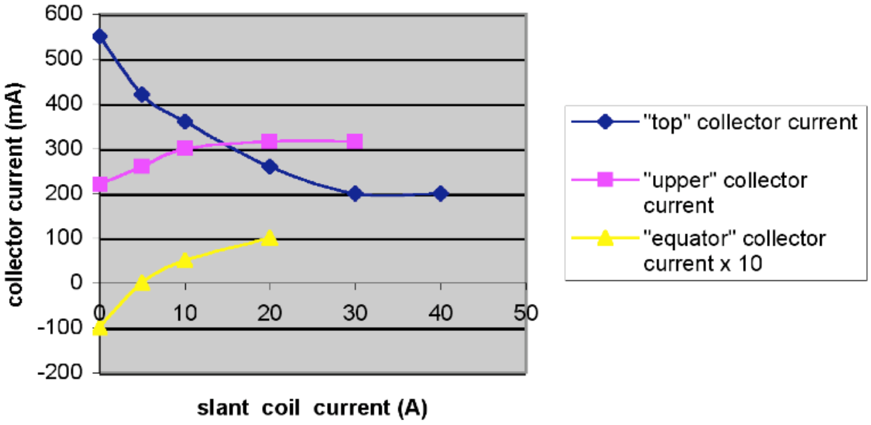


Figure JRA1.4.9: Ion currents flowing to different collectors within the experimental mock RF-cavity vs. the magnetizing current flowing through the slant coil.

It was found that for I_{sl} = 20 A (corresponding to about 3 mT field at the coil center) the plasma ion current to the "upper" half-cell collector becomes larger than that to the top collector. At the same time a positive-ion current of density exceeding 1 mA/cm^2 is delivered to the equator region. For I_{sl} > 20 A all three collector-currents become saturated. This result suggests that, by rotating the slant coil around the RF-cavity axis, it might be possible to obtain a sufficiently uniform coating upon the upper part of the cavity and the tubular outlet.

Characterization of samples coated at different conditions

To study any influence of the orientation of the coated surface, six sapphire samples were placed at different angles to the z-axis and coated within the planar-arc device equipped with the T-type filter. SEM pictures showed relatively uniform Nb-layers with a reduced amount of micro-droplets, as presented in Fig. JRA1.4.10.

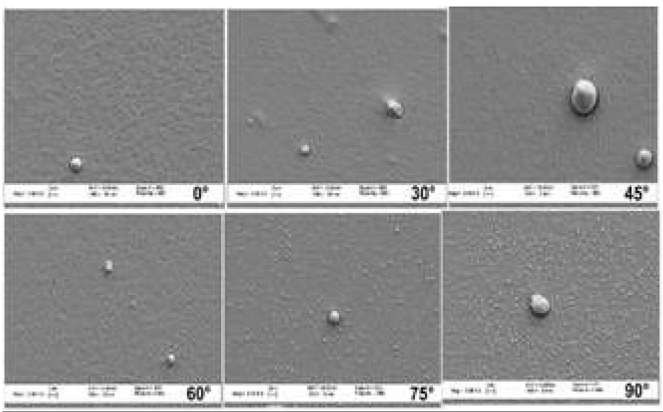


Figure JRA1.4.10: SEM pictures of the Nb-coated sapphire samples exposed at different angles.

Those samples were also analyzed with other techniques. The obtained data showed that the Nb-layer thickness spread from about 1 μm to 3.5 μm, whereas the RRR values were from 26 to 50 for bias voltages above -40 V. The task concerning the characterization of Nb-coated sapphire samples (4.2.2.2) was completed, as reported in the previous Quarterly Reports, at the workshop in Legnaro (Oct. 2006) and the CARE Annual Meeting in Frascati (Nov. 2006).

<u>Start of coating procedures with pulsed bias</u>

It was expected that the pulsing of bias voltages might help to make the layer thickness (upon the cavity inner-surface) more uniform, but the pulse frequency and duty cycle have to be matched to plasma dynamics. To study this dependence, a new pulse power supply unit was designed and built at IPJ. It has recently been applied at Tor Vergata laboratory, as shown in Fig.JRA1.4.11.

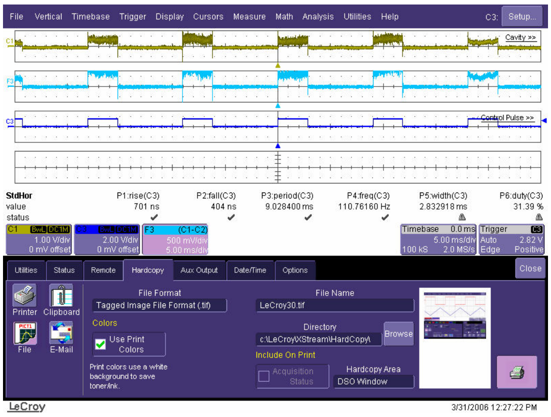


Figure JRA1.4.11: Traces recorded during test with the pulsed bias: the upper trace - the ion-current upon the cavity wall vs time (at bias -60V, repetition - 110 kHz, 31.5% duty); the middle trace - a differential current readout with noise filtering; the bottom trace – the bias voltage waveform.

Research on the influence of the pulsed bias will be continued in 2007 under different operational conditions.

<u>Characterization of Nb-coated copper samples</u>

The Nb-layers deposited upon copper substrates were investigated by means of the XRD technique. The most important result was that for all the applied bias voltages, which ranged from -20 V to -80 V, the Nb-films upon copper substrates showed the lattice parameters of bulk Nb, as reported at the international workshop in Legnaro (Oct. 2006).

To continue the task (4.2.2.3), four new copper samples of large diameter and the shape used at Cornell laboratory (for Q and RRR measurements) were coated within the UHV planar-arc system in order to collect information about the influence of different surface-preparation processes and effects of the improved plasma column deflection systems (i.e. magnetic filters). The sample positioning inside the experimental chamber was adjusted by changes in the length of the holder, as shown in Fig. JRA1.4.12.

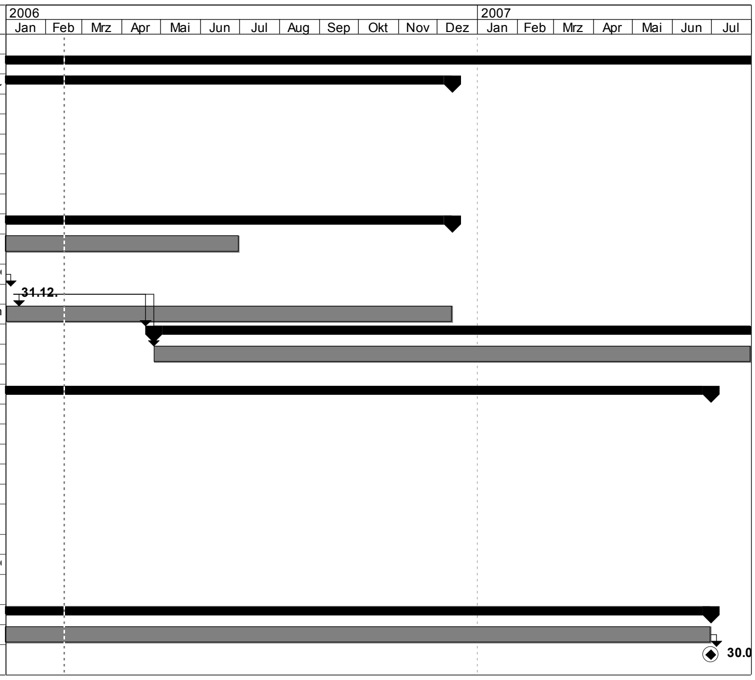
Figure JRA1.4.12: Large copper sample fixed upon an insulating support (just before the coating).

Studies of other HTC superconducting coatings

A task concerning HTC superconducting coatings (4.2.3) has been continued. The UHV planar-arc apparatus needed to study the production of NbN films has already been modified in order to control accurately the working gas (pure nitrogen) flow into the arc chamber. The triggering and stability of arc discharges at appropriate nitrogen pressures needs further investigation.

JRA1.4.3 Overall Progress of Work Package 4

N°	Task Name
4	**WP4 THIN FILM CAVITY PRODUCTION**
4.1	**Linear-arc cathode coating**
4.1.1	**Installation & commissioning of coating apparatu**
4.1.1.1	Modification of a prototype facility for single cells
4.1.1.2	Optimization of a triggering system
4.1.1.3	**Prototype facility ready**
4.1.1.4	Study of arc current reduction and stabilization
4.1.1.5	Optimization of powering system
4.1.1.6	**Coating apparatus operational**
4.1.1.7	**Coating single cells**
4.1.1.7.1	Coating of single cells without micro droplet filtering
4.1.1.7.2	Design and construction of a micro droplet filt
4.1.1.7.3	**Droplet filter ready**
4.1.1.7.4	Coating of single cell with micro droplet filterin
4.1.2	**Coating multi-cell**
4.1.2.1	Design and commissioning
4.1.2.2	First multicell coating
4.2	**Planar-arc cathode coating**
4.2.1	**Modification of a planar-arc & trigger system**
4.2.1.1	Modification
4.2.1.2	Optimization of the laser triggering system
4.2.1.3	**Planar arc system fully tested**
4.2.2	**Routine Operation of planar arc system**
4.2.2.1	Characterization of samples coated at different conditions
4.2.2.2	Characterization of Nb-coated sapphire sam
4.2.2.3	Characterization of Nb-coated copper sampl
4.2.2.4	**Summary report on quality of planar arc coating**
4.2.3	**Studies of other HTC superconducting coating**
4.2.3.1	Study of superconducting properties
4.2.3.2	**Report on quality of superconducting properties**



JRA1.5 Work Package 5: Surface Preparation

JRA1.5.1 Electropolishing (EP) on single cells

Sub-task *5.1.1 EP on Samples*

EP on samples like defined in the JAR1 proposal is completed and showed results which will be applied on single cell EP preparation. Basis of this research was the change of mixture in the existing acid components (H2SO4 +HF +H2O). New mixtures basing on different acid compositions like proposed in 5.4 will be examined with the existing test set up as well.
To investigate the phenomena of hydrogen implantation during EP treatments, some samples, treated with different fluorine concentrations and temperatures, have also been electro polished. In order to study H contamination the samples are measured by gaseous chromatography at DESY. This work showed first results on H2 contamination will be continued.

Modelling electro polishing phenomena with COMSOL software has been presented in CARE report-06-010-SRF. This study has been completed. For example, influence of the numbers of species considered in the model has been studied.

Sub-task 5.1.2 + 5.1.3 Single cell cavities:

3 Single cell cavities have been fabricated and will serve as test objects for optimization of EP mixtures.
The EP bench is completed and commissioned. For qualification of the set up a single cell cavity with well know performance is polished and retested at DESY. To calibrate the new infrastructure the polishing process was done under the standard conditions with a 1/9 EP Mixture and @18 V (Fig. JRA1.5.1).

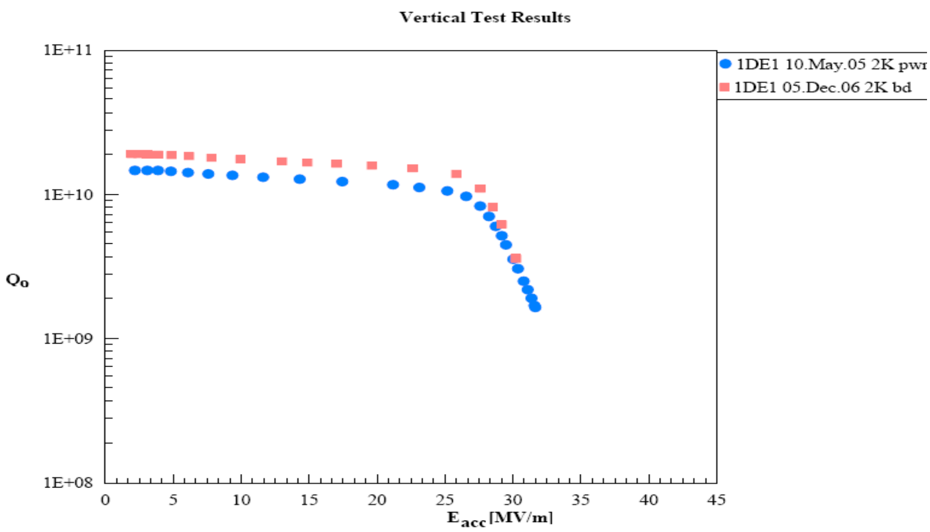


Figure JRA1.5: Test result of the reference resonator 1DE1
(Blue dots = after EP @DESY Red dots = after EP @ Saclay)

The results show that the EP set up and the handling of cavities and the EP infrastructure is qualified and completed. First test with changed EP Mixtures are on the way.

JRA1.5.2 Electropolishing (EP) on multi-cells

Sub-task 5.2.1.1 – 5.2.1.2

The subtasks are finished and the DESY infrastructure for nine cell resonators is running continuously. Basing on the investigations on aging of the EP acid (SRF document 2004-001) an online sensor to control the U/I curves is installed in the DESY EP apparatus. First results show that the sensitivity of the sample is too small to dedicate small variation in the HF Concentration. A new probe with improved surface to distance correlations is build and will be installed during the maintenance shutdown in 2007.

Subtask 5.2.1.1.3

Due to the high investments and the necessary shut down of the DESY EP facility the hot water rinsing after EP treatments will not be installed into the DESY EP apparatus. The goal of the subtask is shifted to a different point of cavity treatment with the same high influence factor on cavity performance. We investigate the effect of hot water high pressure rinsing (UPWHHPR). This new method makes use of the strong bipolarity of hot water and the energy of a high pressure rinse jet at the same time and can be applied at the set up of the new high pressure rinsing facility at DESY. This facility will allow to heat ultra pure water to about 70 C. We will study the effect of removal of acid residues by UPWHHPR.

Subtask 5.2.1.2

Computer software is commissioned. First calculations on simulation of the existing electrode shape show that there is about a factor of 3 differences in the absolute value in the results of the current density distribution calculated from the RF data of cavity measurements and the computer calculations so far, while the distribution of current density shows the same result.

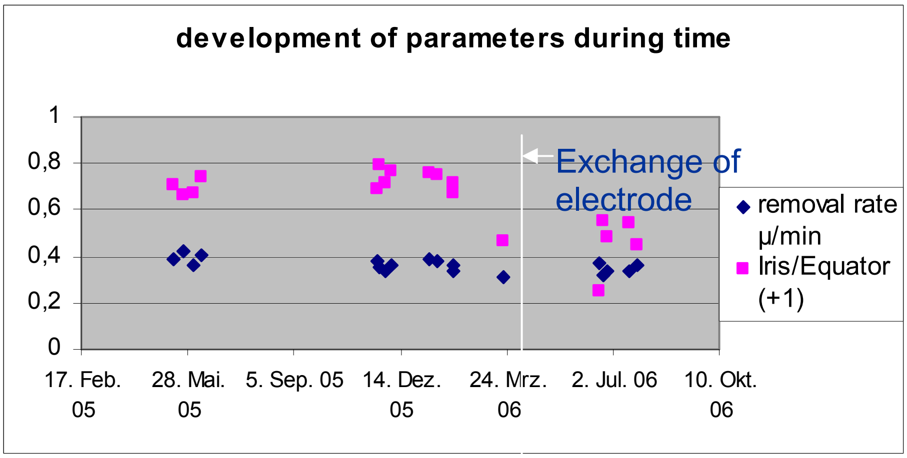


Figure JRA1.5.2: Variation of parameters global removal rate and removal rate ration Iris / Equator after exchange of the electrode

One effect will be the hydrodynamic of the acid.
It is found that a change in diameter of the acid ejection holes of the EP electrode leads to a ratio reduction form 1,7 down to 1,5 (Fig. 5.2.1) . This effect will be studied and analysed. Never the less this software with out the liquid modelling module allows optimizing the electrode shape to study the basic influence of the geometry. New designs are under investigation.

Subtask 5.2.1.3.2 + 5.2.1.3.3

Beside the laboratory investigations, which are finished on that laboratory level, an industrial study for quality control and acid management is launched. First results were presented at the TTC meeting in Japan in October 2006. A report on these activities is under preparation.

Subtask 5.2.3.2+5.2.3.3

A design for a nine cell cavity oxi-polishing (OP) set up is finished. The design bases on the usage of the existing nine cells EP hardware. Only a piping system to inject the oxidizing acid into the cavity before starting the oxidation process needs to be fabricated. A test of the set up and the study of the effect of oxi - polishing is depending on the usage of the DESY infrastructure for the on going activities of the preparation for the XFEL and the build up of modules for the flash accelerator at DESY.

JRA1.5.3 Automated EP

The development of new forming techniques for the fabrication of seamless TESLA-type cavities requires good control of the electro-polishing (EP) process. We have developed a new process for electro-polishing niobium resonators based on a dynamical automated control that takes into account the surface roughness evolution during the EP. The process consists of a dynamical control of the minimum of the differential electrolytic bath conductance extracted from the I-V characteristics (polarization curve). The results obtained are very good, i.e. a smooth and high reflectivity niobium surface is obtainable, even by using electrolytes whose composition is not necessarily known. This last result makes the automated EP tool particularly interesting, especially when searching for alternative electrolytes, where a large amount of new baths need to be tested.

The Electro-polishing Characteristics

Fig. JRA1.5.3 shows a typical I-V characteristic for the electro-polishing of copper in an orto-phosphoric acid solution for the case of planar and parallel faced electrodes, when edge effects are negligible [Jacquet, P.A., Metal Finishing, 48, 1, 2 (1950)].

The following behaviour is observed at different sections of the polarization curve:

- Over section Va to Vb the current increases as a linear function of the voltage. The copper dissolution happens too slowly. The process is accompanied by the evolution of oxygen bubbles sticking to the anode and promoting local pitting of the copper surface.
- The polishing effect is observed between Vb and Vc; the copper structure is brought into relief, as long as the process takes place. However roughness levelling and a brilliant surface are obtained at the end of the plateau. Here, at voltages close to Vc, there is the minimum of oxygen bubble evolution. Even a minimum amount of bubbles can represent a limitation to the achievement of the desired roughness levelling. Migrating toward the top, oxygen bubbles produce undesired vertical traces depending on the solution agitation.
- At a higher potential the gas evolution becomes stronger and the surface erosion is accompanied by pitting. A better surface quality, although mat, is obtainable at voltages well above Vc, since oxygen bubbles have no time to stick to the surface.

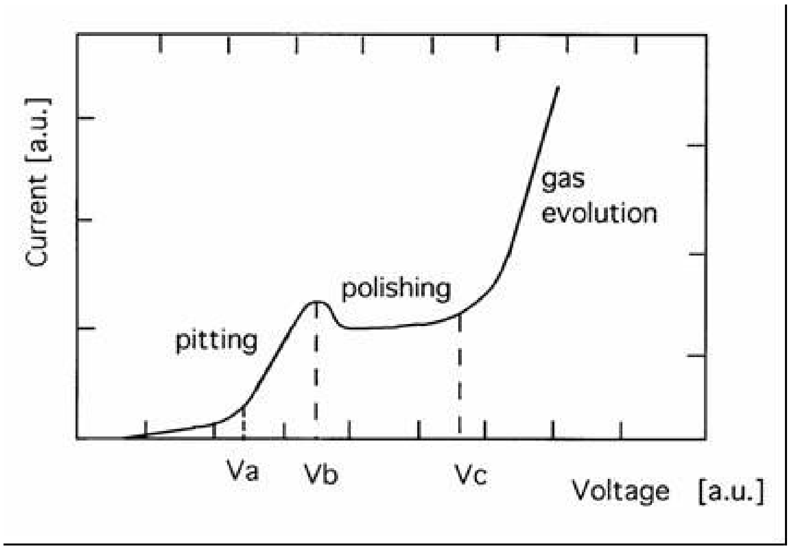


Figure JRA1.5.3: Typical I-V characteristic for copper electro-polishing in orthophosphoric acid solution.

The behaviour in Fig JRA1.5.3 can be found, however, in many metal-electrolyte systems, even if the plateau is extremely narrow, being determined by a minimum of the first derivative of the I-V characteristics.

Several hypotheses exist for explaining the mechanism of electro-polishing in acid solutions. All of them concern the existence of the thin bluish viscous layer of electrolyte formed in proximity to the anode. The simplest explanation is the one proposed by Jacquet [1]. When a current passes across the electrolyte, the anodic film has higher viscosity and higher electrical resistivity than the bulk of the electrolyte. The thickness of such a film on a rough surface (Fig. JRA1.5.4) differs from site to site: above protrusions the film is thinner than above valleys. Hence protrusions dissolve more rapidly than wells.

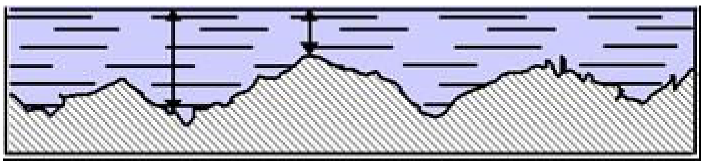


Figure JRA1.5.4: - The Copper anode coated by the viscous liquid film.

The thin layer of electrolyte in the vicinity of the anode assumes a bluish color. Moderate agitation of the solution reduces the thickness of the bluish layer while the voltage drops. Vigorous agitation reduces the thickness to a few tenths of a mm and the voltage drops even more. Jacquet assumed that a relationship exists between the formation of the viscous layer in the electrolyte and the polishing effect. According to him, the process should be controlled by maintaining a constant voltage rather than a constant current density; in this case it is unnecessary to calculate the total surface area of the sample to be polished. Rigorously speaking, it would be not possible to control the electro-polishing process solely on the basis of voltage or current density measurements,

The applied voltage V is a function of the anode and cathode potentials, the voltage drop in the electrolyte ($I R_{electr}$) and the voltage drops in the conductors and contacts ($I R_{Conduct}$), i.e.

$$V = (V_{anode} - V_{cathode}) + I R_{electrol} + I R_{Conduct}$$

V depends on the electrode potentials, the electrolyte concentration, the anode and cathode surfaces, the arrangement of electrodes in the bath and the shape and size of the bath. Hence, the "applied voltage" used by Jacquet as a control parameter would not always correspond to the optimum polishing conditions. On the other hand, the potentials of the anode and of the auxiliary electrode do not remain constant. They change as a function of the time of electrolysis and the composition of the electrolyte.

Given that the plateau region in the I-V characteristics gives the best polishing conditions, it is important to examine the effect on the plateau of the process parameters. The four most important parameters are the electrolyte temperature, acid concentration, viscosity and stirring. The temperature does not affect the plateau voltage range, but only the current density; the same holds for acid concentration, the plateau voltage remains unchanged, while the current density increases; the current density is inversely proportional to viscosity; while stirring increases almost linearly the current density.

We have proposed one useful technique that makes it easy to automatically find the optimum electro-polishing conditions. The technique consists of locking the minimum of the differential conductance found by numerically differentiating the polarization curve. The idea is that, since the viscous layer has higher viscosity and greater electrical resistivity with respect to the bulk of the electrolyte, by finding the minimum of the differential conductivity of the I-V characteristics, one automatically obtains the right electro-polishing voltage. Computer control helps in finding this ideal working point and constantly tuning the process following the evolution of this point.

The I-V characteristic is monitored and controlled by the use of a PLC field-point programmed in Labview. Working with a PLC gives the big advantage of not loosing the control of the working point during the locking procedure around the minimum of the EP bath differential conductivity. This was indeed the main problem we faced during our preliminary attempts at dynamic control of the EP differential conductivity by a simple PC, due to the fact that standard PCs often interrupt the process just when refreshing so that the dynamic control is often lost. The process is driven by voltage. An automatic program displays the numerical derivative of I versus V. The working point is chosen as the minimum of such a derivative, i.e. the minimum of the bath differential conductance.

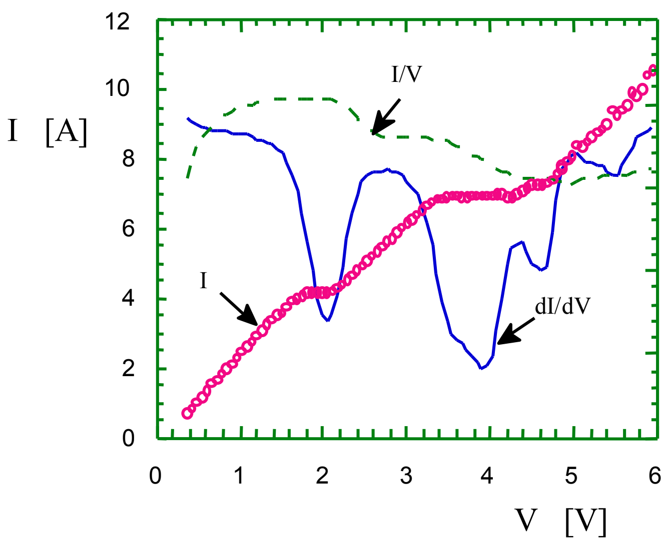


Figure JRA1.5.6: I-V characteristic for a standard electro-polishing process (circles); The differential conductivity dI/dV (continuous line) and the ratio I/V (shaded line) are displayed versus voltage. We interpret the first minimum in differential conductance as due to edge effects and to the non uniform distance between electrodes.

In Fig. JRA1.5.6., we display the differential conductance compared to the ratio I-V and together with the I-V characteristic. Some literature approximates the minimum of dI/dV with the minimum of I/V. Already from fig. 4, it is clear that the two minima differ quite substantially in voltage. In any case, an electrolytic cell is a non-linear circuit, hence the solution conductivity is a differential quantity while, the ratio I/V has no any physical sense in such a case. The I-V characteristic evolves with time. Fig. JRA1.5.7 displays the evolution of the current plateau.

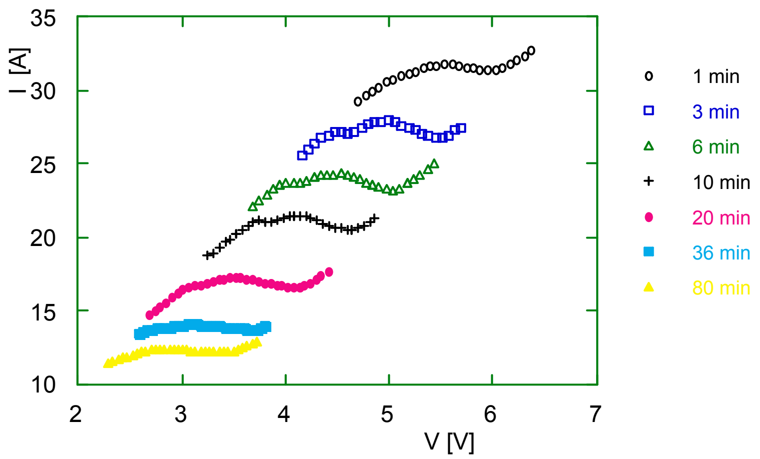


Figure JRA1.5.7: Time evolution of the I-V characteristic plateau.

The reason for the plateau decreasing is twofold. The levelling action decreases the roughness, but also the surface area decreases. Moreover, under the hypotheses of an anodic, passivating oxide film, the longer the process lasts, the more stable is the film and the weaker is the etching. By locking the minimum of the differential conductance, we could lower the plateau up to very low values of metal dissolution rate. Hence when the viscous layer becomes too thick, equivalently the voltage becomes too low, the process is reset by a sudden increase of the supplied voltage and by starting the process again from the beginning by plotting the I-V characteristics. In other words, whenever we need to remove hundreds of microns of metal, we apply the method of locking the minimum of differential conductance for one hour, than for a few minutes we work at a much higher voltage in order to destroy the passivation layer, then we restart locking the minimum for another hour and so on.

At the minimum of the differential conductance there is already low gas evolution. However as soon as the process is started and the plateau starts to get lower, at a certain voltage threshold, gas evolution can even disappear. We have written a computer program that automatically locks onto the minimum of the bath differential conductance. In this way not only is the process constantly driven according the best parameters, but also we can directly find the best electro-polishing current density, without the need to know them a priori. The method applies to any metal (copper, niobium, magnesium, aluminium, titanium and its alloys, gold alloys, and many technical alloys), and the operator does not even need to know what electrolyte he is using.

The automated EP Labview program

The rotating cavity EP System built for electro-polishing cavities is a standard closed loop circuit and it is seen in Fig. JRA1.5.8. Mono-cell and three-cell cavities can be easily treated. Copper and niobium cavities can be simultaneously treated. The architecture of the automated EP is sketched in Fig. JRA1.5.9. The best working point of the I-V characteristic is searched for and dynamically followed during the whole EP process.

Figure JRA1.5.8: The rotating cavity EP system built for the treatment of both Niobium and Copper.

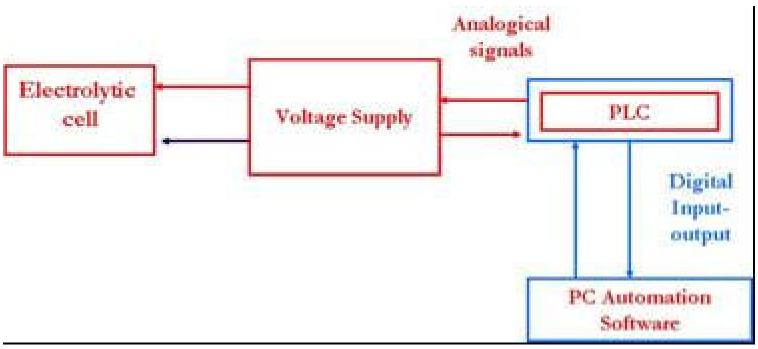


Figure JRA1.5.9: Scheme of the automated EP

The apparatus is composed of:

- An industrial power supply controlled by means of an analog current signal;
- A special PLC, the FieldPoint® FP-2010 from National Instruments, that uses the software written by LabView® 7.1;
- The LabView® program written on a computer, and then transferred onto the memory of FieldPoint®.

The Hardware consists in an ALINTEL S4000 power supply (100V max - 40V max) with a remote controller. The 0-10 V applied to the pins at the interface produces 0-100 V in output. The analog readings from the power supply are converted to digital signal in a PLC and treated by the automation software. The digital output from the automation software is converted to voltage signals that drive the power supply.

The PLC is a LabView® programmable National Instruments Field Point 2010 and it is composed of 2 modules; 1 supply; 1 RS-232 Serial interface; 1 Ethernet 10/100 Mbps. It is possible to drive the process by several PCs connected to the PLC in a network as shown in Fig. JRA1.5.10.

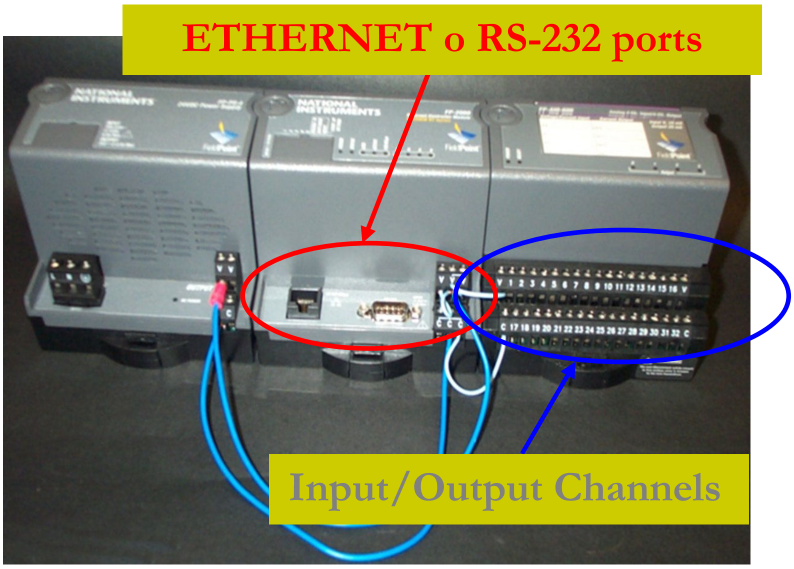


Figure JRA1.5.10: The LabView® programmable National Instruments Field Point 2010

The control software for electro-polishing is written in LabView 7.1, which is a graphical language specifically designed for interface and control of the instruments of National Instruments. This language combines with a simple graphic interface and a powerful set of functions. The core of the program is the algorithm for the search and recognition of the working point. The program initially makes a large scan from two values set by the user. After the scan, the software calculates the derivative of the I-V curve, and sets the voltage that matches to the minimum point as shown in Fig. JRA1.5.11. Then the program maintains the voltage for a time set by user, after it makes a little scan around the minimum voltage. By recalculating the derivative, the program follows the new voltage minimum. After a time, set by user, the program uses the initial data to rescan the characteristic curve. This system allows the program to adjust the minimum if the working point moves away from plateau. If the point found by program is not at the right place, the user can stop the automatic search and manually set a new minimum. The program continues the automatic search around the new minimum. All parameters can be changed in real time.

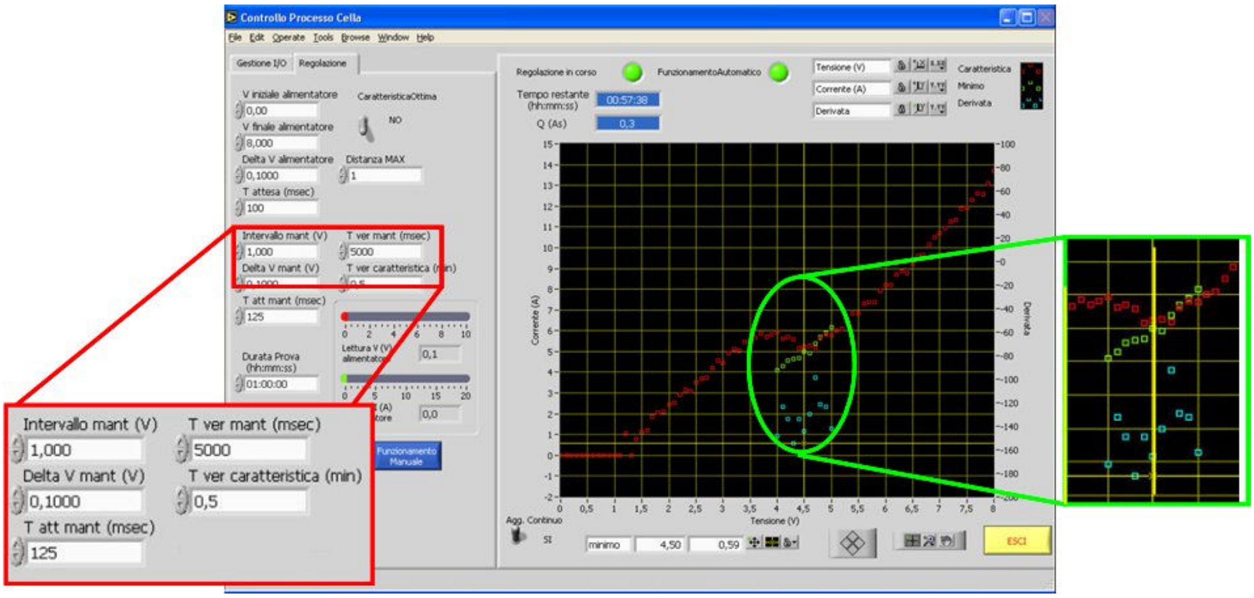


Figure JRA1.5.11: Typical I-V characteristics (red dots), displayed on the computer screen, controlling the electro-polishing processes. The curve drawn by the blue dots is the derivative of current versus voltage. The numbers on the left are the process parameters; the knobs at the bottom-right are needed for setting the starting point.

The program tested on niobium, displays the typical oscillations given by the forming and the cracking of the forming oxides and displayed in Fig. JRA1.5.12. Oscillations create difficulties on setting the working point, but it is sufficient to directly start the acquisition of the polarization curve after the oscillation and to search the working point on the plateau after the oscillating regime.

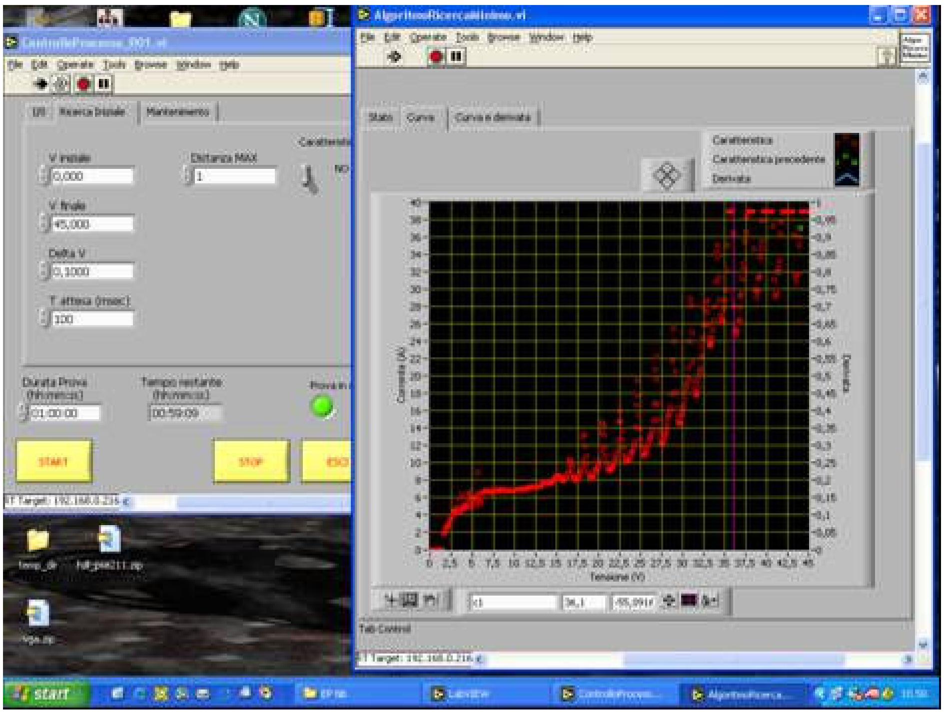


Figure JRA1.5.12: Typical oscillating regime in the I-V characteristics when electro-polishing niobium.

The programme has been successfully used for the electro-polishing of a mono-cell cavity and it is a unique tool for the development of the research of new hydrofluoric-free electrolytes for the electro-polishing of niobium. The Automated EP tool has been satisfactorily used by our laboratory and it is available for all CARE partners working on JRA1.5.3. on electro-polishing.

JRA1.5.4 Dry-ice cleaning

A jet of pure carbon dioxide snow loosens and removes different types of surface contaminations by its unique combination of mechanical, thermal and chemical effects. The cleaning process acts locally, is mild, dry and without residues requiring no additional cleaning agent. The spontaneous relaxation of liquid carbon dioxide leaving the nozzle results in a snow/gas mixture with 45 % snow and a temperature of 194.3 K (-78.9°C). This jet is surrounded by supersonic nitrogen, which, firstly, provides an acceleration and focussing of the jet and, secondly, prevents the condensation of humidity at the cleaned object. The cleaning effect is based on thermo-mechanical and chemo-mechanical forces. The former are created by three effects: brittling of the contamination as a result of rapid cooling (shock-freezing), the tough pressure and shearing forces due to the high momentum of the snow crystals hitting the surface and the powerful rinsing due to the 500 times increased volume after sublimation. Particles down to 100 nm can be removed. Chemo-mechanical forces occur when high momentum snow particles hitting the surface are melting at the point of impact. In its liquid phase carbon dioxide is a good solvent for non-polar chemicals, especially for hydrocarbons and silicons. The thermal effect of shock-freezing is thereby directly correlated with the snow intensity, while the mechanical effect however depends on the velocity and angle of the jet. The chemical effect depends on the momentum of the crystals. An optimal cleaning impact is achieved if the thermal gradient between contamination and substrate is high. To avoid recontamination an effective and well-defined exhaust system is necessary. In summary the advantages of the carbon dioxide dry ice cleaning are:

- dry cleaning process,
- no cleaning agents,
- removal of particulate and film contaminations,
- no polluting residues.

The basic cleaning parameters are shown in Table 1.

Table 1: Dry ice cleaning parameters

CO_2-pressure	~ 50 bar
N_2-pressure	12 – 18 bar
Particle filtration	< 0.05 µm
Temp. of liquid CO_2	-5° - -40° C
Enviroment of cleaning	Laminar flow class 10

In order to achieve high gradients for future accelerators like XFEL, ILC, etc., without field emission loading, advanced cleaning and handling procedures must be applied. Surface contaminations like particles, hydrocarbons, etc. and mechanical damages like scratches have been shown to cause enhanced field emission limiting the usable gradient of accelerating structures. Although high pressure rinsing with ultra-pure water has been proven to be a powerful technique to reduce the enhanced field emission of cavities, dry–ice cleaning might have additional cleaning potential. Moreover it avoids a wet cavity surface with its enhanced sensitivity against recontamination. It should be applicable to ceramics (coupler windows) without loosing the gain of an earlier conditioning. Due to these properties dry-ice cleaning is considered as very attractive for the final treatment of horizontally assembled cavities with their power couplers.

Description of Work

After successful pre-tests on samples and cavities in 2002 and 2003 using the facilities of Fraunhofer Institute IPA, Stuttgart (Germany), in early 2004 the infrastructure installation at DESY started. An ultra pure gas supply system for both carbon dioxide and nitrogen was installed and successfully tested in the existing clean room (Fig.JRA1.5.13). At the end of 2004 / beginning of 2005 the CO_2 cooler/purifier unit (Fig.JRA1.5.13, JRA1.5.14) was ordered as an important component in order to filter, purify and liquify the CO_2.

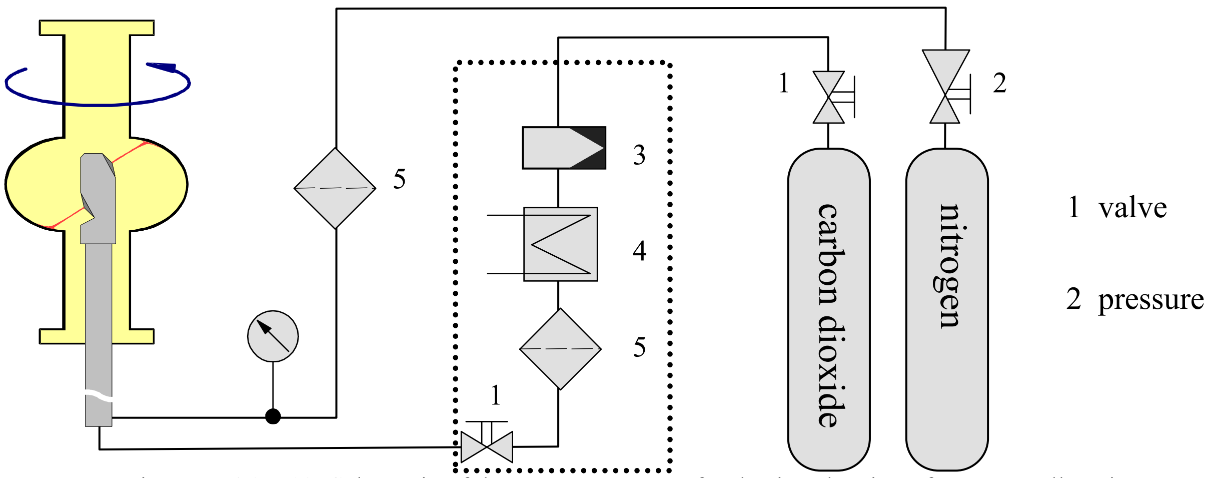


Figure JRA1.5.13: Schematic of the prototype set-up for dry-ice cleaning of a mono-cell cavity.

As described in the introduction, dry-ice cleaning should be well suited for horizontal cleaning of SC cavities. Therefore the set-up for cleaning of 1-3-cell cavities was designed for horizontal cleaning differing from the proposal for task 5.4. In 2005 the horizontal motion unit using the existing spraying cane and a new motion unit started operation (Fig 5.4.2). Due to man-power problems, caused by unexpected repair work at the DESY HERA accelerator, the complex control system of the cleaning unit was delayed significantly. This delay has not been compensated to date.

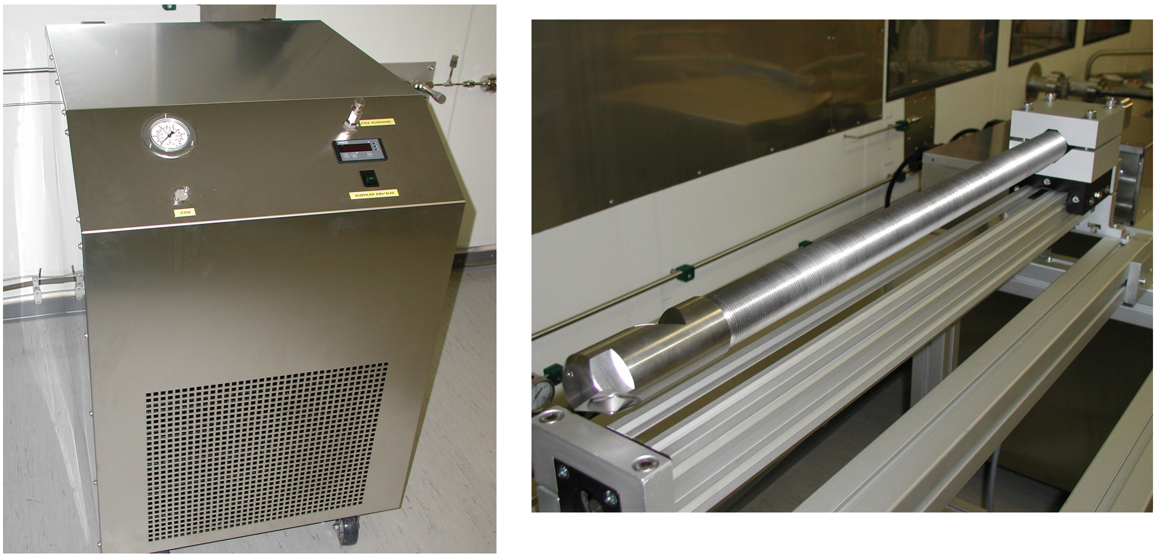


Figure JRA1.5.14: CO_2- cooler/purifier unit (left) and horizontal motion unit with the spraying cane assembled on the linear drive (right).

The heat removal from the cavity during operation of the dry-ice jet makes it necessary to apply a heater system to avoid cooling and freezing of the cavity. Several options have been considered. With respect to clean-room requirements and for simple assembly, a prototype of an IR heater system was tested. After first operational tests it turned out, that the power was insufficient. Furthermore the assembly procedure after cleaning of the integrated heating and exhaust box was too complicated. A new dedicated design of an optimized, high power IR heater (Fig JRA1.5.15, JRA1.5.16) had to be developed, constructed and installed. This caused a delay during commissioning of approximately six months. The new heater system fully meets its requirements and allows continuous dry-ice cleaning almost without freezing of the cavity.

Figure JRA1.5.15: Dry-ice cleaning system with the new IR heater

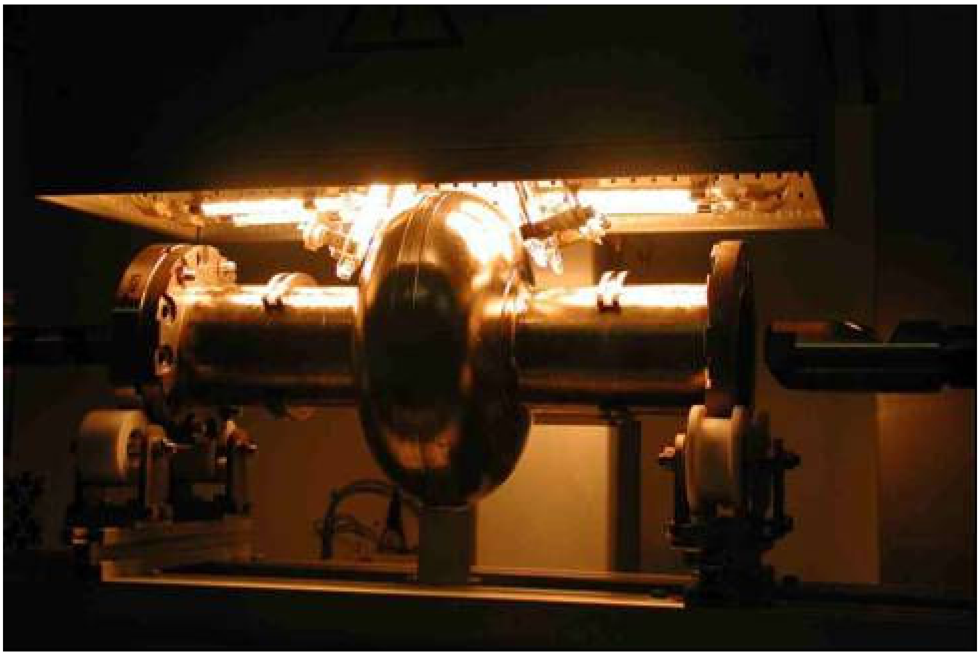


Figure JRA1.5.16: The new IR heater system in operation

To fulfil the requirements of personnel safety for routine operation a gas alarm system was installed. During the installation phase the commissioning continued under special safety conditions.
Recently, new capillaries with lower diameter have been tested in order to reduce the cooling of the cavity and the consumption of CO_2. The former is important to keep a high temperature gradient on the inner surface for an optimum cleaning efficiency. A reduced CO_2 consumption enhances the usable time of one set of pressurised bottles and is in general preferable with respect to safety aspects. A capillary with 12% reduced diameter has been used since November 2006. In addition, the assembly procedure of the cavity to its vacuum and RF connections ("antenna") is improved by a simple, but effective new fixture.
In 2005 and 2006 the commissioning of the dry-ice cleaning system was continued successfully (Fig. JRA1.5.17). Several cavities have been cleaned both for system tests and for RF measurements of the cavity. Additional samples have been cleaned and tested (see WP 6.3). The cleaning parameters and cavity results are discussed in the next chapter.

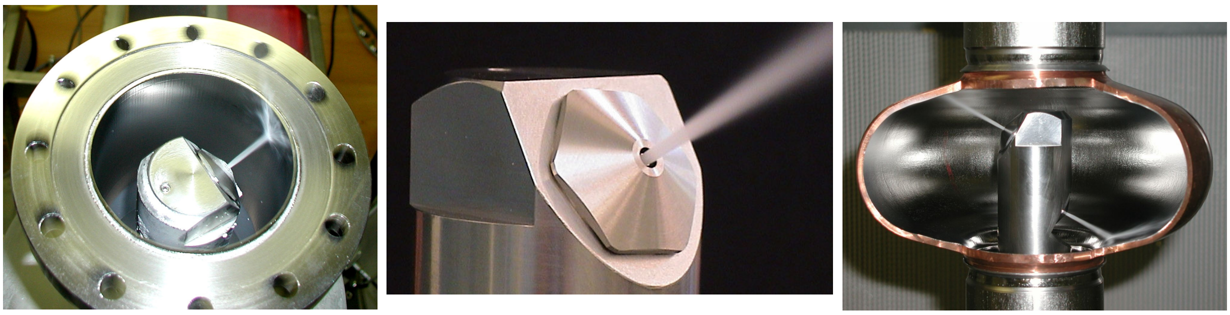


Figure JRA1.5.17: Commissioning of the dry-ice system: Optical checks of the jet under different conditions.

Discussion of Work

The dry-ice cleaning system is operable and a preliminary cleaning parameter set is established. With respect to the results there is still some contradiction between excellent cleaning results on samples (WP6.3.) compared to most of the cavity tests which still suffer from field-emission loading (Fig JRA1.5.18). The reason can be either due to the cleaning parameters or a contamination of the cavity during the final assembly after the dry-ice cleaning. After the recent modification of the CO_2 – capillary and assembly fixture an excellent cavity result, with no field-emission loading up to 33 MV/m, was achieved (Fig. JRA1.5.19). The goal of the next tests will be the reproduction of this result.

In spite of this good result the preparation of the construction of the nine-cell cleaning apparatus requires a careful re-investigation of the nozzle system and cleaning parameters together with the experts in dry-ice cleaning of the Fraunhofer Institute for Manufacturing Engineering and Automation (Fraunhofer IPA). This will continue until the middle of 2007. In addition, further sample measurements on various niobium materials are foreseen in close collaboration with task 6.3.

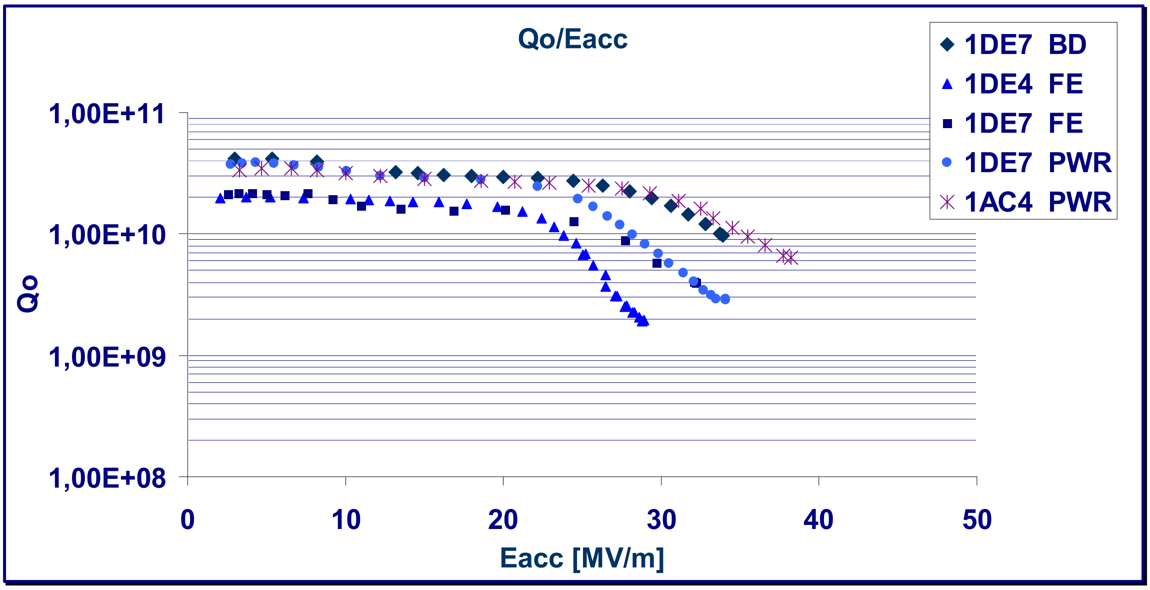


Figure JRA1.5.18: $Q_0(E_{acc})$-performance of latest rf-tets after dry-ice cleaning

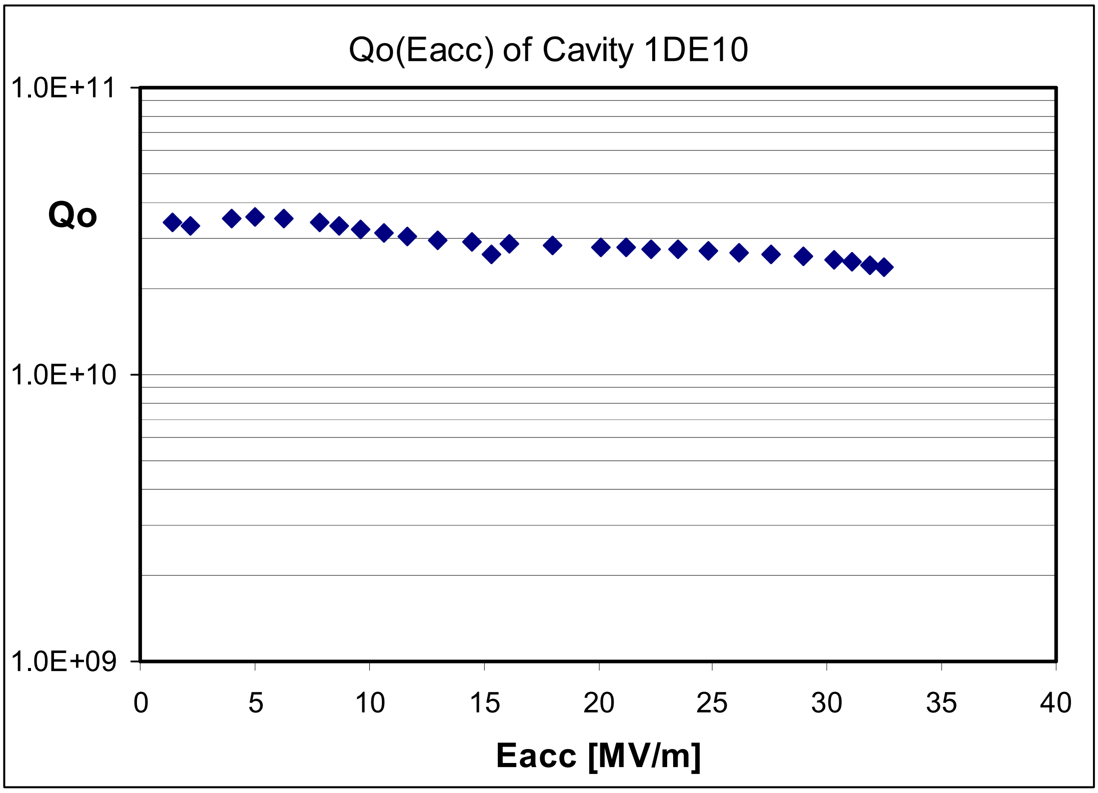


Figure JRA1.5.19: Recent best $Q_0(E_{acc})$-performance after dry-ice cleaning with the new capillary.

Conclusions and Future

Dry-ice cleaning has shown its capability for successful cleaning of SRF cavities. Nevertheless, the results are not as reproducible as is necessary for multi-cell applications.
The next steps in the near future will be the evaluation of the cleaning parameters described above and the understanding of critical conditions during cavity cleaning. Although the multi-cell cleaning apparatus is significantly delayed, this is a necessary pre-condition for the successful construction of a next generation set-up. Reproducibility of the cavity cleaning is essential for the envisaged applications. Only minor modifications of the existing apparatus

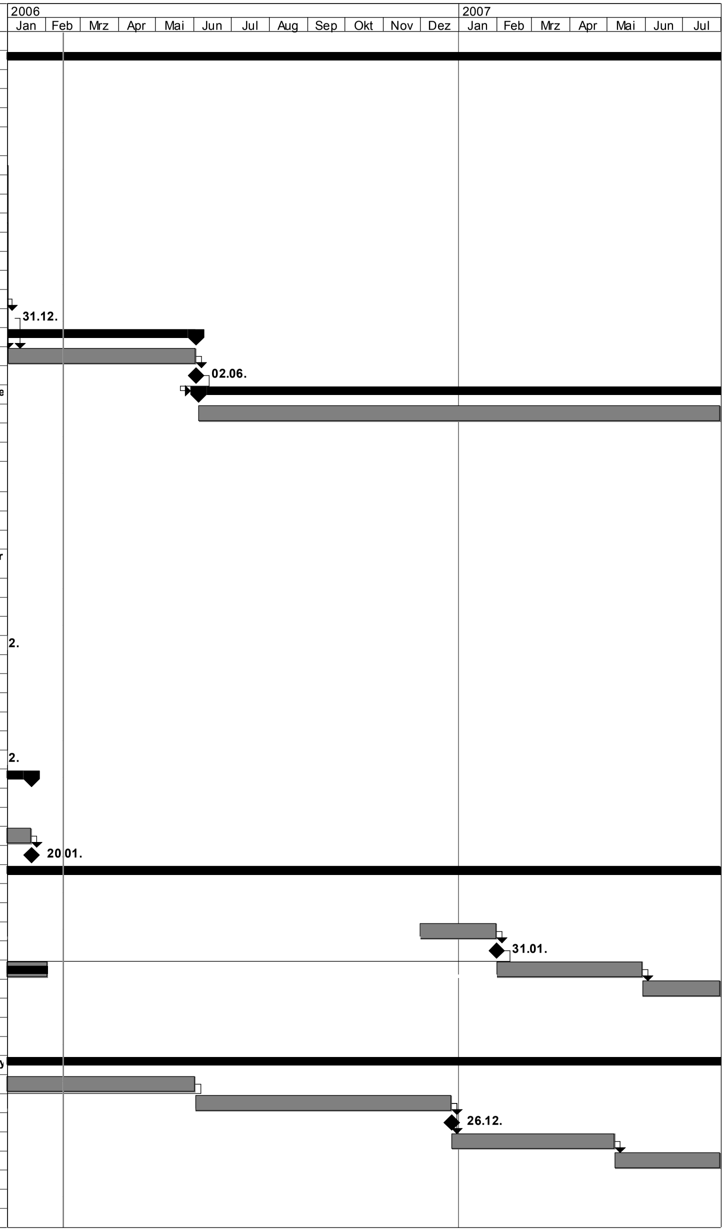
are planned. An additional heater of the gas pressure bottles will avoid the cool-down of the bottles in order to stabilize the CO_2 pressure during operation.

References

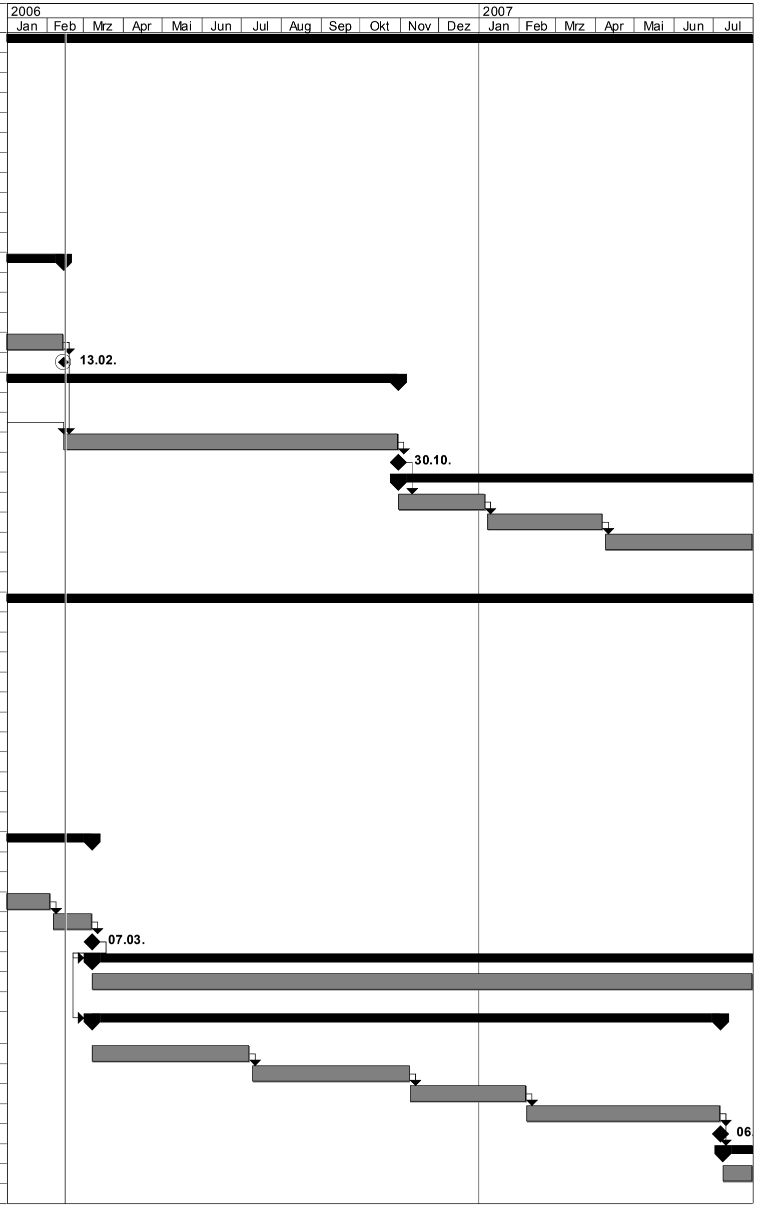
1) "Dry-ice cleaning for SRF Applications", D. Reschke et al., Proc. of the 9th Workshop on RF superconductivity, KEK Proc. 2003-2, Tsukuba-shi, Japan (2003)
2) "First experience with dry-ice cleaning on SRF cavities", D. Reschke et al., Proc. Of the LINAC 2004, Lübeck, Germany (2004)
3) Presentation at the ELAN Meeting, May 4th – 6th 2004, Frascati, Italy
4) "Further improvements with dry-ice cleaning on SRF cavities", A. Brinkmann et al., Proc of the 11th Workshop on Rf superconductivity, Cornell, USA (2005)
5) "Dry-ice cleaning on SRF cavities", A. Brinkmann et al., Proc. of the EPAC 2006, Edinburgh, Scotland (2006).

JRA1.5.5 Overall Progress of Work Package 5

N°	Task Name
5	**WP5 SURFACE PREPARATION**
5.1	**EP on single cells**
5.1.1	**EP on samples**
5.1.1.1	Establishing method of surface characterization
5.1.1.2	**Surface characterization fixed**
5.1.1.3	Series of EP with samples for surface investigations
5.1.1.4	**Best EP parameters**
5.1.2	**Single cell cavities**
5.1.2.1	Order Nb and fabricate 3 cavities
5.1.2.2	**3 cavities fabricated**
5.1.3	**Build EP chemistry for single cells**
5.1.3.1	Design of EP set-up
5.1.3.2	Fabrication of EP set-up
5.1.3.3	Commissioning of EP set-up
5.1.3.4	**First operation of EP set-up**
5.1.4	**Operation of single cell EP**
5.1.4.1	Continous single cell operation
5.1.4.2	**Define working parameters for single cells**
5.1.5	**Continuous operation, search for best paramete**
5.1.5.1	Parametrising EP procedure
5.1.5.2	**EP parameters fixed**
5.2	**EP on multi-cells**
5.2.1	**Transfer of parameters from 1 cell to multi cell equipment**
5.2.1.1	**Finish EP setup nine-cells at DESY**
5.2.1.1.1	Improved gas cleaning system
5.2.1.1.2	Design for hot water rinsing
5.2.1.1.3	**Proof-of-Principle experiment hot water rinsing**
5.2.1.2	**Optimize electrode shape**
5.2.1.2.1	Develop computer model / Evaluate software
5.2.1.2.2	Design improved electrode
5.2.1.2.3	**Electrode design fixed**
5.2.1.3	**Fix process parameters/ Quality control**
5.2.1.3.1	Setup chemical lab
5.2.1.3.2	Bath aging
5.2.1.3.3	Bath mixture
5.2.1.3.4	Alternative (salt) mixtures
5.2.1.3.5	**Process parameters fixed**
5.2.2	**Laser roughness**
5.2.2.1	Evaluate existing systems
5.2.2.2	Specify laser system
5.2.2.3	Built laser system
5.2.2.4	**Roughness measurement finished**
5.2.3	**Oxipolishing as final chemical cleaning**
5.2.3.1	Laboratory studies
5.2.3.2	Design of OP system
5.2.3.3	Setup one-cell system
5.2.3.4	**Proof-of-Principle experiment Oxipolishing**
5.2.3.5	Design OP for nine-cells
5.2.3.6	Build OP for 9-cells
5.2.3.7	**OP for 9-cells ready**
5.2.3.8	Study op with 9-cell cavities
5.2.3.9	Evaluate experiments
5.2.4	**Transfer Electropolishing technology to industry**
5.2.4.1	Qualify industry with one-cells
5.2.4.2	Industrial design study on setup for multi-cells
5.2.4.3	**Report on industrial design**
5.2.4.4	Fabricate EP multi-cell industrial prototype
5.2.4.5	Commission EP multi-cell industrial prototype
5.2.4.6	**EP multi-cell industrial prototype ready**
5.2.4.7	Operate EP multi-cell industrial prototype
5.2.4.8	**Final report on industrial EP**



N°	Task Name
5.3	**Automated EP (AEP)**
5.3.1	**Prototype EP installation**
5.3.1.1	Design installation
5.3.1.2	Fabricate/ order components
5.3.1.3	Assemble EP installation
5.3.1.4	**First operation of automated EP**
5.3.2	**EP computer control**
5.3.2.1	Design control architecture
5.3.2.2	Developed software
5.3.2.3	Test of software
5.3.2.4	**Software ready**
5.3.3	**Operation of AEP prototype**
5.3.3.1	Correlate surface finish/ conductance
5.3.3.2	Determine optimum conductance
5.3.3.3	Optimize automated operation
5.3.3.4	Design report on AEP
5.3.3.5	**Automated EP is defined**
5.3.4	**Alternative electrolytes**
5.3.4.1	Review of EP chemistry
5.3.4.2	**Proposal for alternative electrolytes**
5.3.4.3	Experiments with alternative electrolytes
5.3.4.4	**Conclude experimental results**
5.3.5	**Define best AEP**
5.3.5.1	Compare standard/new electrolyte method
5.3.5.2	Modify AEP installation for best electrolyte
5.3.5.3	Operate modified AEP
5.3.5.4	Design report on best AEP
5.3.5.5	**Conclude on best electrolyte**
5.4	**Dry ice cleaning**
5.4.1	**Installation of full system for 1-3 cell cavities**
5.4.1.1	Installation of CO2 piping
5.4.1.2	Installation of motion system
5.4.1.3	Installation of control system
5.4.1.4	Commissioning
5.4.1.5	**Installation finished**
5.4.2	**Optimization of cleaning parameters**
5.4.2.1	Sample cleaning
5.4.2.2	1-cell cavity cleaning
5.4.2.3	Fix best cleaning parameters
5.4.2.4	**Cleaning parameters fixed**
5.4.3	**VT 9-cell cleaning apparatus**
5.4.3.1	Design 9-cell apparatus VT
5.4.3.2	Fabricated 9-cell apparatus
5.4.3.3	Installation of 9-cell apparatus
5.4.3.4	Commissioning of 9-cell apparatus
5.4.3.5	**VT Cleaning Installation finished**
5.4.4	**VT Cleaning of 9-cell cavities**
5.4.4.1	Continuous cleaning
5.4.4.2	**Evaluation of experimental results**
5.4.5	**Design & construction of H 9-cell cleaning apparatus**
5.4.5.1	Design 9-cell apparatus VT
5.4.5.2	Fabricated 9-cell apparatus
5.4.5.3	Installation of 9-cell apparatus
5.4.5.4	Commissioning of 9-cell apparatus
5.4.5.5	**Start H 9-cell cleaning**
5.4.6	**Cleaning of horizontal nine-cell cavity**
5.4.6.1	Continuous cleaning
5.4.6.2	**Evaluation of experimental results**



JRA1.6 Work Package 6: Material Analysis

JRA1.6.1 Development of SQUID based equipment for detection of defects in Nb

Scanning of artificially produced defects

A niobium test sheet with artificially imbedded flaws (tantalum inclusions of size 0.1-0.05 mm close to the surface) was produced and scanned with a SQUID scanner developed and built at WSK (Fig.JRA1.6.1).

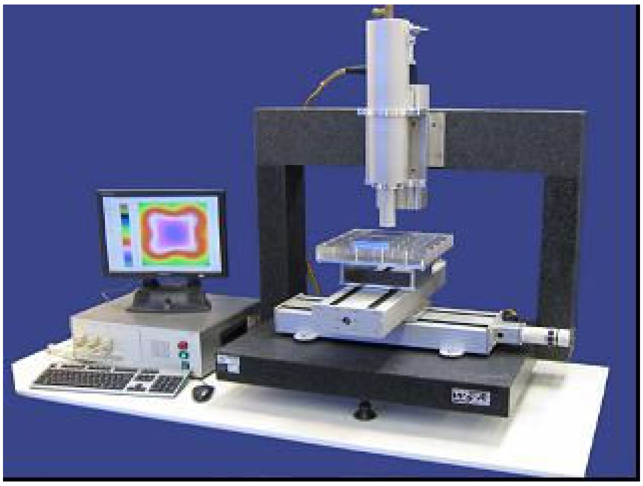
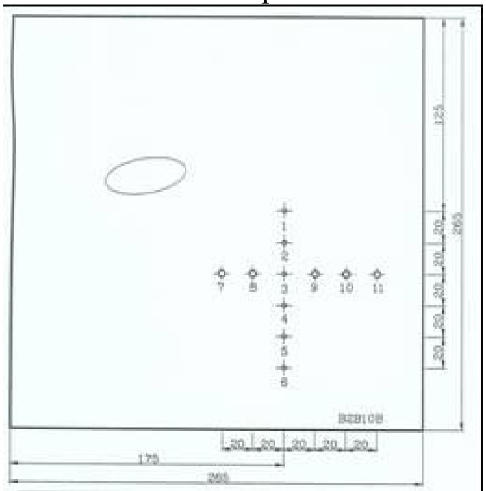


Figure JRA1.6.1: SQUID scanner developed at Fa. WSK

Holes of different diameters and depth were drilled and filled with tantalum. After, these locations were heated by a defocused electron beam up to the melting point. Finally, grinding of the complete sheet surface was done so that the defect positions were barely visible (Fig. JRA1.6.2).



Fehler	Sackloch Ø[mm]	t[mm]	V[mm³]	mit Tantal gefüllt
1	0,12	0,078	0,0009	Ja
2	0,14	0,21	0,0032	Ja
3	0,145	0,298	0,0049	Ja
4	0,145	0,376	0,0062	Ja
5	0,15	0,474	0,0084	Ja
6	0,15	0,469	0,0083	Nein
7	0,22	0,234	0,0089	Ja
8	0,23	0,333	0,0127	Ja
9	0,22	0,435	0,0165	Ja
10	0,22	0,495	0,0188	Ja
11	0,22	0,501	0,0190	Nein

Figure JRA1.6.2: Nb test sheet with tantalum inclusions.

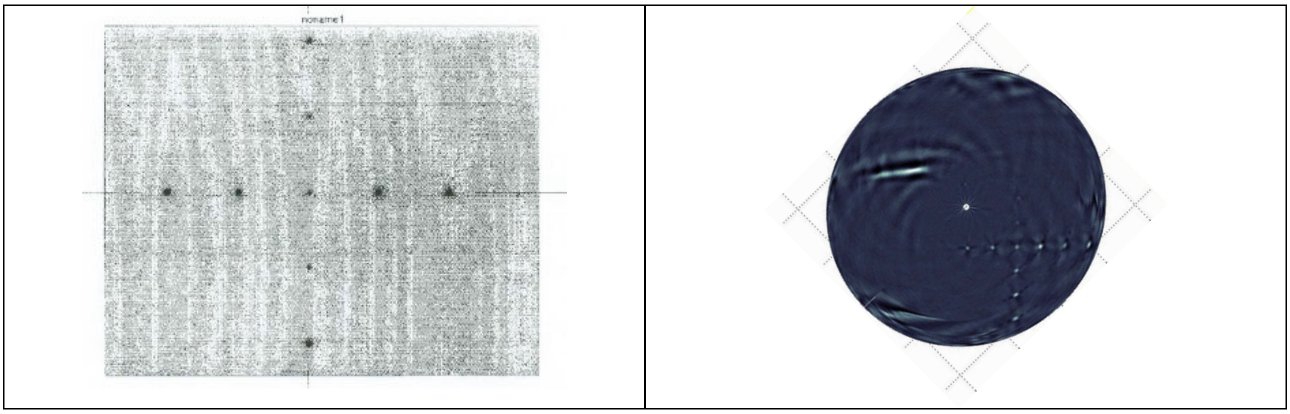


Figure JRA1.6.3: NAA Neutron activation analysis and eddy current images of the test sheet

The neutron activation analysis and eddy current images of the test sheet are shown in Fig.JRA1.6.3. All artificially produced defects can be located.
SQUID scanning was done with an excitation coil of 1 mm diameter and 40 windings. The scanning speed was around 10cm/sec. The excitation frequency was 6 kHz. The scanning results can be seen in Fig. JRA1.6.4. All artificially produced defects were identified.

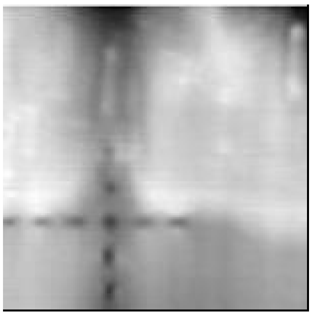


Figure JRA1.6.4a: SQUID scanning results of Nb test sheets.

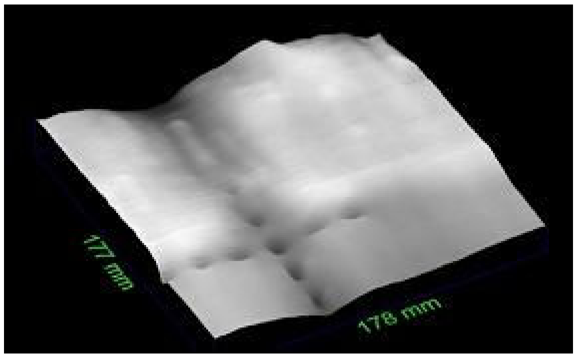


Figure JRA1.6.4b: 3D SQUID scanning image of Nb test sheet with artificial Ta defects.

Fabrication of more systematically produced artificial defects is in progress. A drawing of the defect distribution can be seen in Fig. JRA1.6.5. The following materials are foreseen to be imbedded; tantalum, cooper, iron, niobium, stainless steel.
Unfortunately this work has been delayed. The contract for the production of holes for defects with very small diameter was placed with the company Swiss-Laser, which is now insolvent. The company Rofin-Sinar-Laser Micro took over the contract and the fabrication of the holes is foreseen for beginning of 2007. After that the holes will be filled with implanted material and closed by a defocused electron beam at DESY. Scanning of the sheets with the artificial defects is foreseen to start after grinding at WSK.

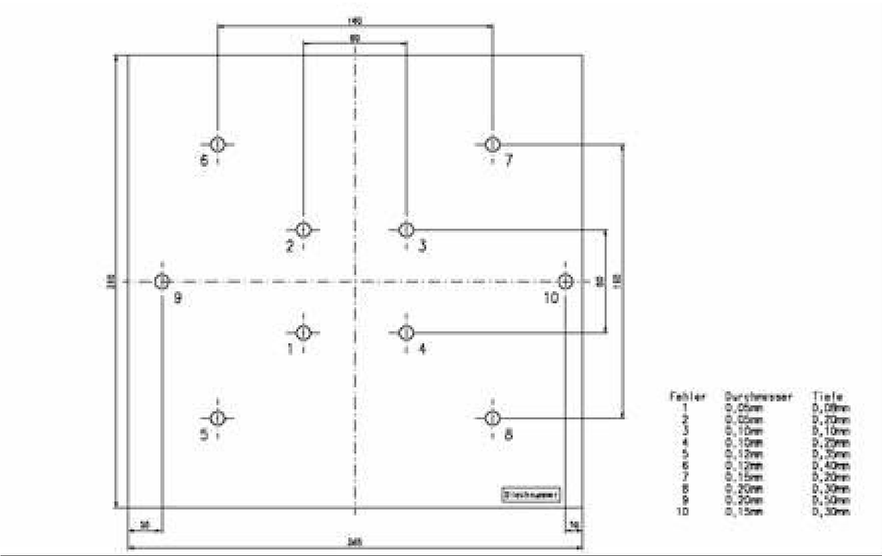


Figure JRA1.6.5: Drawing of niobium sheet with imbedded defects

Scanning of industrially produced niobium sheets for 1.3 GHz resonators

Twenty niobium sheets from the Fa. Plansee for the cavity AC115 were scanned before annealing with the WSK SQUID scanner. The excitation frequency was 6.3 kHz.

- Surface structures (increasing of surface roughness), detected in sheets Nos. 14, 24 and 26 is probably caused by the rolling.
- Sheets 12, 17, 18 und 20 demonstrate small density gradients in corners.
- All sheets (excluding sheet No. 28) are defect free. Sheet No. 28 has a de-lamination in the lower left corner penetrating from the surface into the bulk (Fig. JRA1.6.6). This sheet was removed and not used for cavity fabrication.

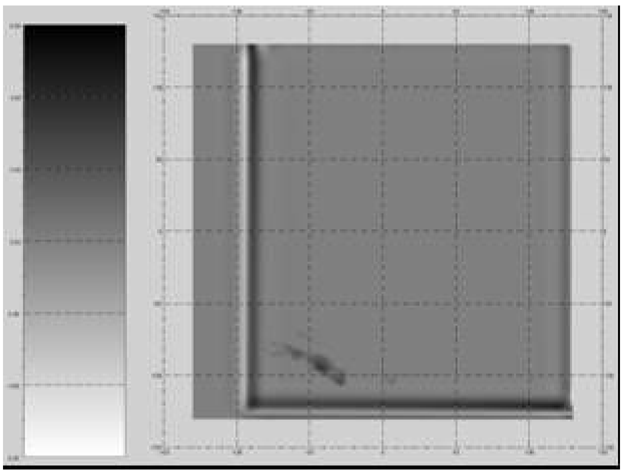


Figure JRA1.6.6: De-lamination detected in a sheet by SQUID scanning.

JRA1.6.2 Flux gate magnetometry

The activity on flux gate magnetometry has proceeded comparing what can be obtained by a flux gate and what can be obtained by the same EP process by a GDR. We have applied the magnetometer to an Electropolishing cell section (Fig. JRA1.6.7).

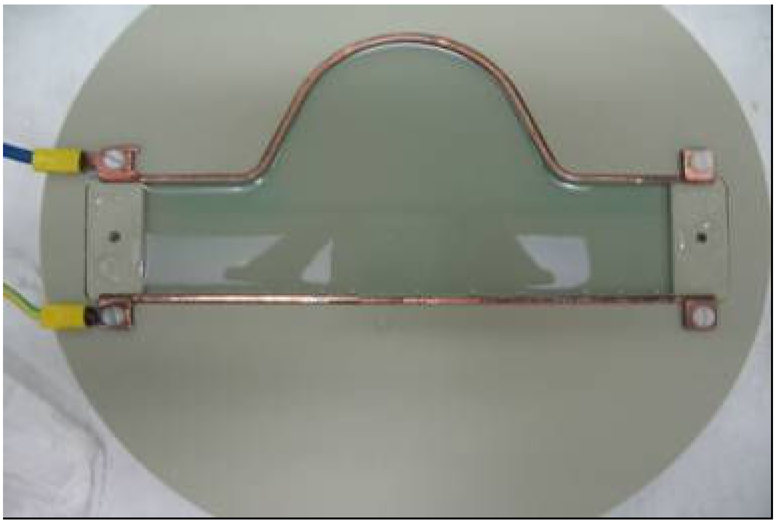


Figure JRA1.6.7: Experimental Arrangement for magnetometric investigation of EP current distribution.

The left picture (Fig. JRA1.6.8) is the field distribution obtainable by a Flux gate 1st order gradiometer. The right picture is the current distribution GMR 2nd order gradiometer, showing that room temperature non destructive evaluation can easily make electrochemistry diagnostics.

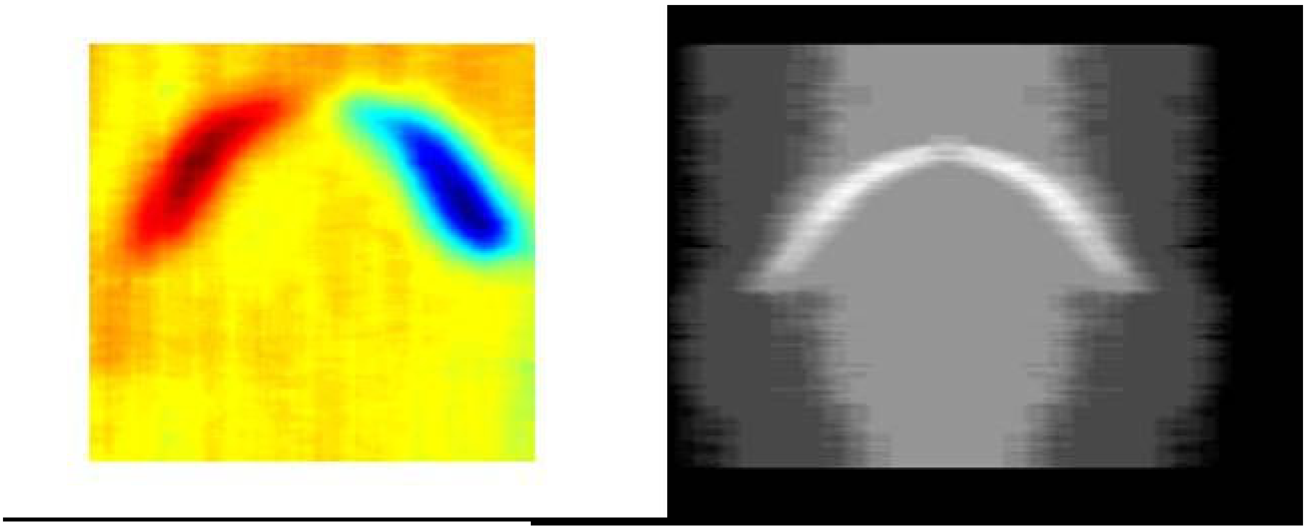


Figure JRA1.6.8: Field and current distribution of EP cell.

JRA1.6.3 DC field emission scanning

Quality control field emission measurements were performed on a standard Nb sample, electro polished and high pressure rinsed, inside a nine-cell cavity at DESY. Also, to study the improvement of surface quality by applying dry ice cleaning (DIC) as a final surface cleaning procedure, a series of successive field emission scans and local FE, SEM and EDX measurements of emitters were performed on two circular Nb samples (28 mm diameter). The curvature and surface roughness of the samples were measured by means of a new optical profilometer. Moreover, we also started to study the FE properties of two single-crystal Nb samples cut from ingot plates and chemically polished only. A series of systematic field emission scans on these circular Nb samples (28 mm diameter) at surface fields of up to 200 MV/m was performed and was followed by local measurements of the emitters found. The surface treatments and measurement details of the samples are listed in the table below.

Sample names	Suface treatment	Parameters	Measurement, Analysis
SEP1†	Dry ice cleaning (EP+HPR before)	T (liquid CO2)= -5 to - 40 0C CO2 pressure = 45 bar N2 pressure = 12-18 bar	FE measurement, SEM, EDX Profilometer scans
SEP2*†			
QCNb1	Sample prepared (EP+HPR) inside a 9-cell cavity	Standard for cavities at DESY	FE measurements Profilometer scans
SCNb1	BCP + HPR	# Single crystal or large grains Only 30µm removal by BCP ⇒ Mirror like surface	FE measurement, SEM, EDX
SCNb2			
CryNb1			
CryNb2			

The main results of this work are summarized as follows:

<u>Quality Control Nb sample EP+HPR inside 9-cell cavity:</u>

The electro-polished Nb sample showed a very smooth surface with step heights of ~ µm due to the grain structure and a very small micro-roughness of less than 0.2 µm, as measured with the profilometer (Fig.JRA1.6.9).

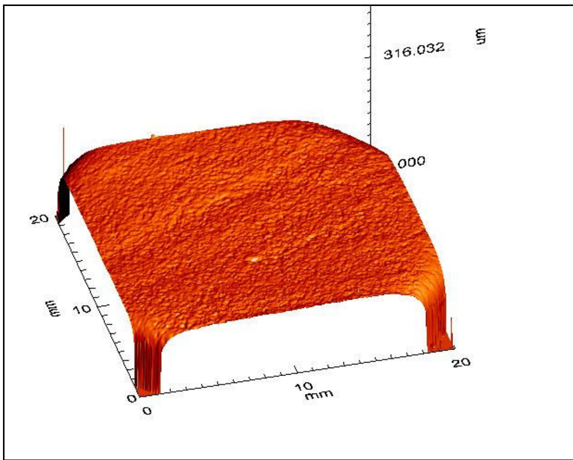
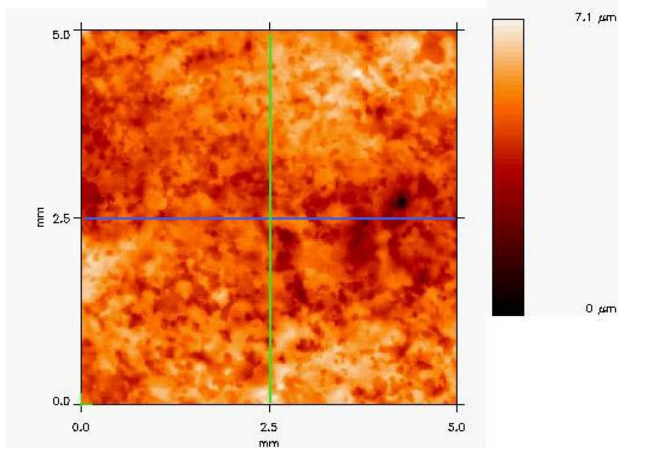
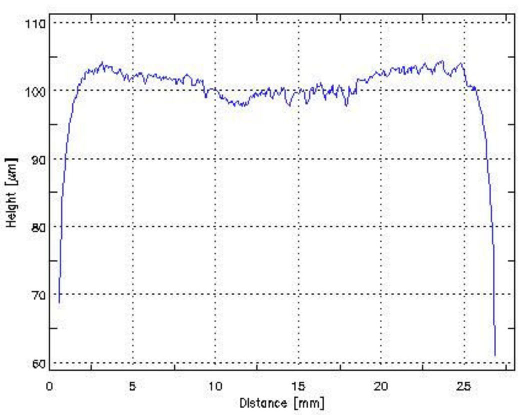
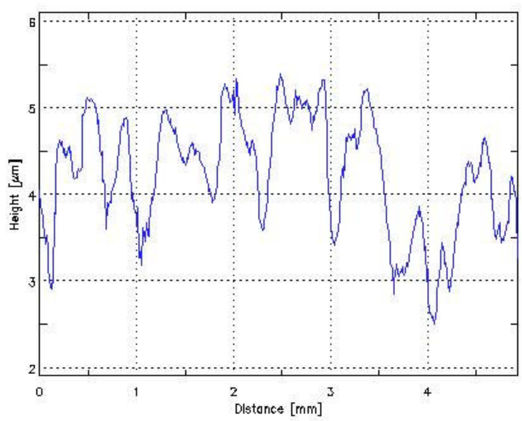
No field emission was observed in the voltage scans up to a surface field of 120 MV/m over a $(10mm)^2$ area; while at 150 MV/m the number density of emitters observed is $9/cm^2$ (Fig.JRA1.6.10). This is the best result observed to date on polycrystalline EP/HPR Nb samples.

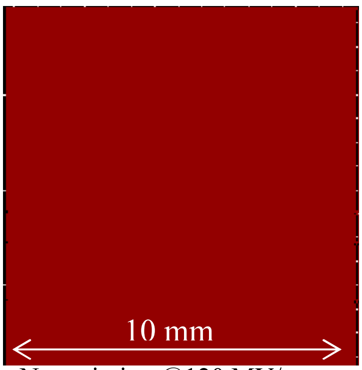
<u>Suppression of FE on EP Nb samples after HPR and DIC:</u>

Treatments on Nb:	EP	EP + HPR	EP+HPR+DIC
E onset (1 nA)	40 MV/m	60 MV/m	90 MV/m
N @120 MV/m	30/cm2	14/cm2	< 2/cm2
β values	(31-231)	(17-167)	(17- 80)

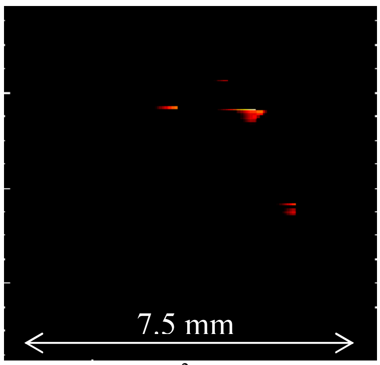
High resolution SEM on Nb samples revealed two types of emitters: particulates of 500 nm to 20 µm size and scratch-like surface defects. Most of the particulates show foreign elements.

SEM images (Fig.JRA1.6.11) of an emitter before and after DIC, show the destructive effect of DIC on one of the emitters which could not be removed by HPR.

	
	
Profile: Curvature: 6.7 µm over 20 mm	Horizontal profile: Height steps: < 1.5 µm over 0.5 mm Microroughness: < 0.2 µm
Figure JRA1.6.9: Profiles of electropolished quality control sample (NbQcEP*1)	



No emission @120 MV/m



9 emitters/cm^2 @ 150MV/m

Figure JRA1.6.10: Regulated voltage scans for Nb sample electropolished inside the 9-cell cavity.

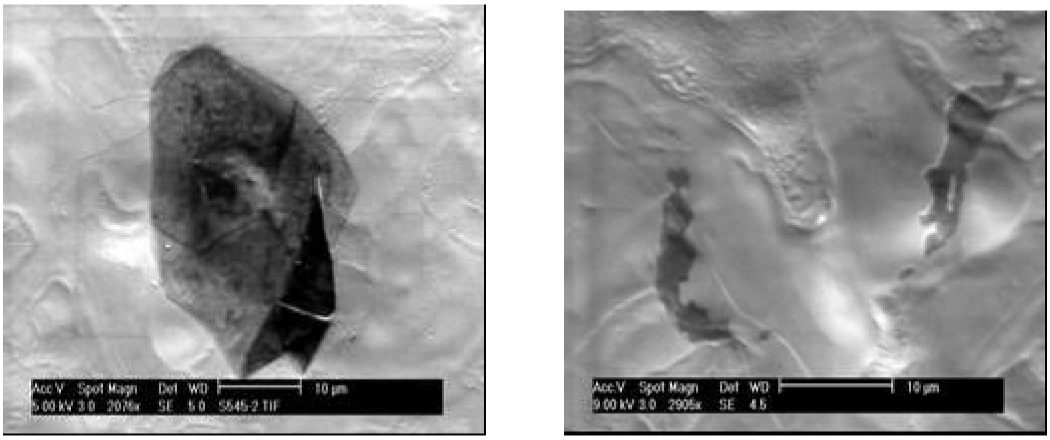
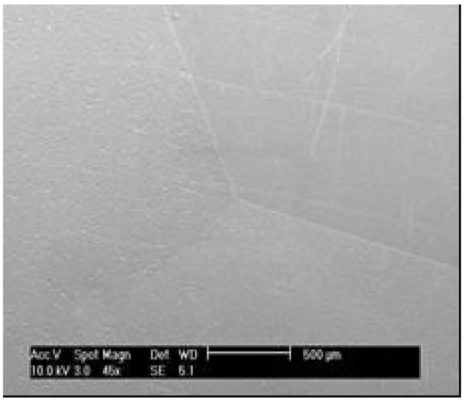


Figure JRA1.6.11: SEM images of an emitter after HPR and after dry ice cleaning. Most of the part of the emitting particle has been destroyed by DIC, but remnants still emitting with reduced strength.

Single crystal and large grain Nb samples:

Crystalline Nb samples were only 30 µm BCP treated and high pressure rinsed, giving the visual appearance of a mirror like surface, i.e. surface roughness <<1 µm. Two samples were of single crystal Nb (SCNb1, 2) and another two samples were of large grain Nb with only three grain boundaries on the sample (CryNb1, 2). The grain boundaries observed in SEM are shown in Fig. JRA1.6.12.



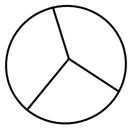


Figure JRA1.6.12: SEM image of the intersecting grain boundaries at the center of the sample surface (CryNb2)

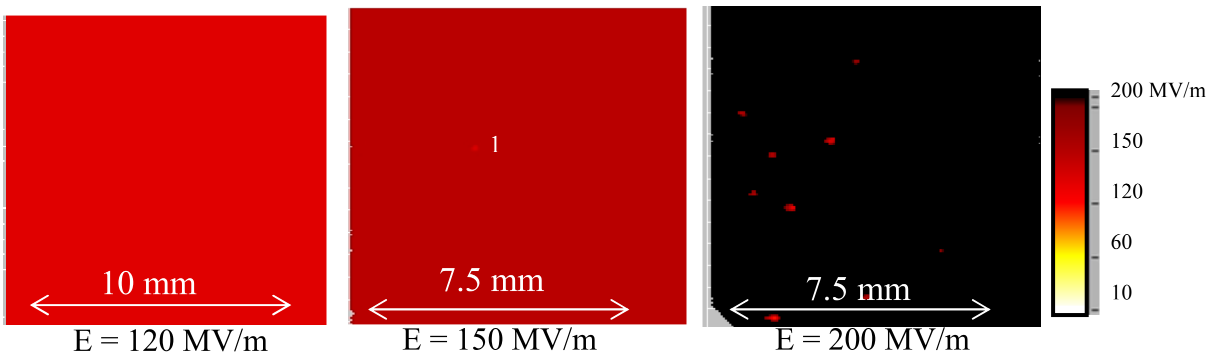


Figure JRA1.6.13: Regulated voltage scans on a single crystal Nb sample.

FE results on large grain samples are summarized as:

1. The onset of FE was observed in the regulated V-scan for 2 nA current at 150MV/m (Fig.6.3.5) and the emitter density at 200MV/m is (18, 21) and (9, 16) /cm^2 for large grain and single crystal samples.

2. Locally measured emitters show stable FN behavior after conditioning at I_{max} < 35 nA. The onset field lies in the range of 64 to 175 MV/m, β values in (22 – 75) and S-parameters in (10^{-5} to 10^{-8} μm^2) range, which are typical for particulates and surface irregularities.

Comparison of emitter statistics on all measured samples:

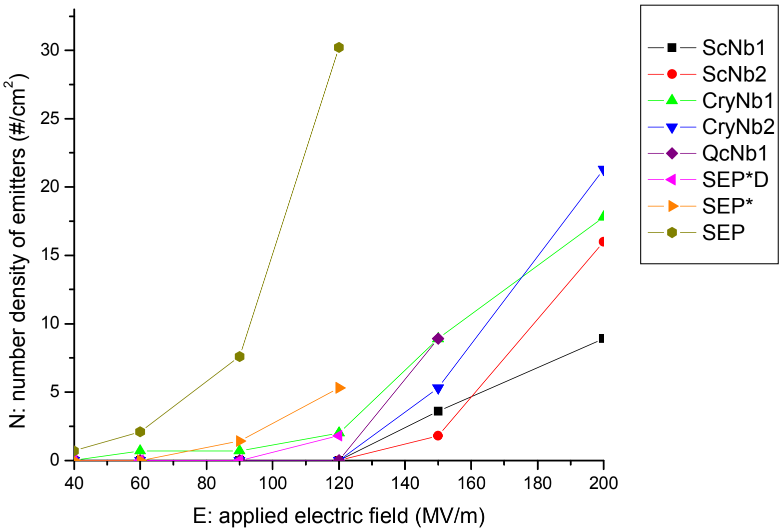


Figure JRA1.6.14: Emitter statistics on various investigated Nb samples. Single crystal Nb samples show least emitter number densities and minimum onset field. (SEP: EP in Saclay, SEP*: EP+HPR, SEP*D: EP+HPR+DIC, QcNb: EP+HPR inside cavity for quality control)

In conclusion of all the above measurements, single crystal Nb samples (only with 30 µm BCP + HPR) provide better performance than the best EP Nb sample measured yet (Fig.JRA1.6.14). Measurements on dry-ice cleaned large grain samples are in progress. Further, a series of measurements on EP Nb samples prepared inside 9-cell cavities for quality control scans are planned. Moreover, the effect of heat treatments on FE will be studied for the best Nb samples.

JRA1.6.4 Overall Progress of Work Package 6

N°	Task Name	2006: Jan Feb Mrz Apr Mai Jun Jul Aug Sep Okt Nov Dez / 2007: Jan Feb Mrz Apr Mai Jun Jul
6	**WP6 MATERIAL ANALYSIS**	
6.1	**SQUID scanning**	
6.1.1	**Produce calibration defects**	
6.1.1.1	Production of surface defects	
6.1.1.2	Production of bulk defects	
6.1.1.3	**Calibration defects finished**	
6.1.2	**Design components of Squid scanner**	
6.1.2.1	Design of the scanning table and support	
6.1.2.2	Design of the SQUID cooling system	
6.1.2.3	**Design Scanner finished**	
6.1.3	**Construction of scanning apparatus**	
6.1.3.1	Fabrication of the SQUID	
6.1.3.2	Fabrication and purchase of components for SQUID apparatus	
6.1.3.3	Software for the SQUID scanner	
6.1.3.4	Commissioning and calibration of scanning apparatus	
6.1.3.5	**Scanning apparatus operational**	6.12.
6.1.4	**Scanning of sheets with artificial defects**	
6.1.4.1	Scanning of sheets with artificial surface defects	
6.1.4.2	Scanning of sheets with artificial bulk defects	
6.1.4.3	Development of algorithm for material defects classification	
6.1.4.4	**Classification of defects finished**	08.02.
6.1.5	**Scanning of production sheets**	
6.1.5.1	Scanning of sheets of different producers	
6.1.5.2	Identification of defects by (EDX, SURFA etc.)	
6.1.5.3	Conclusive comparison with eddy current data	
6.1.5.4	**Final report on SQUID scanning**	
6.2	**Flux gate magnetometry**	
6.2.1	**Produce calibration defects**	
6.2.1.1	Production of surface defects	
6.2.1.2	Production of bulk defects	
6.2.1.3	**Calibration defects finished**	
6.2.2	**Design components of flux gate head**	
6.2.2.1	Design electronics	
6.2.2.2	Design of flux gate head	
6.2.2.3	Design of operations software	
6.2.2.4	**Design flux gate head finished**	
6.2.3	**Fabrication of flux gate detector**	
6.2.3.1	Fabrication of flux gate head	
6.2.3.2	Fabrication of mechanics	
6.2.3.3	Implementation of software	
6.2.3.4	Commissioning of flux gate detector	
6.2.3.5	Calibration of flux gate detector	
6.2.3.6	**Flux gate detector operational**	19.12.
6.2.4	**Commissioning of flux gate detector**	
6.2.4.1	Operational tets tests	
6.2.4.2	Evaluation of test results	
6.2.4.3	**Flux gate scanner commissioned**	04.01.
6.2.5	**Operation of flux gate detector**	
6.2.5.1	Regular operation	
6.2.5.2	Report of operation	
6.2.5.3	**Conclusion of flux gate scanning operation**	
6.2.6	**Comparison with SQUID scanner**	
6.2.6.1	Compare measurements	
6.2.6.2	**Conclude SQUID scanner vs. flux gate detector**	
6.3	**DC field emission studies of Nb samples**	
6.3.1	**Quality control scans**	
6.3.1.1	Modification of Scanning apparatus	
6.3.1.2	Calibration of Scanning apparatus	
6.3.1.3	**Start scanning activity**	
6.3.1.4	BCP and HPR samples	
6.3.1.5	EP and HPR samples	
6.3.1.6	BCP/EP and DIC samples	
6.3.1.7	**First report on BCP/EP and DIC surface**	
6.3.1.8	Continue QA scanning	
6.3.1.9	**Evaluation of scanning results**	
6.3.2	**Detailed measurements on strong emitters**	
6.3.2.1	Calibrate apparatus for high current	
6.3.2.2	**Start strong emitter evaluation**	1.
6.3.2.3	I/V curves and current limits	
6.3.2.4	SEM and AES	
6.3.2.5	Influence of heat treatment and ion impact	
6.3.2.6	**Evaluate strong emitter investigations**	

JRA1.7 Work Package 7: Couplers

JRA1.7.1 New Prototype Couplers

For task 7.1 we have designed two new proto-type couplers named TTF-V and TW60 respectively. Both types of coupler are being produced in industry and were received in summer-autumn of 2006. Four couplers of each type have been delivered by ACCEL. A new test transition for these 8 couplers has also been built.

A first pair of TTF-V proto-types was tested at low power. This revealed an important shift in the matched frequency (~ -80 MHz) with respect to the calculated value of 1300 MHz. The second pair shows a shift of about -45 MHz (Fig JRA1.7.1).

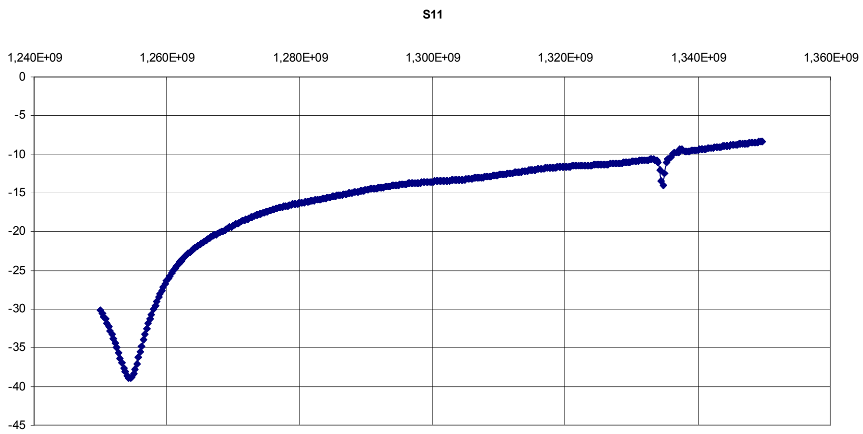


Figure JRA1.7.1: S11 parameter low level measurements for the second pair

With a return loss of ~ 14 dB at 1300 MHz we attempted power conditioning. The klystron is protected with an interlock and a circulator in the wave-guide distribution system. This conditioning showed a very slow power ramping time and finally it was interrupted.
To solve the problem of the frequency shift three actions are planned:

1) Mechanical measurements and checks.
-All the mechanical dimensions in the drawings were re-checked. The checked dimensions were re-evaluated in the HFSS simulations. A new version of HFSS is operational and it allows also a full simulation of an entire pair of couplers on their test stand. In the most critical points (ceramics, short circuit….), to increase the precision, the simulation was performed locally with an increased number of lattice nodes. All these simulations confirmed the original results with the reflection minimum at 1.3 GHz.
-The mechanical dimensions were measured (within the limit of accessibility) to check also if the tolerances were respected. Some discrepancies were found especially in the antenna penetration and in the transition box. These measured dimensions were re-inserted as input for new simulation but they do not show any drastic effect that can explain the frequency shift. A full documentation has been produced and exchanged with the industry to collaborate in understanding the origin of the problem.

2) Simulation
- Besides the above mentioned simulations other computational work was performed to understand the effect of different parameters on the resonance frequency. Different simulations were performed for various values of the properties of the ceramics, the penetration of the antennas, and the position of the short circuit. Considering each parameter

in turn we do not find any explanation to the problem since the calculated shift in frequency is not of the same order of the measured one. Only a strong coherent variation of the ensemble of different parameters can justify the frequency shift but this seems strongly improbable.

3) Low level measurements.
- Apart from the activities carried out to understand the problem an empirical approach was adopted to find a solution. Different low level measurements were taken while trying to vary the antennae penetration (compressing or stretching the bellows or inserting different thickness plates between the test stand and the cold part flange). Promising results were obtained but they are affected by a mechanical inclination of the couplers. A new measurement is envisaged with a mechanical support to block the inclination of the couplers and especially the bellows.

A high power conditioning attempt also for the second pair is foreseen for the beginning of 2007.

The TW60 proto-type was also expected before summer but it has a delay in production. They were received in October with a certain delay due to difficulties encountered in the TiN coating. Mechanical and endoscopic checks were performed. A number of anomalies were noticed and the manufacturer was so informed. A major fault in the tolerances of the cold part flanges prevents any mounting for low level tests. The cold parts were sent back to ACCEL for mechanical modification. They are expected back before the end of 2006.

JRA1.7.2 Fabrication of a titanium-nitride coating bench for the coupler ceramic windows

As far as the task 7.2 is concerned we have to announce a certain delay (4-5 months on the last milestone) on the time schedule due to the difficulty of finding an industrial partner that could assure the construction of the prototype with the required performances in a reasonable time schedule and budget.
Finally we have established collaboration with an Italian research consortium that can meet our needs. This collaboration will also mean the participation of LAL personnel to the development and testing phases of the coating station. A device using the sputtering solution seems to be the preferred choice.
The TiN coating will be performed by sputtering under vacuum using a magnetron. The machine has been designed to have an oil free pumping system to adjust the pressure to the order of $1x10^{-7}$ mbar. A nitrogen (99.999% pure) inlet has been foreseen designed to facilitate vacuum breaking. Nitrogen and argon bottles will be of 99.999% purity. All gas entrances have to be designed with filters filtering particles with a diameter bigger than 0.2 μm and the filters will be inserted as close as possible to the chamber. A vacuum measurement system will operate from atmospheric pressure to $1x10^{-7}$ mbar or from 10 mbar lower vacuum. All flanges with a low probability to be dis-assembled, such as pumps, instrumentation etc.. will be CF flanges with metallic seals, while only the coupler entrance porthole, the magnetrons and the UHV gate valve will use rubber seals. Those parts that constitute the internal part of the vacuum chamber will be made of; 316L stainless steel (a part the magnetron AISI 304); Copper for UHV; beryllium-copper, pure titanium and titanium nitride and ceramics.
Fabrication drawings: Conceptual drawings of a planar magnetron and target have been made. The vacuum design is now complete, while the plasma chamber mechanical drawings have been started and they are expected before the end of 2006.
The sputtering system will be turbo pumped. The rough vacuum will be done by a Scroll pump. Vacuum gauges will be of the Pirani, capacitive and ionization types.

In the meanwhile we have performed some testes on different samples to validate the sputtering technique for TiN coating on alumina. The results were extremely encouraging. A diffractometer analysis showed the deposition of a nearly stochiometric layer of TiN. The same results were obtained on an 800 nm coated sample analysed by ESCA and SIMS techniques (Fig. JRA1.7.2). In this last analysis contaminants were found, more precisely oxygen and some contamination. Both can be fully explained by the low vacuum quality in the device used for the sputtering and in a minor accident that produced a limited quantity of carbonates.

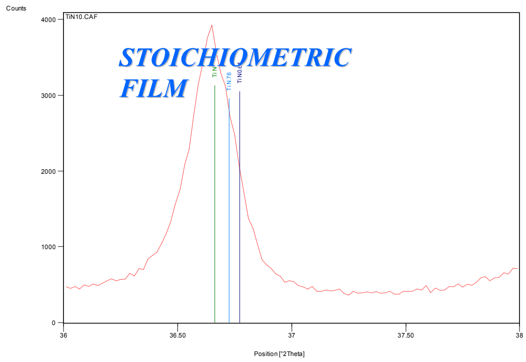


Figure JRA1.7.2: (Left) Tin coated ceramic window, thickness = 800nm. (Right) results of the diffractometry are shown. The film appears to be stochiometric.

JRA1.7.3 Conditioning studies of proto-type couplers

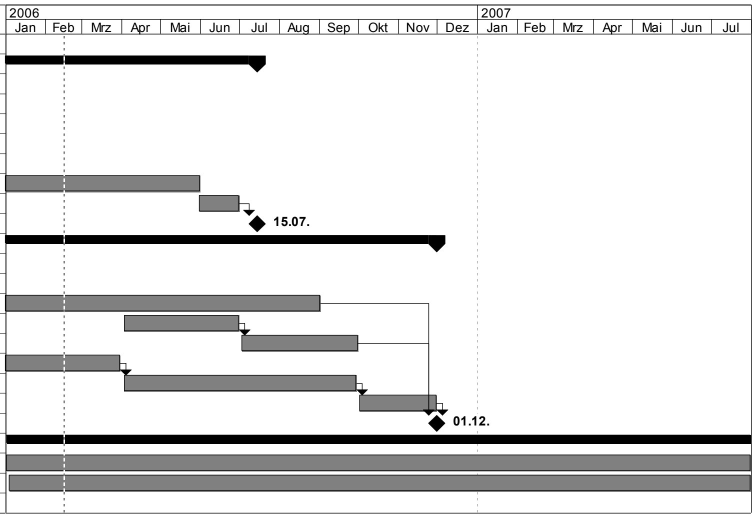
Concerning Task 7.3 we are still waiting to condition the new prototypes. In the meantime, preparation for the new tests has been performed. A lot of simulations have validated the models as far as the thermal response, multipacting activity and the Q_{ext} parameter are concerned. Multipacting for TTF-V was simulated and shows a possible 2^{nd} order 2-point multipacting threshold at ~ 700 MHZ. Presently, we are calculating the transverse kick effect on the beam of the coupling field of the prototypes couplers on the cavity.

A number of technical modifications have also been implemented in the conditioning station to be able to receive the new prototypes.

A great deal of experience has been acquired working on the conditioning of the TTF-III couplers and a strong evidence of conditioning time reduction is the result. The conditioned pairs have been also installed and tested on a SC cavity giving excellent results. All the improvements on the conditioning procedure that have been studied in this activity will be applied to the new prototypes. We have tested a pair of fully TiN coated TTF-III couplers. The result was strongly affected by multipactor in only one cold part. An endoscopic analysis of the concerned part is expected. Different tests were also performed to bias the TTF-III antennas. The capability to suppress the electronic activity in the biased region was clearly demonstrated.

JRA1.7.4 Overall Progress of Work Package 7

N°	Task Name
7	**WP7 COUPLERS**
7.1	**New Prototype Coupler**
7.1.1	RF Simulations of Coupler
7.1.2	Report on Simulation
7.1.3	Detailed Engineering Drawings
7.1.4	Engineering complete
7.1.5	Call for tenders
7.1.6	Prototype Fabrication in Industry
7.1.7	Low Power tests
7.1.8	**Ready for High Power Tests**
7.2	**Fabrication of TiN Coating System**
7.2.1	Mechanical design of vacuum chamber
7.2.2	Fabrication drawings
7.2.3	Construction of vacuum chamber
7.2.4	Define vacuum needs
7.2.5	Appropriation of vacuum equipment
7.2.6	Design of electronic circuitry
7.2.7	Fabrication of electronics in industry
7.2.8	Installation and Test at Orsay
7.2.9	**First Window Coating**
7.3	**Conditioning Studies of Proto-type Couplers**
7.3.1	Conditioning of couplers
7.3.2	Evaluate conditioning results
7.3.3	**Final report on conditioning**



JRA1.8 Work Package 8: Tuners

JRA1.8.1 UMI Tuner (INFN-Mi)

A coaxial (blade) tuner solution has been developed for the compensation of the Lorentz force detuning of the superconducting cavities under the high gradient pulsed operation foreseen for ILC operation. The device is based on the prototypes successfully tested at DESY in 2002 both on CHECHIA and on the superstructures inserted in the TTF string. In order to compensate the Lorentz force detuning foreseen at 35 MV/m, fast elements, such as piezo ceramics, have been integrated into the tuning system. Each tuner can accommodate up to four piezo actuators. Two existing blade tuner assemblies have been equipped with a revised leverage system, and two modified Helium tank systems have been manufactured by Zanon in order to include the piezo active elements (see Fig. JRA1.8.1, Fig. JRA1.8.2 and Fig. JRA1.8.3).

Figure JRA1.8.1: TTF cavities modified Helium tanks

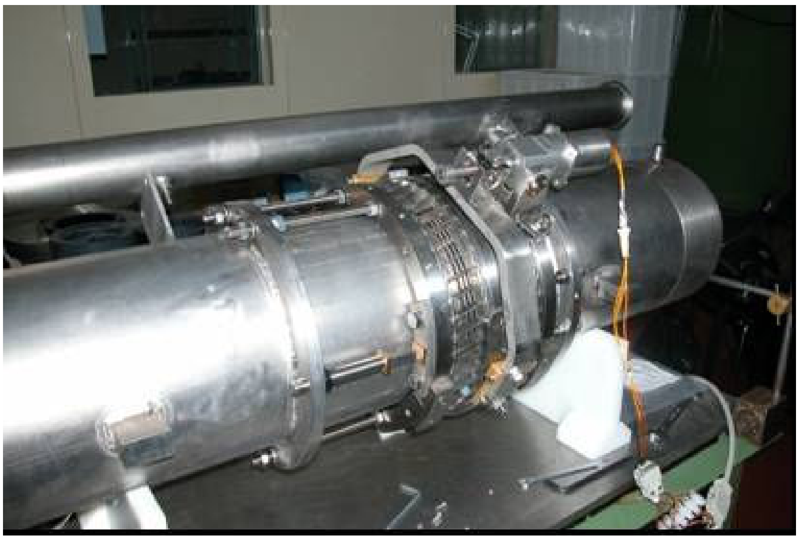


Figure JRA1.8.2: Complete assembly provided with leverage mechanism and stepping motor.

The ring-blade assembly that provides the slow tuning of the cavity is shown in Fig. JRA1.8.2 together with the leverage system. This is the main tuner mechanism and consists of a three-ring bending system. One of the external rings is rigidly connected to the helium tank, while the central one is divided in two halves. The rings are connected by thin, welded titanium plates (the so called “blades”) at an angle which transforms the azimuthal rotation (in opposite directions) of the two halves of the central ring, into a variation of the distance between the end rings, producing an elastic change of the cavity length.
Each tuner can accommodate up to four piezo actuators with length of up to 72 mm and a section of up to 15 mm^2. This part, during operation, can provide the fast tuning capabilities needed for Lorentz force compensation and micro-phonic stabilization. In Fig. JRA1.8.2 a 40mm long aluminum dummy piezo is also shown mounted on its support in order to verify the mechanical constraints without risking damage to the real piezo actuators, while in Fig. JRA1.8.3 a 3-D drawing of the cavity-tuning system assembly is shown.

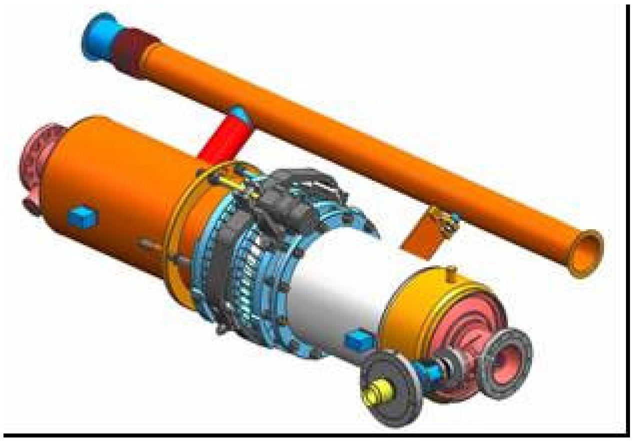


Figure JRA1.8.3: The cavity dressed with the modified helium tank and piezo blade tuner.

The cavity elasticity is used to provide the piezo pre-load. During the first cold tests in a horizontal cryostat, foreseen at DESY and Fermilab for the beginning of 2007, two 15 mm^2 cross section and 70 mm long NOLIAC piezos will be employed for each tuner.

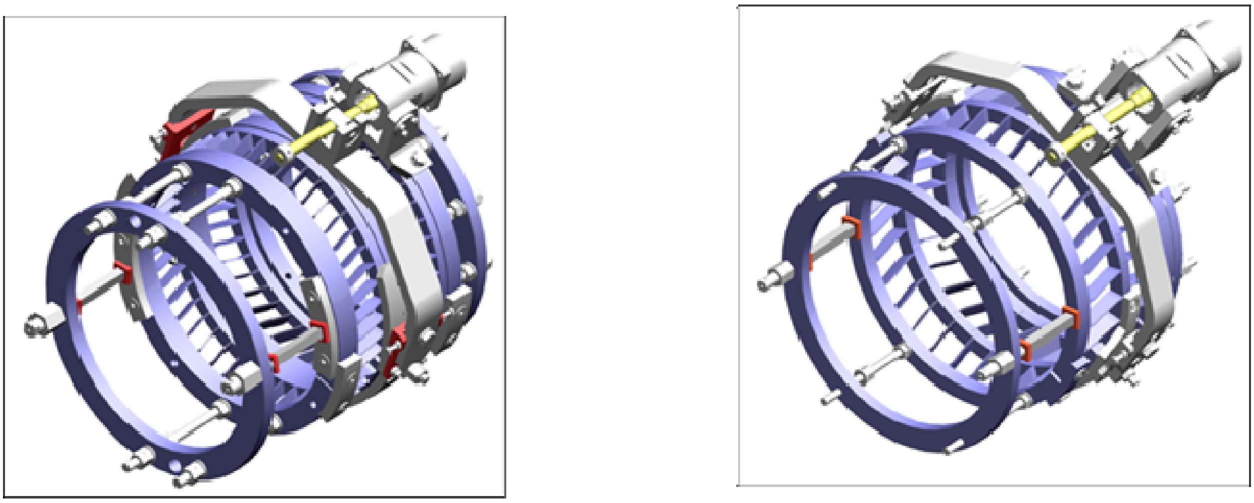


Figure JRA1.8.4: The piezo blade tuner (left) compared with the “lighter” one (right).

Meanwhile, we have started to analyze design modifications to the coaxial blade tuner concept in order to reduce manufacturing costs and simplify the manufacturing process, in view of large scale industrialization for the ILC. All of this, keeping in mind the perspectives of the large scale production foreseen for the collider (> 16,000 components for the baseline 500 GeV design).

This consideration led us to begin exploring possible simplifications and cost reduction efforts for an industrial scale blade tuner. By lowering the requirements on the ring-blade stiffness, on the basis of the considerations that the overall combined tuner stiffness (as provided to the cavity) is essentially limited by the leverage mechanism, especially in terms of slack and tolerances, and by the helium tank conical end plates, a “lighter” version was devised. This version reduces the required material and the number of machining and welding procedures. The width of the Ti rings has been reduced, as well as the number of blade elements. Now the system has an array of 14 “packs” of 2 blades on each side, for a total of 112 flexural elements (blades), with a 40% reduction in the number of blade packs, and a consequent reduction of the assembly time and number of EB welds. This leads to a corresponding decrease of the nominal stiffness of the ring-blade mechanism that is still consistent with the overall stiffness requirement dominated by the other system components (see above). The blade length and width have also been adjusted to improve the tuning range in order to relax the pre-tuning requirements. The current tuner 3-D drawing is shown in Fig. JRA1.8.4, together with the lighter one.

Once installed the new coaxial blade tuner will be the core of a complex control system designed to ensure a stable resonant frequency to the superconducting cavity. The whole system must be able to implement an affordable control with good performance, involving both feed-back and feed-forward architectures. For this purpose a complete electronic platform based on a SIMCON 3.1 FPGA board (courtesy of the TESLA LLRF group) is now under development and will allow us to quickly implement a first prototype of the blade tuner control system. The block diagram of the tuner control system is shown in Fig. JRA1.8.5.

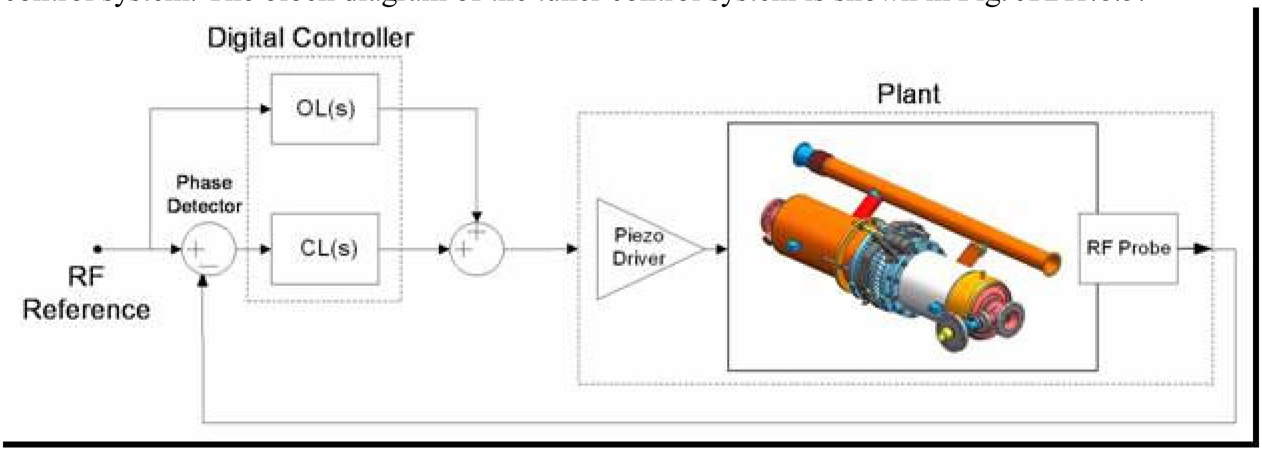


Figure JRA1.8.5: Tuner control system schematic view.

Last, but not least, we obtained, from Celmi, and tested a cryogenic (i.e. realized using strain gauges and glue suitable for cryogenic applications) load cell of reduced dimensions. This device is of size comparable to the piezo-ceramic support and will allow us to measure forces exerted on (or by) piezo elements directly inside cryogenic environments. The new load cell (compared to the former, bigger one) can be seen in Fig. JRA1.8.6.

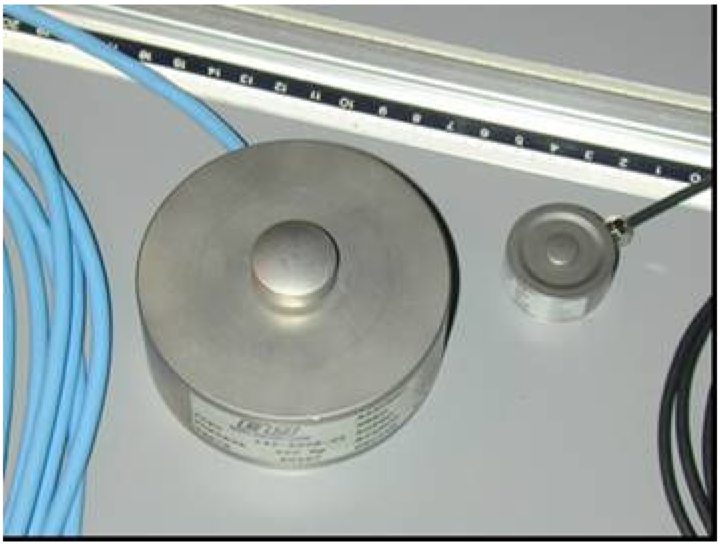


Figure JRA1.8.6: Cryogenic load buttons.

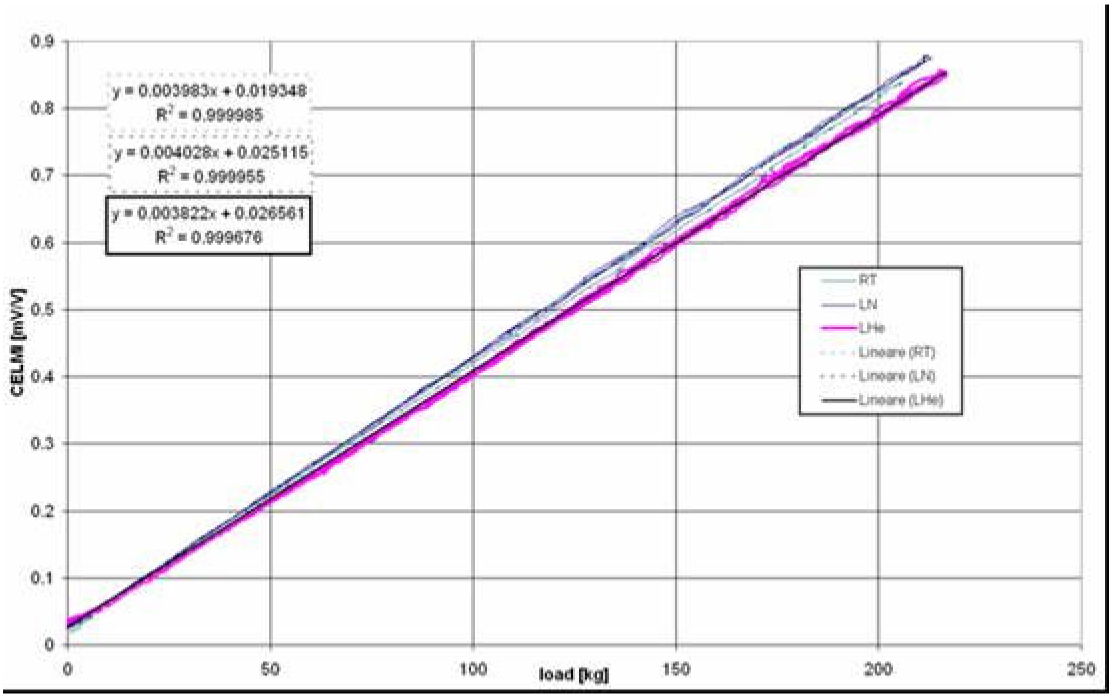


Figure JRA1.8.7: Characteristics of the new cryogenic load cell for different working conditions.

The tests of the new load cell in liquid helium have been successful and the device characteristics taken at different temperatures all shown good linearity and repeatability, as one can see from Fig. JRA1.8.7.

JRA1.8.2 Magnetostrictive tuner (TUL)

The prototype of a magneto-strictive tuner is ready for tests with a cavity. The control system aswell as the driver is already prepared. Due to the movement of the CRYHOLAB test stand the specific experiment with magneto-strictive tuner has been postponed. According to the recently updated schedule, the test will be performed in middle of 2007. Moreover, the huge progress which was made with piezoelectric stack indicates that this alternative solution will not be used for the XFEL.

The control algorithm was developed for both piezostack and magnetostrictive operation. The test with piezostack mounted in the VUV-FEL shows that the Lorentz force was compensated in at least 4 steps by 90% for a gradient of 20MV/m. Further developments are focused on implementation of the algorithms employed in the FPGA based board used for LLRF control. Currently, the online Lorentz force detuning algorithm has been successfully implemented and tested in a module test stand with ACC6. Further research will be focused on microphonics compensation.

A new amplifier for piezo element control has been developed. It is based on the single APEX PB58 power amplifier. It is suitable for resonant compensation, since it can supply current up to 300 mA and voltage up to 50 V. As it uses only one chip, instead of two as previously, it is a cheaper solution. The amplifier successfully passed a preliminary test with a dummy load. At the present time tests in a real system are being performed. The results will be presented in January 2007.

JRA1.8.3 CEA tuner (CEA)

The fabrication of the new CEA tuner is finished. The tuner was mounted in CRYHOLAB and then tested. The detailed report of this study is covered by the report of WP 10.

JRA1.8.4 IN2P3 activities (CNRS-Orsay)

The IPN-Orsay has prepared two piezoelectric actuators PICMA#6 and PICMA#7 (see Figure 8.4.1) for their integration (sub-task #8.4.5) in the new Piezo-Tuning System (PTS) developed at Saclay. As it is a critical part of the PTS, the fixture of the actuators was carefully designed in order to avoid shear forces and/or torsion forces to the actuator and fit very precisely (e.g. ~10 µm) into the PTS in order to avoid loss of mechanical contact during cool down to 2 K. To fulfil these requirements, a cone-on-sphere system is used. In the actual PTS, the cavity, acting as a spring, is used for preloading the piezostacks.

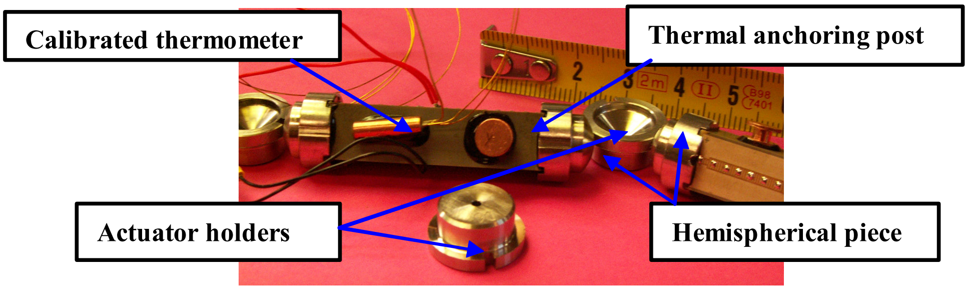


Figure JRA1.8.8: Piezoelectric actuators ready for integration into Saclay PTS.

The critical dimensions were measured with high precision in industry (micrometer and 3-D machine). In particular, the following overall lengths (see fig. JRA1.8.9) (actuator with their holders) were measured: L_6=51 mm $_{-0}^{+5\mu m}$ and L_7=51 mm $_{-0}^{+7\mu m}$ for the piezostacks PICMA#6 and PICMA#7 respectively.

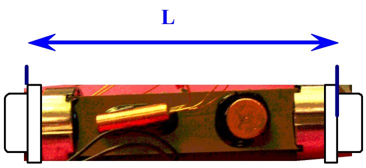


Figure JRA1.8.9: Definition of the overall length L

Moreover, each actuator is equipped with an Allen-Bradley thermometer which was calibrated on an IPN-Orsay facility in the temperature range 1.56 K - 71 K (see Fig. JRA1.8.10).

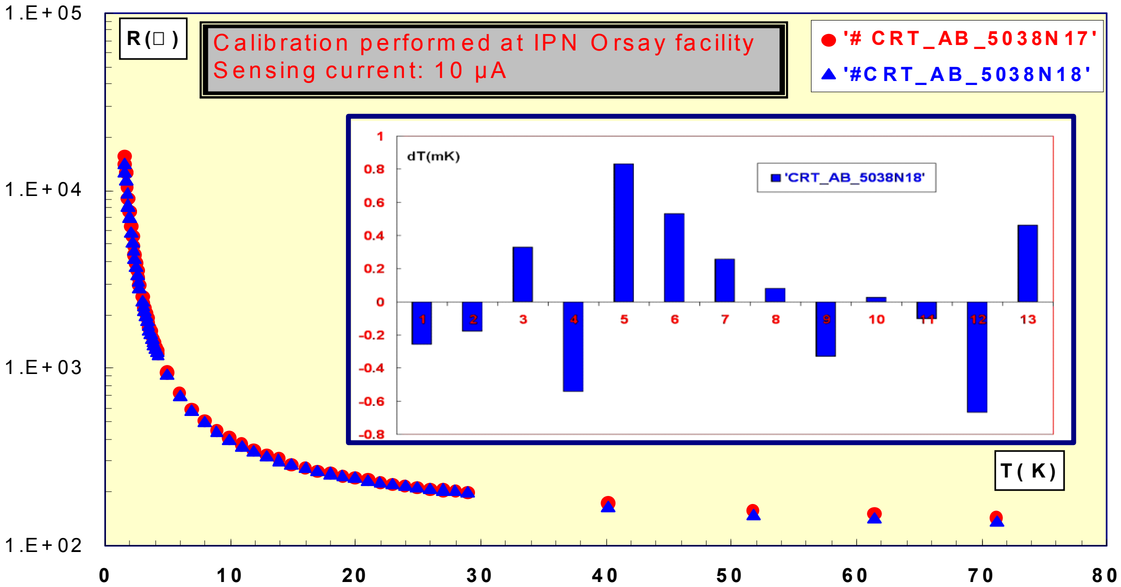


Figure JRA1.8.10: Calibration curves and fit error histogram (insert) in super-fluid helium region (1.56 K-2.1 K).

The actuators were integrated into the PTS and then the assembly was mounted on the cavity C45 and installed in CRYHOLAB test facility (see Fig. JRA1.8.11).

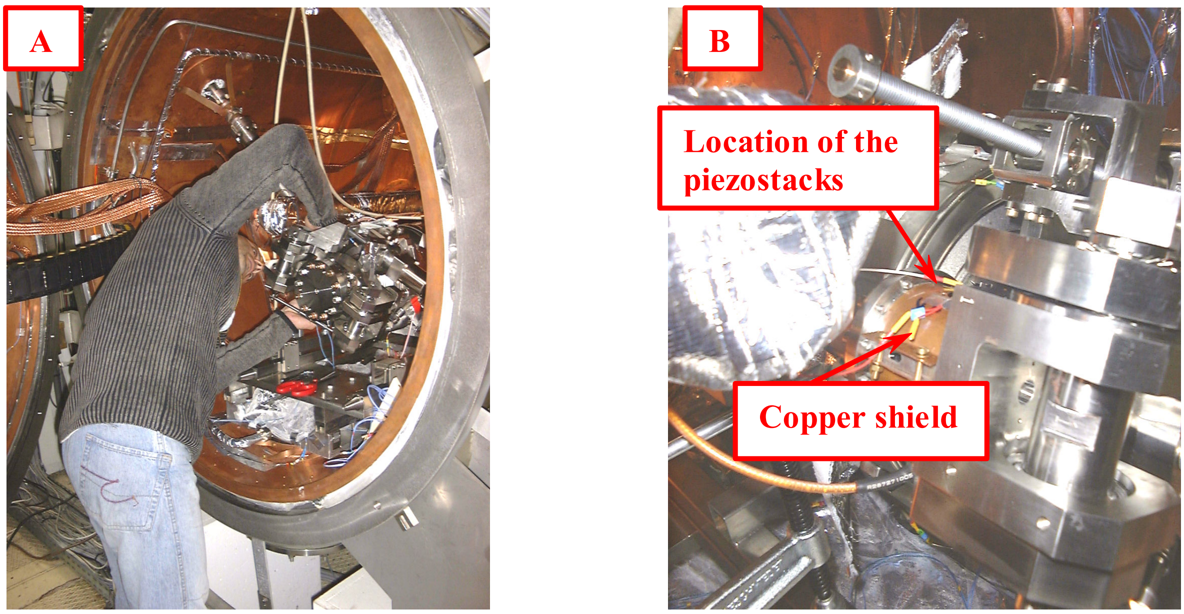


Figure JRA1.8.11: (A) Mounting the PTS in CRYHOLAB, (B) close up view of the fixture of the actuators.

In order to investigate (subtasks #8.4.6 and #8.4.7) the electro-acoustic behavior of the TESLA cavity #C45 and to measure the performance of the PTS developed at Saclay with PICMA actuators, the following tests in CRYHOLAB were performed during three weeks (10-27 April 2006):

1) Measurements of the transfer functions.
2) Study of the mechanical modes of the cavity including quality factors.
3) Measurements of the actuators response to the applied preloading force.
4) Study of Lorentz detuning and detuning compensation with PTS (Pulsed RF tests).

The experimental data were reported at LINAC2006. The pulsed RF tests were started: the status of this activity is summarized in WP#10 quarter report QR's 1 & 2/2006 (Cryostat integration tests). Finally, the sensitivity of PICMA piezo stacks to a preloading axial force at cryogenic temperature were investigated and the corresponding results were reported and discussed in detail (CARE Note and EPAC06). The variations of the relative capacitance $\Delta Cp = Cp\text{-}Cp_0$ (Cp_0: capacitance at zero preload (F = 0)) as function of the preloading force F at T = 2 K are shown in Fig. JRA1.8.12. Non-linear effects are observed at low pre-loading force when F is increased from zero: they are due to friction, stick-slip among non linear phenomena in the pre-loading device mechanism (rotating arm, bellows, etc). Further, these data clearly show a large hysteresis for an increase and decrease of the pre-loading force. This behaviour could be attributed to the intrinsic irreversibility in the piezoelectric material itself.

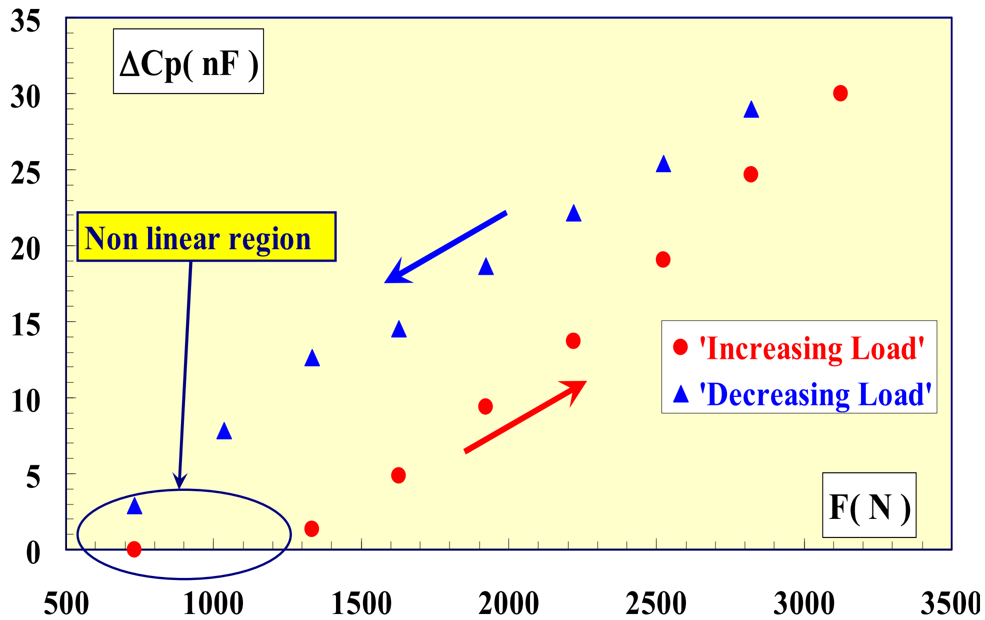


Figure JRA1.8.12: Capacitance versus preload at T = 2.05 K

At T = 2 K, the measured sensitivities to preloading for the force increasing and decreasing are 16 nF/kN and 10 nF/kN respectively. The behavior of the piezostacks as a dynamic force sensor was also studied. The transient response of a PICMA type actuator to a steep preload variation ΔF at T = 2K is presented in fig. JRA1.8.13:

1) a steep voltage increase (capacitor charging) followed by an exponential decrease (capacitor discharging) is observed,
2) the peak actuator voltage ΔV_p ($\Delta V_p \propto \Delta F$) is reproducible to within 3 %.

The actuator is a very sensitive dynamic force sensor with a strong temperature dependence: $\Delta V_p/\Delta F$ = 4.7 V/kN at T = 2 K and $\Delta V_p/\Delta F$ = 21.4 V/kN at T = 4.2K.

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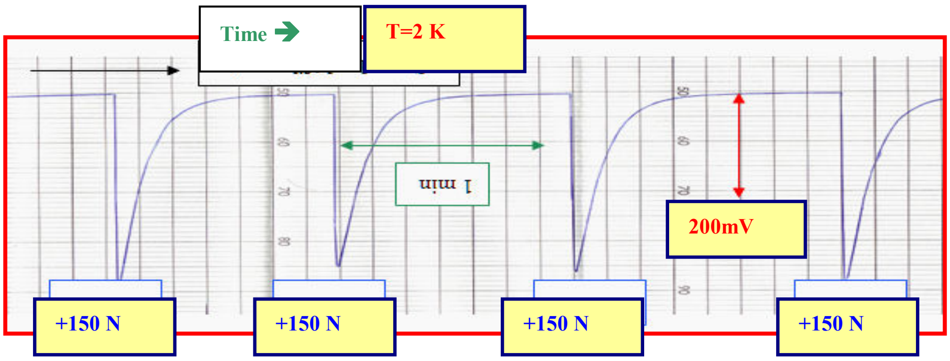
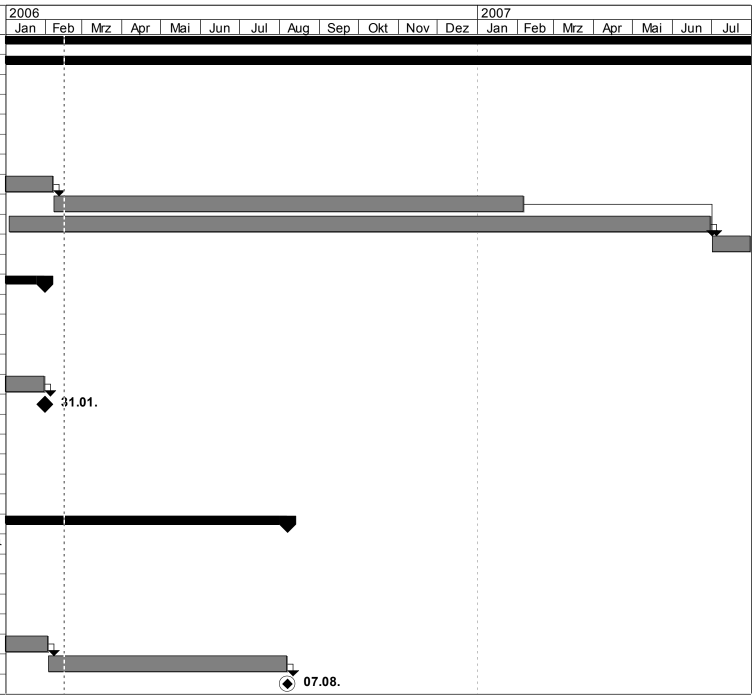


Figure JRA1.8.13: Transient response of a PICMA type actuator to a steep preload variation □F=150 N at T= 2 K.

JRA1.8.5 Overall Progress of Work Package 8

N°	Task Name
8	**WP8 TUNERS**
8.1	**UMI TUNER**
8.1.1	Control electronics
8.1.2	Mechanical tuner design, leverage system/motor
8.1.3	Integration piezo design
8.1.4	Choice of transducer/actuator
8.1.5	**Report UMI tuner**
8.1.6	Tuner fabrication
8.1.7	Piezo fabrication and bench tests
8.1.8	Cavity-tuner-coupler integration
8.1.9	Pulsed RF tests
8.1.10	**Evaluation of tuner operation**
8.2	**Magneto-strictive Tuner**
8.2.1	Complete specification
8.2.2	Conceptual design
8.2.3	Prototype and performance evaluation
8.2.4	Finalize tuner and drive electronics design
8.2.5	Test of tuner
8.2.6	**Report on magneto-strictive Tuner**
8.3	**CEA Tuner**
8.3.1	Design Piezo + Tuning System
8.3.2	Fabrication
8.3.3	Installation RF
8.3.4	**Start of Integrated Experitments**
8.4	**IN2P3 Activity**
8.4.1	Characterize actuators/piezo-sensors at low temperatu
8.4.2	Report on actuator/piezo sensor
8.4.3	Test radiation hardness of piezo tuners
8.4.4	Report on radiation hardness tests
8.4.5	Integration of pieco and cold tuner
8.4.6	Cryostat tests
8.4.7	Tests with pulsed RF
8.4.8	**Report on IN2P3 tuner activities**



JRA1.9 Work Package 9: Low Level RF (LLRF)

JRA1.9.1 Operability and technical performance

JRA1.9.1.1 Transient detector

Progress: In line with schedule.

During the reporting period the activities were focused on improving the transient detection system. It was equipped with fine-tuning circuitry for an RF feed-forward comb filter (Fig. JRA1.9.1) and it uses an IQ modulator for precise filter adjustment. The system was moved from building 28F to the injection area in Hall 3 in order to reduce the cable lengths. It was also connected to all cavities in module ACC1 (Fig. JRA1.9.2). All these upgrades enable the measurements and tests with any cavity in module ACC1.

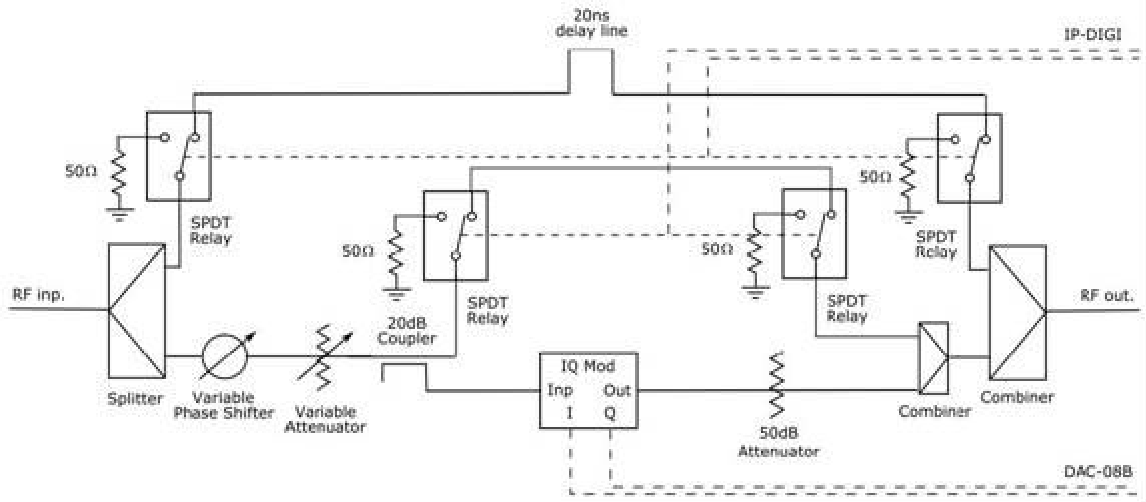


Figure JRA1.9.1: Schematic diagram of the RF feed-forward comb filter with fine-tuning circuitry

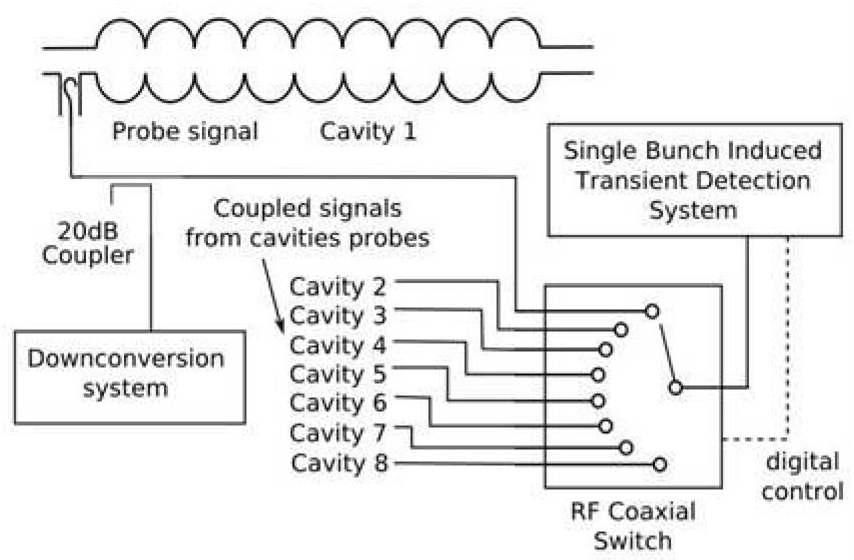


Figure JRA1.9.2: Transient detector connection in ACC1

Milestones and deliverables: None defined in contract for this period.

Significant achievements and impact: Filter for transient detection was improved with fine-tuning circuitry. This circuitry allows filter adjustment to keep required attenuation transparent to normal operation.

Deviations from schedule: None

JRA1.9.1.2 LLRF Automation

Progress: In line with schedule.

During the reporting period a new solution was developed to facilitate automation of the RF-power station. The main effort was focused on elaboration of a general conceptual architecture and its preliminary implementation. Major changes concern relinquishing of the Harels FSM computation model and expansion of the environment driven aspect of the project. The implementation of the FSM is currently done using Prolog language. A general conceptual scheme of the solution is presented in Fig. JRA1.9.3.

The other task in progress was the identification of the high power chain (klystron and its pre-amplifiers) non-linearities and development of a method for their compensation. The developed method distorts the klystron input signal in a way that compensates the klystron non-linearities. The measurements of the high power chain characteristics with application of a pre-distorter method shows good compensation levels both for phase and amplitude characteristics (Fig.JRA1.9.4).

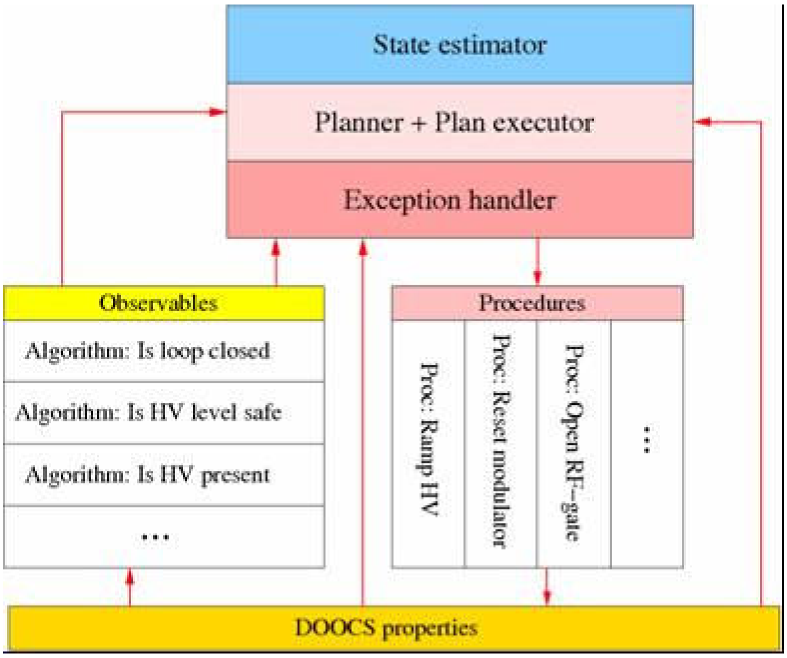


Figure JRA1.9.3: General conceptual scheme of automation module

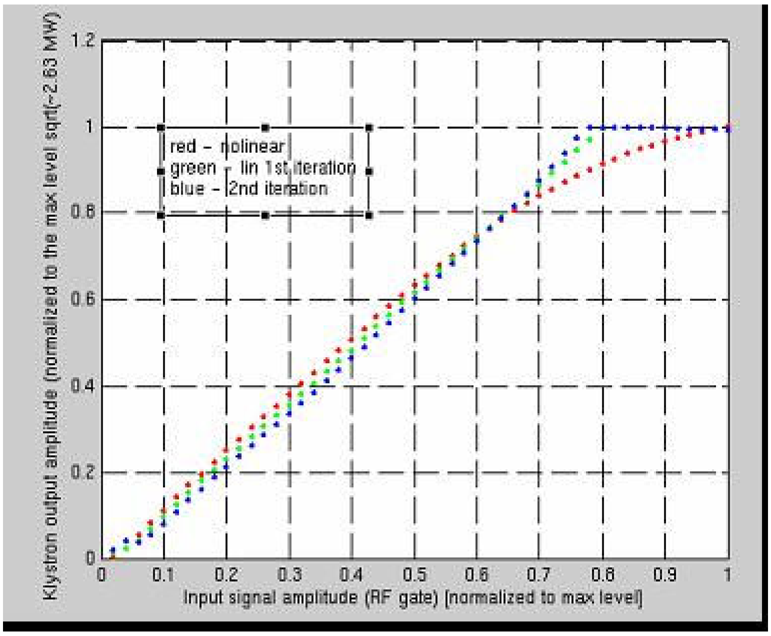


Figure JRA1.9.4: Results of measurements of klystron amplitude characteristics (application of self-adapting predistorter method)

Milestones and deliverables: Final report on “Automation”.
Significant achievements and impact: The development of the FSM for the RF power station and its implementation in Prolog language. The implementation of the pre-distorter method of klystron linearization in FPGA (SIMCON3.1).

Deviations from plan:None

JRA1.9.2 LLRF cost and reliability

JRA1.9.2.1 Cost and reliability study

During the reporting period several possibilities for cost reduction were investigated.

- Automation procedures using knowledge database (rule-based) to reduce cost of operation.
- Application of standard crates (ATCA or μTCA).
- Cabling from the rear side of the crate.
- Reduction in the number of signals.
- In-house development of boards.

Milestones and deliverables: None defined in contract for this period.
Significant achievements and impact: Investigations of overall cost reduction and reliability of the system.

Deviations from plan: None

JRA1.9.2.2 Radiation damage study

During the reporting period the on-line radiation-level monitoring system (RADMON) was installed and operated in the FLASH tunnel. It was integrated with the existing DOOCS control system and now the results of radiation level measurements are accessible remotely

(Fig.JRA1.9.5). Also several techniques for designing SEU-tolerate circuits were worked out and implemented (e.g. SEU tolerant IQ detection algorithm – Fig. JRA1.9.6).

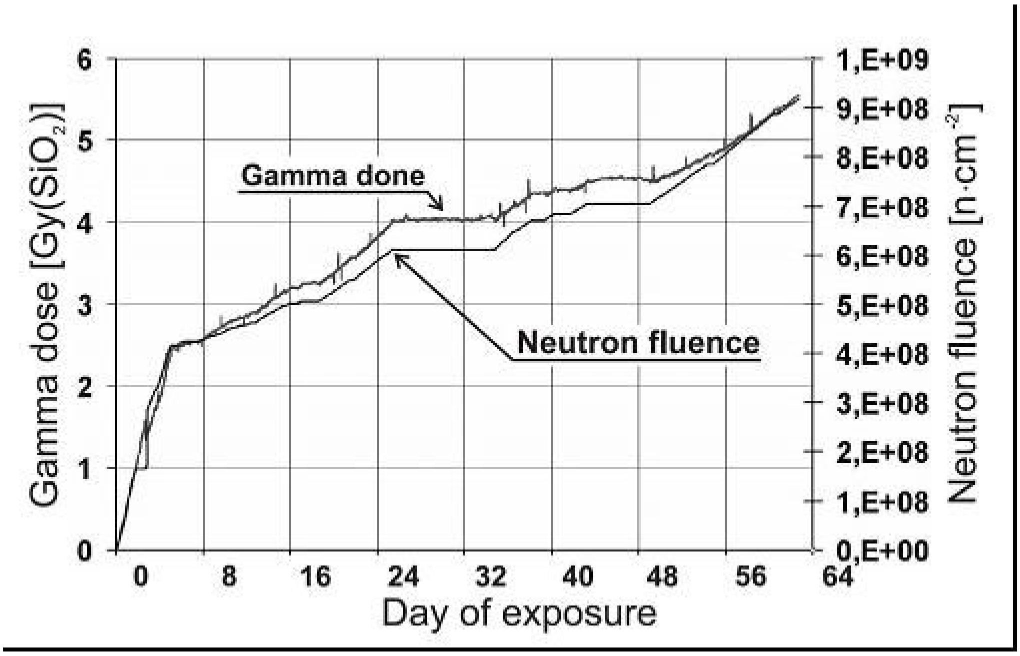


Figure JRA1.9.5: The accumulated dose of gamma radiation and neutron fluence registered on FLASH.

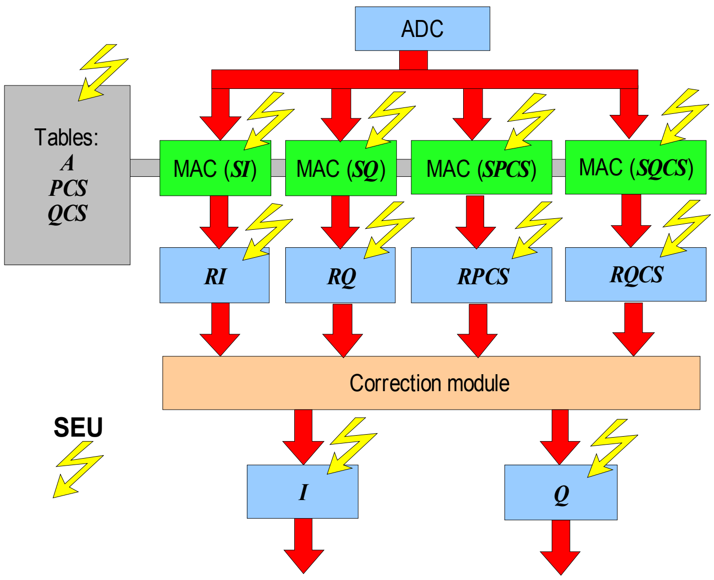


Figure JRA1.9.6: Block diagram of the SEU-tolerant IQ detection algorithm

Milestones and deliverables: None defined in contract for this period
Significant achievements and impact: Development of a new version of SRAM based radiation on-line monitor RADMON. Development of design techniques for radiation tolerant systems.
Deviations from schedule: None

JRA1.9.3 Hardware

JRA1.9.3.1 Multichannel downconverter

During the reporting period new down-converter boards were designed and manufactured. The digital motherboard (Fig. JRA1.9.7) carries mezzanine boards with down-converters and integrated 16-bit resolution fast ADCs. The whole board is a digital down-converter that can perform IQ detection algorithms and provide digital output data.

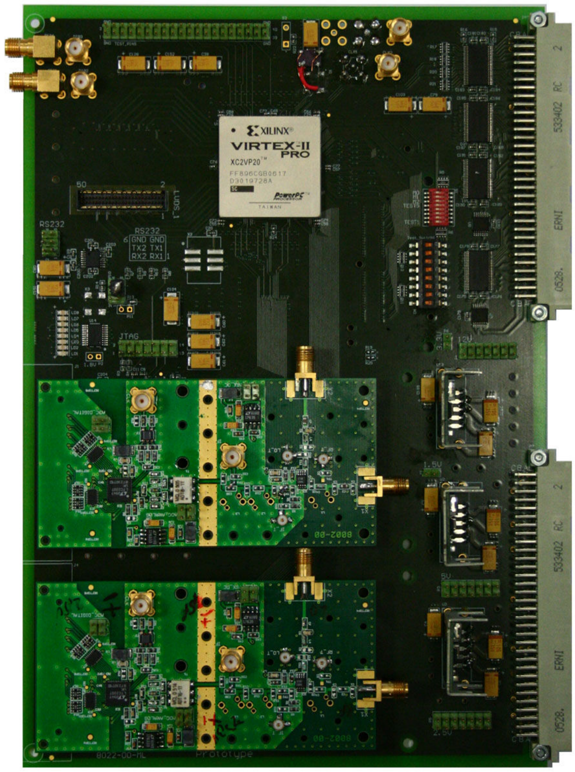


Figure JRA1.9.7: Digital motherboard with down-converters boards integrated with ADC

Milestones and deliverables: None defined in contract for this period
Significant achievements and impact: Development of new down-converter boards.
Deviations from plan: None

JRA1.9.3.2 Third generation RF control

During the reporting period two new boards were designed and manufactured. The SIMCON 3.1 DSP board (Fig. JRA1.9.8.a) is the upgrade of the SIMCON 3.1 board with a DSP chip for real-time floating point operations and 4 additional DACs (8 in total on the board). The second board (Fig. JRA1.9.8.b) is the concentrator board with 8 fast optical links, Virtex II pro and Flash memory slot. The board can exchange data between other SIMCON boards through optical links and VME (it can be VME master) and is meant to be used as a part of distributed, multi-channel, cavity control system.

a) b)

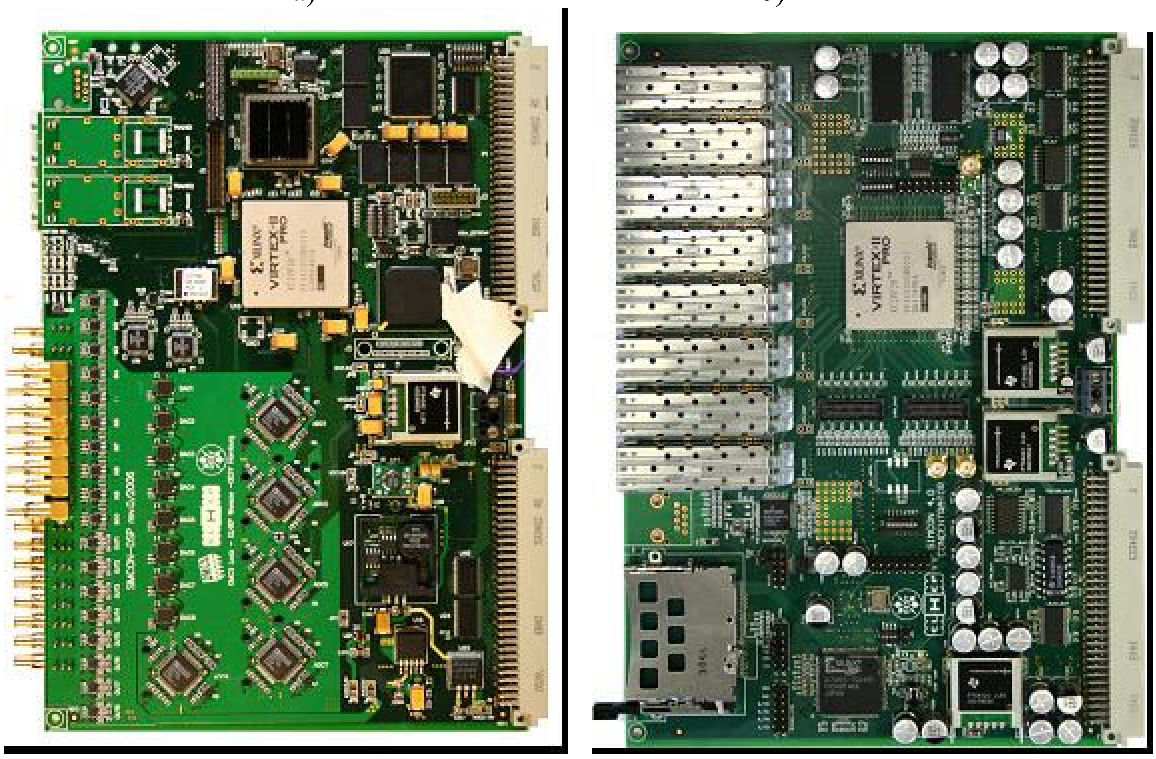


Figure JRA1.9.8: New control boards (a) SIMCON DSP board, (b) Concentrator board

Milestones and deliverables: None defined in contract for this period
Significant achievements and impact: Development of new controller boards.
Deviations from plan: None

JRA1.9.3.3 Stable frequency distribution

During the reporting period a new frequency distribution system was designed and partially assembled and tested. The stability requirements of the Master Oscillator were 100 fs and 1 ps for times shorter than 100 ms and longer 1000 s respectively. The frequency distribution system (Fig. JRA1.9.9) consists of a MO supplying several reference frequencies and power amplifiers for signal distribution. The low-level part of the system is already finished and the stability requirements are fulfilled (Fig.JRA1.9.10). The implementation of the power part of the system is in progress.

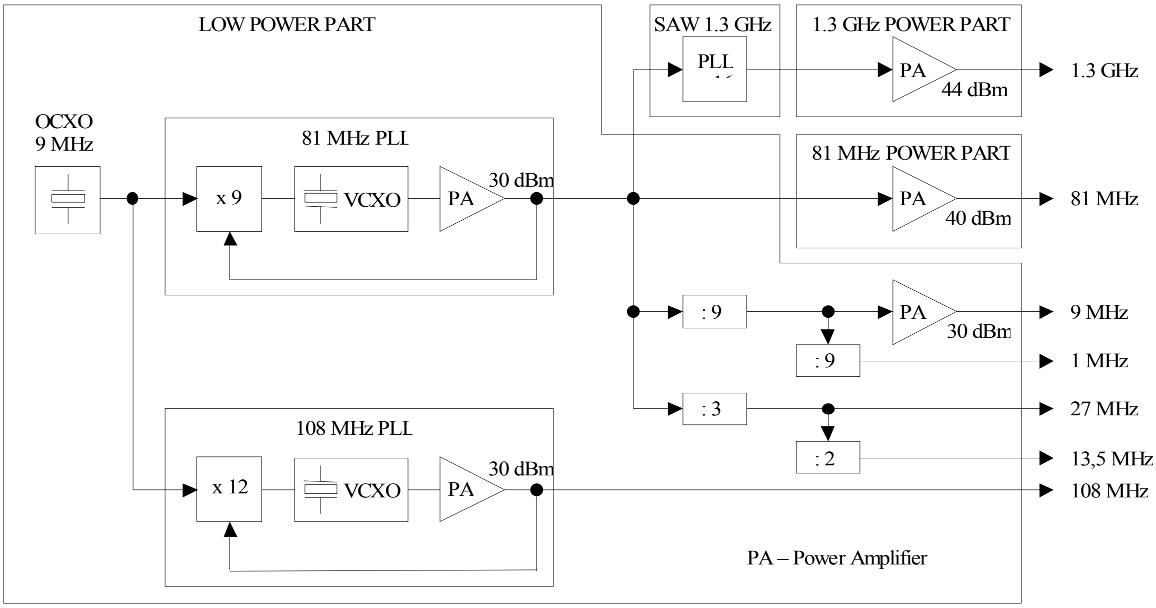


Figure JRA1.9.9: The block diagram of frequency distribution system

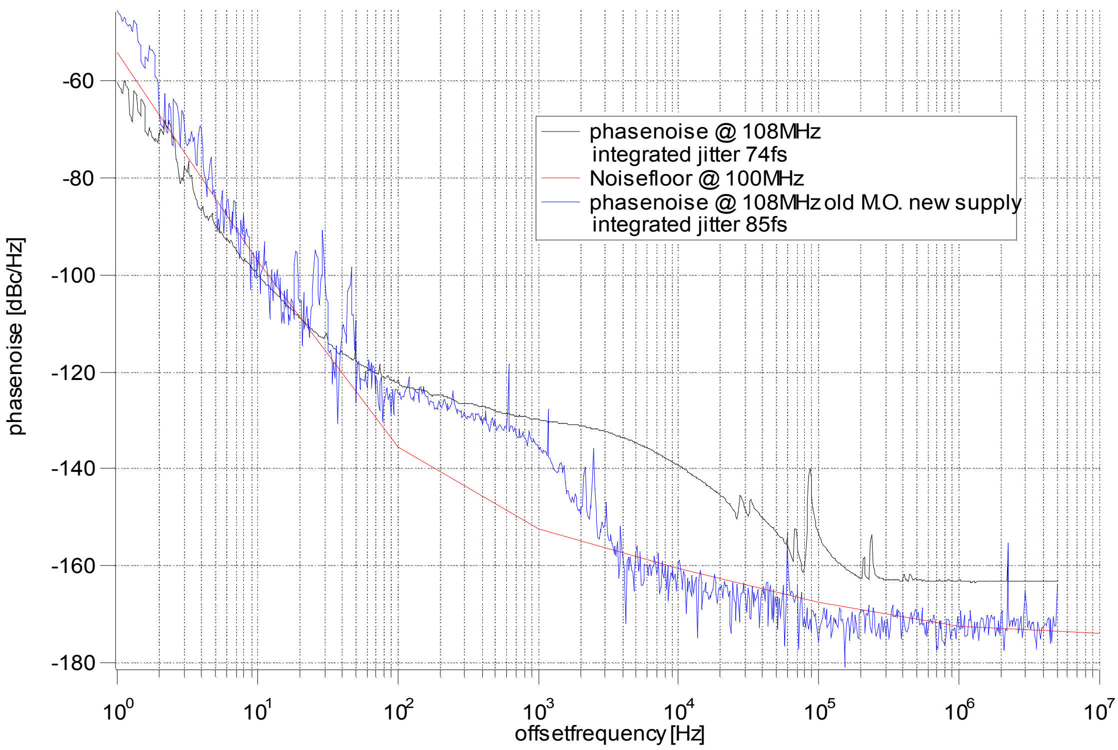


Figure JRA1.9.10: Stability of 81MHz frequency output of the MO.

Milestones and deliverables: Final report on "New LLRF hardware components"
Significant achievements and impact: Development of a new frequency distribution system.
Deviations from schedule: None

JRA1.9.4 Software

JRA1.9.4.1 Data management development

Progress: In line with schedule.
Task completed in 2005 and final report published. The database is currently under tests in DESY – Hamburg.

Milestones and deliverables: None defined in contract for this period
Significant achievements and impact: Database and supporting programs installed and exercised.
Deviations from schedule: None

JRA1.9.4.2 RF Gun control

During the reporting period the new FPGA based RF gun controller was developed together with control algorithms. The field of the RF gun at FLASH is well stabilized for SASE operation. For RF pulse lengths of the order of 100 μs PI control alone is sufficient. Longer RF pulses and bunch trains require AFF control in addition.

Milestones and deliverables: Final report on “RF Gun Control”
Significant achievements and impact: Development of FPGA based control system for rf gun.
Deviations from schedule: None.

JRA1.9.5 Overall Progress of Work Package 9

N°	Task Name	2006–2007
9	**WP9 LOW LEVEL RF (LLRF)**	
9.1	**Operability and technical performance**	
9.1.1	**Transient detector**	
9.1.1.1	Define requirements	
9.1.1.2	Electronics design	
9.1.1.3	Build prototype and evaluate	
9.1.1.4	Final design of detector	
9.1.1.5	Installation and commissioning	
9.1.1.6	Test with beam	
9.1.1.7	**Report on transient detector test**	08.12.
9.1.2	**LLRF Automation**	
9.1.2.1	Dialogue with industrial experts	
9.1.2.2	Develop full specification	
9.1.2.3	Implement FMS for subsystems	
9.1.2.4	Test and evaluation	
9.1.2.5	Implement improvements	
9.1.2.6	Evaluation and acceptance by operators	
9.1.2.7	**Report on LLRF atomization design**	23.06.
9.1.3	**Control optimization**	
9.1.3.1	Specification of system	
9.1.3.2	Conceptual design of controller	
9.1.3.3	Performance simulation	
9.1.3.4	Implementation in DSP hardware	
9.1.3.5	Implementation and tests on TTF	
9.1.3.6	**Evaluation of test results**	13.10.
9.1.4	**Exceptional handling routines**	
9.1.4.1	Specification	
9.1.4.2	Design of exceptional handler	
9.1.4.3	Implementation and test on TTF	
9.1.4.4	**Report on exceptional handler operation**	2.
9.2	**LLRF cost and reliability study**	
9.2.1	**Cost and reliability study**	
9.2.1.1	Identify cost drivers of present LLRF	
9.2.1.2	Develop cost reduction ideas	
9.2.1.3	Build prototypes and evaluate	
9.2.1.4	Final design of LLRF system	
9.2.1.5	**Complete design of LLRF system for reduce cost**	29.09.
9.2.2	**Radiation damage study**	
9.2.2.1	Identify critical electronics issues	
9.2.2.2	Evaluate TESLA radiation	
9.2.2.3	Develop tests for components	
9.2.2.4	Procure and assembles test set up	
9.2.2.5	Data acquisition from radiation tests	
9.2.2.6	Analyze results and develop countermeasures	
9.2.2.7	Implement countermeasures and verify	
9.2.2.8	**Report on radiation damage studies**	27.10.
9.3	**Hardware**	
9.3.1	**Multichannel downconvertor**	
9.3.1.1	Study and compare technologies	
9.3.1.2	Select optimum PCB design	
9.3.1.3	Build prototype and evaluate	
9.3.1.4	Finalize multichannel downconverter	
9.3.1.5	Determine characteristics	
9.3.2	**Third generation RF control**	
9.3.2.1	Integrate system generator with VHDL	
9.3.2.2	Complete specification	
9.3.2.3	Demonstrate simulator	
9.3.2.4	Final design of RF electronic board	
9.3.2.5	Evaluate performance	
9.3.3	**Stable frequency distribution**	
9.3.3.1	Complete specification	
9.3.3.2	Concept ional design of frequency	
9.3.3.3	Build prototype and evaluate	
9.3.3.4	Final design	
9.3.3.5	Procurement and assembly of subsystems	
9.3.3.6	Installation and commissioning	
9.3.3.7	Performance test with beam	
9.3.3.8	**Report on new LLRF hardware components**	01.03.

N°	Task Name	2006–2007
9.4	**Software**	
9.4.1	**Data management development**	
9.4.1.1	Specification	
9.4.1.2	Conceptional design with DOOCS	
9.4.1.3	Prototype	
9.4.1.4	User evaluation	
9.4.1.5	Finalize design	
9.4.1.6	Implementation in TTF	
9.4.1.7	**Report on data management developments**	
9.4.2	**RF gun control**	
9.4.2.1	Write specification	
9.4.2.2	Design of controller	
9.4.2.3	Procurement and assembly	
9.4.2.4	Installation and test	
9.4.2.5	**Report on RF gun control tests**	06.10.

JRA1.10 Work Package 10: Integrated RF tests in a Horizontal Cryostat

JRA1.10.1 Activity Status

At the beginning of 2006 we dedicated our efforts to injecting RF power into a fully equipped 9-cell cavity (C-45 from DESY) installed in the horizontal cryostat CRYHOLAB. An electronic device has been developed to generate a 200 μs pre-pulse necessary to shorten the cavity filling time and to achieve an RF flat top for 800 μs (Fig. JRA1.10.1).

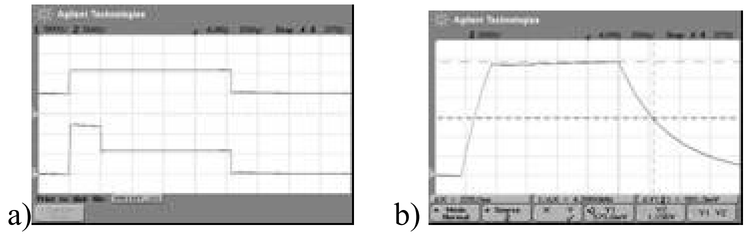


Figure JRA1.10.1: (a) injected RF power with pre-pulse (total length time: 1 ms),

(b) Flat top (800 μs) on transmitted RF power

After coupler conditioning, the pulsed RF power (P=70 kW to 130 kW, 800 μs, 0.87 Hz) with pre-pulse (4P, 200 μs) was injected into the 9-cell cavity cooled down to 1.7 K. We obtained the Q_0 (E_{acc}) curve using transmitted power (P_t) and cryogenic measurements to determine cavity losses (P_{cav}). The maximum accelerator field (~ 25 MV/m) is limited by field emission with X-rays detected (fig. JRA1.10.2).

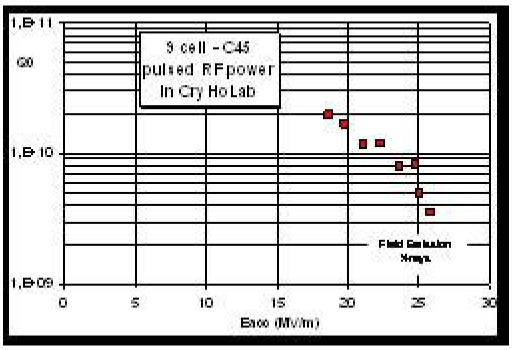


Figure JRA1.10.2: Quality Factor Q_0 versus Accelerating Field E_{acc} for C45 cavity

Under such conditions, compensation of Lorentz Force detuning has been achieved (Fig. JRA1.10.3) using NOLIAC and PICMA piezo-electric devices, characterized by IPN Orsay and assembled on the Cold Tuning System CTS (figure 10.4) developed by CEA Saclay in WP8.

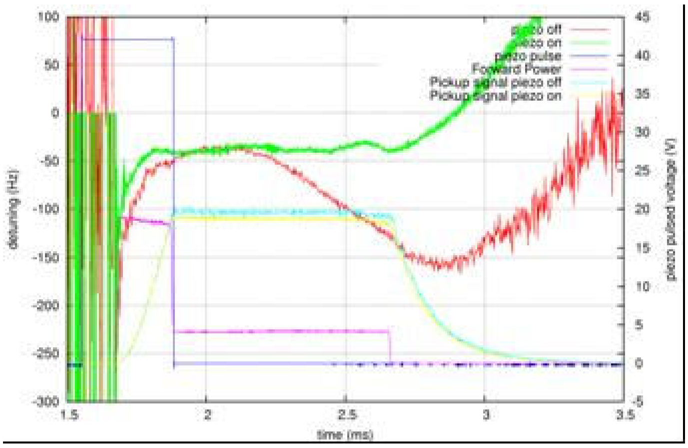


Figure JRA1.10.3: Lorentz Force Detuning for E_{acc}= 20 MV/m (red curve). Compensation using piezoelectric Cold Tuning System CTS (green curve).

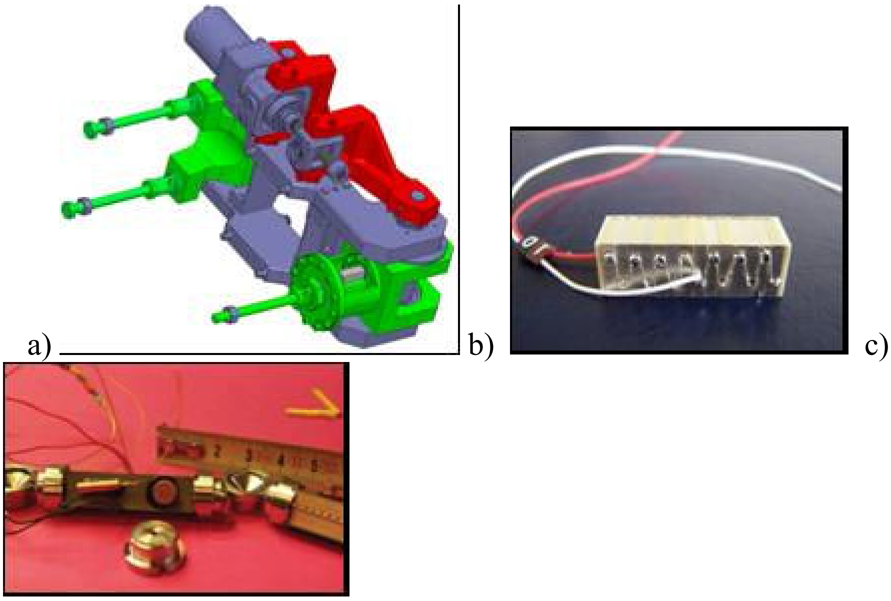


Figure JRA1.10.4: Cold Tuning System (CTS) equipped with (a) Noliac or (b) PICMA (c) piezo-electric.

A third series of tests is planned using a magneto-strictive tuner. A mechanical adaptation to install it on CTS is under manufacture (Fig. JRA1.10.5).

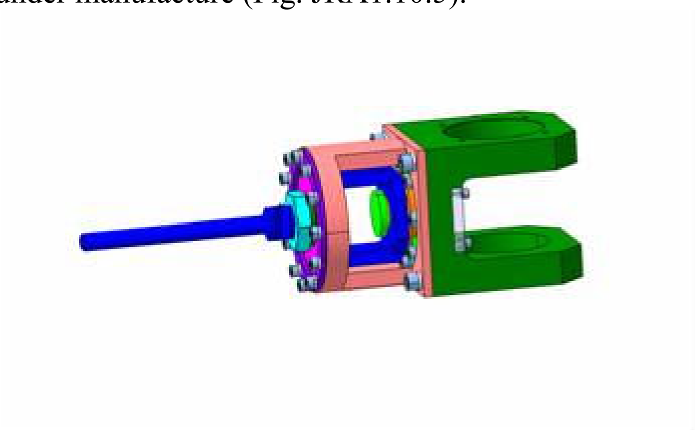


Figure JRA1.10.5: CTS Adaptation for Magnetostrictive fast tuner.

Experiments in CryHoLab were stopped at the end of May 2006 due to the transfer of RF Infrastructure transfer from "l'Orme des Merisiers" area to the main Saclay site. They will restart in the beginning of 2007. Re-assembly of the test facility is in progress (Fig.JRA1.10.6) with probably one month delay compared to the initial schedule.

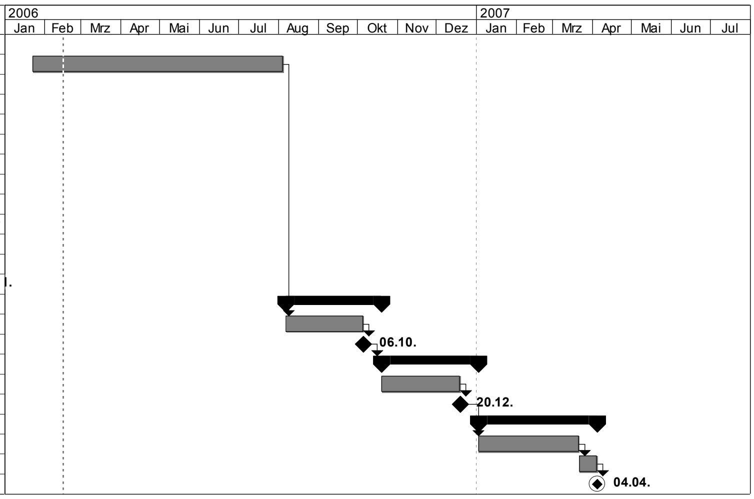
Some modifications are being made to improve:

- the diagnostic tool with new high accuracy flow-meters,
- the stability of the Helium bath pressure at 1.7 K using a new regulation valve.


Figure JRA1.10.6: Re-installation of the helium compressor and vacuum pumping system (left) and the CryHoLab area (right).

JRA1.10.2 Overall Progress of Work Package 10

N°	Task Name
10	**WP10 CRYOSTAT INTEGRATION TESTS**
10.1	Displace CRYHOLAB
10.2	**CRYHOLAB adaption to 9 cell**
10.2.1	Mechanical adaption
10.2.2	Low performance cavity and coupler
10.2.3	Assembly in CRYHOLAB and cryogenic test
10.2.4	High performance coupler - High power pulsed test
10.2.5	Magnetic shielding with cryoperm
10.3	**Integration tests in cryostat (1st test)**
10.3.1	CEA Cold Tuning System + Pezo (Assembly + warm te
10.3.2	Installation of 9-cell & coupler - Cooldown
10.3.3	Cold test in CryHoLab
10.3.4	Evaluate experimental results
10.4	**Integration tests in cryostat (2nd test)**
10.4.1	Magnetostrictive tuner
10.4.2	Evaluate experimental results
10.5	**Integration tests in cryostat (3rd test)**
10.5.1	Piezoelectric tuner
10.5.2	Evaluate experimental results
10.6	**Integration tests in cryostat (4th test)**
10.6.1	New coupler from LAL
10.6.2	Evaluation of results
10.6.3	**Final evaluation**



JRA1.11 Work Package 11: Beam Diagnostics

JRA1.11.1: Beam Position Monitor (CEA)

Status of activity

1. Development of the re-entrant RF BPM

The activity of this year was dedicated to the simulations, the installation, the calibration and the first beam tests of a new re-entrant beam position monitor (BPM) located in the FLASH tunnel at DESY at room temperature. Moreover, some beam tests were carried out on the re-entrant BPM installed in cryo-module ACC1.

I-1 Beam tests on the BPM installed in cryo-module ACC1

In March 2006, an additional calibration operation was carried out on the BPM installed in ACC1. TTF2 was operated in single bunch mode for these measurements which produced statistics and correlations. Two methods were used to calibrate this BPM, called 9ACC1.

The first method uses steerers to move the beam. The setting and the relative beam position are calculated by using a transfer matrix between the steerers and the BPM (composed of drift spaces and accelerating cavities): $\Delta x = R12 * \Delta x'$ where $\Delta x'$ is the angle at the steerer. The HOMs (Higher Order Modes) of cavity 8 installed in the cryomodule ACC1, were minimized by using steerers to move the beam. This minimization permitted adjustment of the BPM center with respect to the beam. The beam tilt was neglected due to the proximity of BPM 9ACC1and cavity 8. An offset was added in the software to have a slope around 1 and to demonstrate the system linearity.

The second method uses 3 BPMs. The relative beam position at the re-entrant BPM (9ACC1) is calculated by extrapolation from the other two BPM readings.

With the first calibration method (transfer matrix), 9ACC1 shows a linear range around 3-4 mm before saturation. We suppose that this saturation comes from the amplifier or ADC saturation.

The second method gives some results which are not very linear in a range of 3-4 mm. The problem may come from long distance between the first and second BPM. In Fig.JRA1.11.1, the plots of the predicted position calculated with the first method vs the position read by 9ACC1, on X and Y channels are presented:

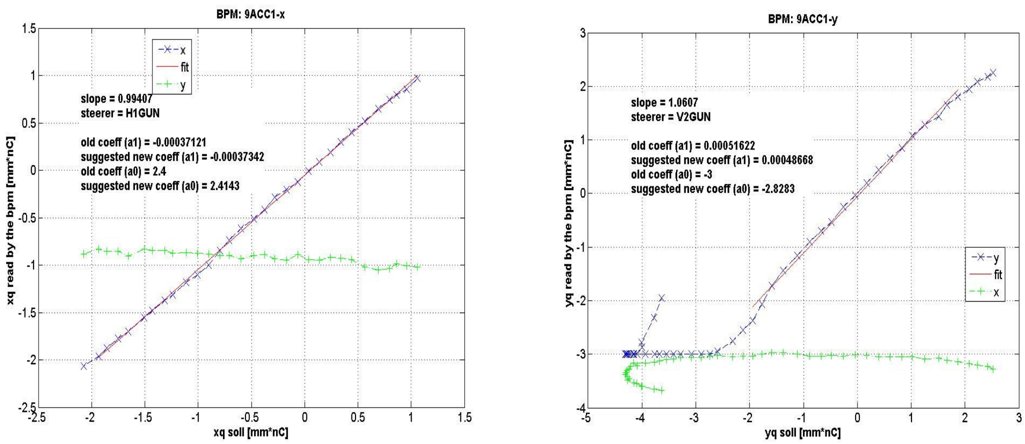


Figure JRA1.11.1: Position read by 9ACC1 vs. the predicted position.

The raw RMS resolution of the system, measured directly from 9ACC1, is around 50µm on the X channel. By using the correlation between different BPMs, the beam jitter can be cancelled and the real resolution can be estimated to be around 20µm. On the Y channel, the resolution is around 30µm without the beam jitter and around 70µm as a raw measurement.

I-2 Estimation of the prototype absolute resolution.

The resolution is limited by the signal to noise ratio of the system. The signal voltage of the BPM is determined by the beam's energy loss to the "TM110" mode and by the external coupling of the coaxial cable.

The noise comes from the thermal noise from the components used in the signal processing. The thermal noise of a system is given by the following equation

$$P_{th} = k_b * T * BW \qquad (1)$$

where k_b is Boltzmann's constant ($1.38*10^{-23}$J/K), BW is defined by the bandwidth of the band pass filter in Hertz, and T is the room temperature in Kelvin.

The noise level present at the output of the cavity BPMs, is amplified by the signal processing devices. To calculate the noise level, the thermal noise is added to the noise factor and to the gain. The noise level is therefore given by the following equation:

$$P_n = NF * G * P_{th}. \qquad (2)$$

where NF is the total noise figure of the circuit, G is the gain of the signal processing and P_{th} is the thermal noise.

The total noise introduced into the system by the electronics can be evaluated by the noise figure in the cascaded system and is applied using the following formula:

$$NF = F_1 + \frac{F_2 - 1}{G_1} + \frac{F_3 - 1}{G_1 * G_2} + ... \qquad (3)$$

where NF is the total noise factor of the signal processing, F_i and G_i are respectively the noise factor and the gain of component i.

To assess the performance of system, a model (cavity+signal processing) was elaborated with Mathcad. The re-entrant cavity model is a resonant RLC circuit. The impulse response of the monopole and dipole modes depends on frequencies and external coupling. The transfer functions of different elements (cables, hybrid couplers, filters, amplifier mixer) which compose the signal processing, are determined by the S parameters measured with a network analyzer. Then those transfer functions are used and combined to simulate the BPM system (RF cavity + signal processing). The transfer function of cables takes the effects of attenuation and dispersion into account.

The results of these simulations show a resolution better that 1 µm for the new re-entrant BPM with a beam offset of +/- 100µm.

I-3 Time Resolution

The damping time can be calculated by using the following formula:

$$\tau_{110} = \frac{1}{\pi * BW}. \qquad (4)$$

where BW is the bandwidth in Hertz .

For bunch to bunch measurements, the time resolution has to be smaller than the interval between bunches of the machine.

Taking an RF cavity, the bandwidth is defined by the relation:

$$BW = \frac{f_{110}}{Q_{l110}}. \qquad (5)$$

where f_{110} is the frequency of the dipole mode and Q_{l110} is the loaded quality factor for the dipole mode. The time resolution is therefore around 9.5 ns for the new re-entrant BPM. It is lower than the separation between bunches on TTF2. The bunch to bunch measurement is therefore possible.

In reality, the rise time of a signal is 3τ. For bunch to bunch measurements, the time resolution has to be smaller than the distance between bunches ΔT. The system has to verify the following equation:

$$6\tau \leq \Delta T \quad (6)$$

To evaluate the time resolution of the BPM system (cavity + electronics), the Mathcad model is used and gives the simulated output signal after synchronous detection. The time resolution is therefore defined by the time interval at 5% of the peak voltage from the baseline.

The time resolution for the new re-entrant BPM was simulated around 40 ns. It confirms the possibility to carry out measurements in multi-bunch mode. Indeed, on TTF2, the time between bunches is 110 ns.

I-4 New monitor installed in beam line and operational

At the beginning of this year, we received the cavity BPM with the feedthroughs (Fig.JRA1.11.2) designed the last year.

Figure JRA1.11.2: Cavity BPM

In spring of 2006, during the maintenance time, the re-entrant BPM was installed on a warm part in the FLASH linac (Fig. JRA1.11.3) at DESY.

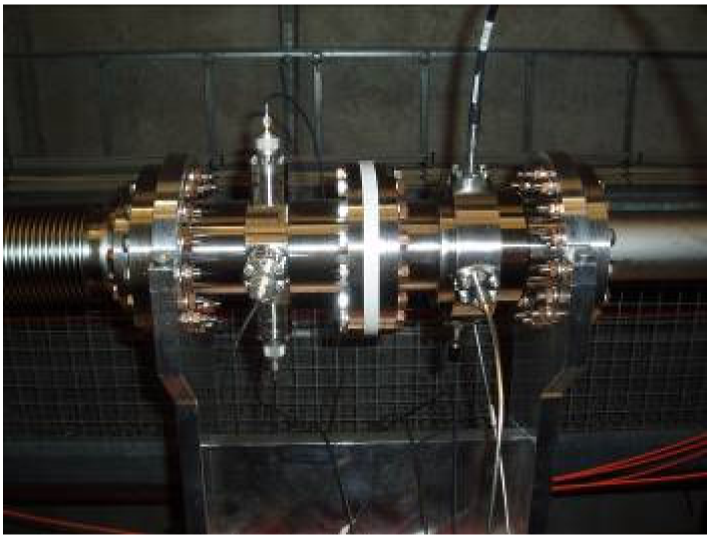


Figure JRA1.11.3a: Re-entrant cavity BPM (right) and button BPM (left) installed in the FLASH linac

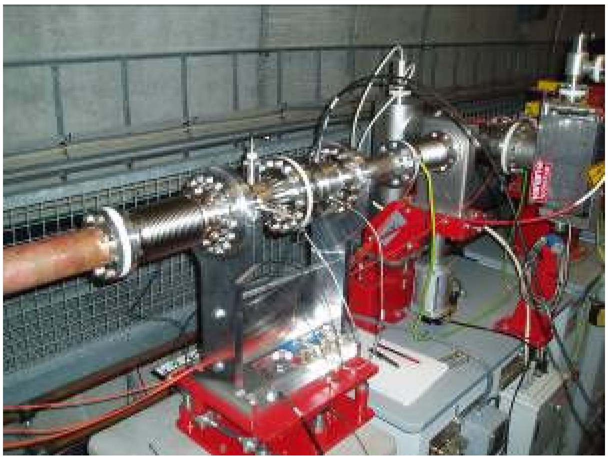


Figure JRA1.11.3b: Re-entrant cavity BPM and subsystem with hybrid couplers and phase shifters installed in the FLASH linac

After mounting, the first RF measurements were carried out to check that the feed-throughs were properly mounted on the cavity. The resonant cavity was first simulated with the software HFSS (Ansoft) to determine its modes and coupling and then it was measured in the laboratory and finally on the linac. The RF measurements, presented in Table 1, provide a comparison that gives information on the sensitivity of the RF characteristics to the mechanical mounting and operating environments.

TABLE 1. RF characteristics of the new re-entrant BPM.

Eigen modes	**F (MHz)**			**Q_l**		
	Calculated	Measured in lab.	Measured on the linac	Calculated	Measured in lab.	Measured on the linac
Monopole mode	1.250	1.254	1255	22.95	22.74	23.8
Dipole mode	1.719	1.725	1724	50.96	48.13	59

The difference in the Q factors can be explained by the boundary conditions which are not the same during the measurements in laboratory and in the tunnel.

The cross-talk was measured to be around 33 dB instead of 41 dB measured in laboratory. This difference could be explained by the fact that the BPM has a rotation/tilt (11.25 degrees) with respect to a button BPM which is very close.

I-5 Calibration of the electronics of the new re-entrant BPM

In summer of 2006, the two subsystems, composing the signal processing, were installed and calibrated:

- a subsystem composed with hybrid couplers, phase shifters and one combiner was installed in the tunnel during a maintenance day. The spectrum analysis of the "delta" signals from the 180° hybrid coupler output shows good common mode rejection. Tuning of the phase shifters gives a high common mode rejection (30 dB at 1.25 GHz).
- the second subsystem (Fig. JRA1.11.4) was installed in the hall. The synchronous and direct detectors, as well as amplifiers and limiters for protection were adjusted to have a linearity range around +/- 10 mm.

Figure JRA1.11.4: BPM subsystem located in the hall

I-6 First beam tests of the new re-entrant BPM

After calibration of the electronics, the first beam tests of the re-entrant BPM were carried out. Our objective was to start the calibration of this BPM, for a high precision beam position measurement in single bunch mode.

As the re-entrant BPM is mounted with a tilt angle of 11.25° with respect to the horizontal direction, a frame rotation change, done by software, is necessary. Fig. JRA1.11.5 shows the first results of this calibration with the frame rotation change.

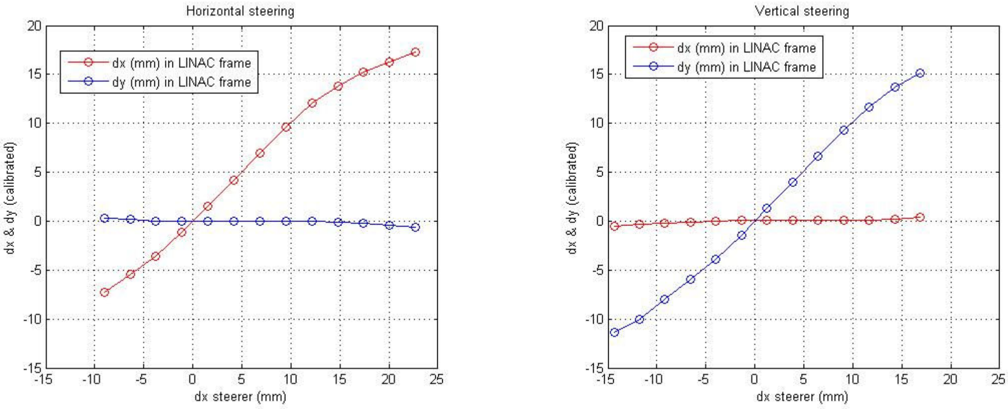


Figure JRA1.11.5: Calibration results in the LINAC frame from horizontal (left) and vertical (right) steering

The re-entrant BPM has, on the X and Y channels, a good linearity over a range of 15 mm but there is an asymmetry and the linearity is better for a positive deviation. This effect is not yet well understood; it may be related to the steering magnets (residual field or saturation). The standard deviation of the calibrated position measurement was plotted for the horizontal and vertical steering (Fig. JRA1.11.6).

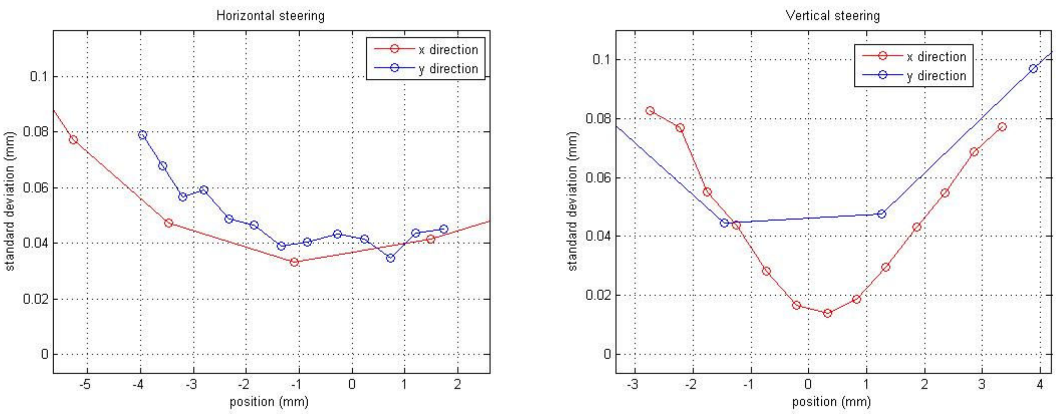


Figure JRA1.11.6: Standard deviation of the position measurement (calibrated)

The raw RMS resolution of the system directly measured by the standard deviation of the readings from the re-entrant BPM (14ACC7) can reach 20 µm on the X channel and around 40 µm on the Y channel, at the BPM centre. But those results also depend on the beam jitter. With simulations, the resolution of this system was determined to be around 15µm.
A second test period was necessary to validate the first results: the same steerers were used; the deviation range was limited to ±4 mm for a more accurate calibration (Figs. JRA1.11.7 and JRA1.11.8).

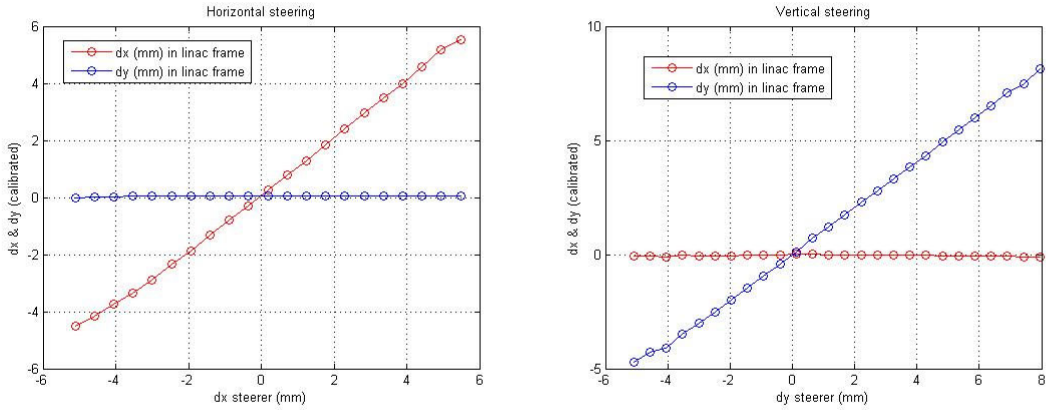


Figure JRA1.11.7: A more accurate calibration results in the LINAC frame from horizontal (left) and vertical (right) steering

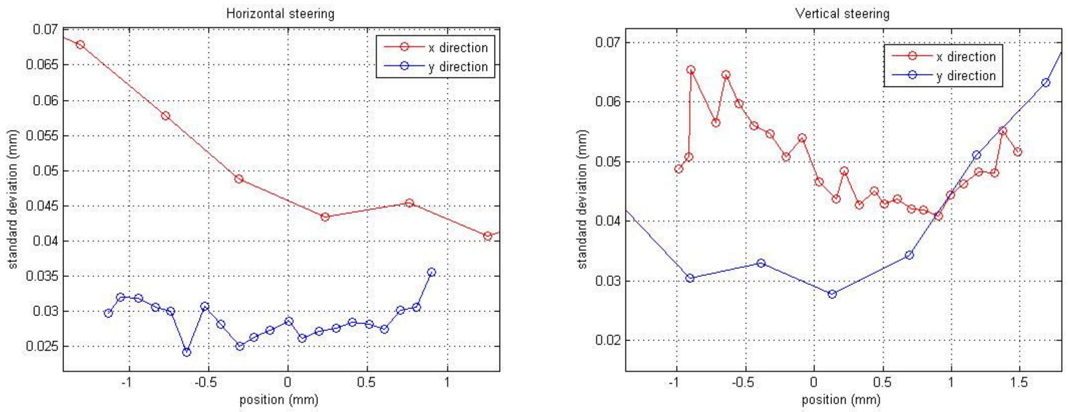


Figure JRA1.11.8: Standard deviation of the position measurement (calibrated)

This second measurement corroborates the first calibration. The linearity in this calibration range is very good for both channels. The minimum standard deviation of the measurements at the BPM centre is around 40 µm for the X channel and around 30 µm for the Y channel.

JRA1.11.2: Beam Emittance Monitor (INFN-LNF and INFN-Ro2)

In the first period of 2006, two blocks of dedicated shifts were assigned to this experiment. We had the possibility to verify the complete system with the beam. The alignment of the optics has to be improved, but the setting was good enough for the first measurements.
The first shifts were used to optimize the beam transport through the by-pass line and to try to obtain the expected beam size at our screen location. The low energy, 450 MeV, and the larger beam size than expected prevented the observation of Diffraction Radiation, but the shifts were useful for the calibration of the optical system with the much more intense Optical Transition Radiation, showing the presence of a strong background due to synchrotron

radiation from the last dipole at more than 50 meters distance, and of the quadrupoles, whose gradient was very high.
This background was not expected, and even if not completely understood, derives from multiple reflections on the pipe surface, showing a much larger angular distribution that what the distance of the magnetic elements would suggest.
In the second set of shifts the energy was higher, about 630 MeV, but still lower than expected. The beam size was still too large, probably due to an imperfectly optimized transport resulting in a higher emittance, so that we were forced to use the largest of the two slits (1 mm width) for which observation of DR was difficult, in particular because the beam was slightly larger than the slit itself. We believe we have found a way to subtract the background by steering the beam out of the screen with the last steerer.
These shifts have taught us that, for the future, hardware shielding of the synchrotron radiation background will be required, a much better transport of the beam will be needed in order to obtain the design beam size and that the ultimate energy of the machine must be reached.

Background Subtraction Procedure
The main limitations during the measurements were given by the background and the large number of hot spots which did not allow us to increase the CCD exposure time.
To separate the background from the beam, the beam needed to be moved out of the screen by using steering magnets upstream of the target. However, since the steered beam hits the beam pipe, this procedure further increases the amount of emitted X-rays. in this regard, an off-line LabView tool, which first eliminates X-rays by selecting a neighbourhood with a 3x3 matrix and then subtracts the background image, has been developed. In order to increase both signal and background intensity, the sum of N images, normalized to the number of images, is analysed.

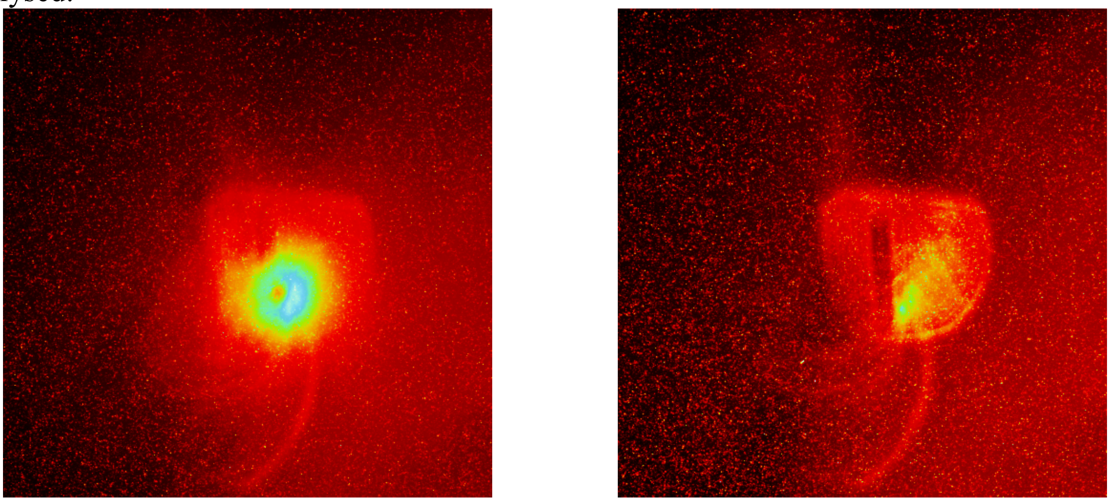


Figure JRA1.11.9: Signal plus background (left) and background image (right).

Fig. JRA1.11.9 shows the OTR angular distribution and the background image on the focal plane. The beam was steered out of the target by an upstream vertical steerer, and the background image was then isolated and recorded to allow its subtraction. Both images are the result of the sum of 20 images taken with 10 bunches per macro-pulse, 0.3 nC per bunch and 2 s exposure time.
Fig. JRA1.11.10 shows the OTR angular distribution after removing X-rays and subtracting the background. The result is a clean image whose profile is the one we expect.

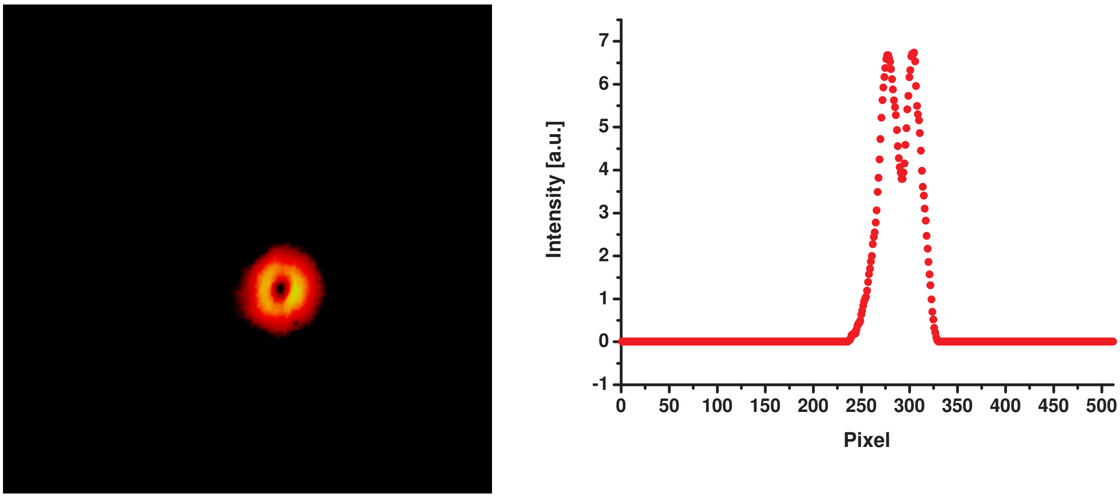


Figure JRA1.11.10: Subtracted OTR angular distribution (left) and its profile (right).

This tool becomes mandatory for the analysis of ODR signals which, being of the same order of magnitude and even weaker than the background, are covered by it.

<u>From OTR to ODR.</u>

The aim of these first measurements was to demonstrate that we are able to detect a difference between OTR and ODR angular distributions.

To do so we used a vertical steerer to change the position of the beam on the screen in order to smoothly go from OTR to ODR emission. To detect ODR as well as to distinguish OTR and ODR, a high quality electron beam, in terms of small transverse emittance, high beam energy and good stability, is required. Unfortunately, during the whole set of measurements, the transverse beam size was too large even for the 1 mm slit. To reduce the emittance, i.e. the beam size, the charge was reduced down to 0.3 nC per bunch, and to increase the signal intensity the number of bunches per macro-pulse was increased to 25. The signal was integrated over 1 s. The nominal beam energy was 620 MeV.

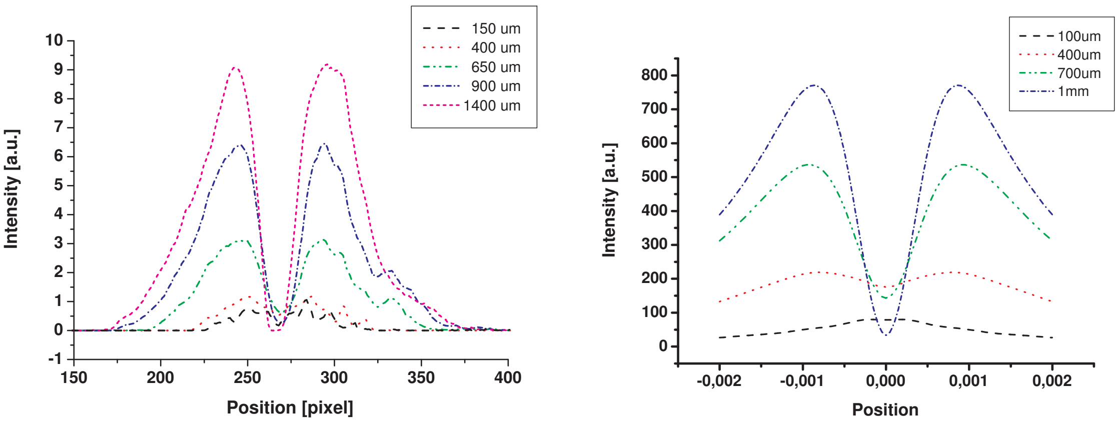


Figure JRA1.11.11: Angular distributions for different positions of the beam with respect to the center of the slit: experiment (left) and simulations (right).

The plot in Fig. JRA1.11.11 (left) shows the angular distribution profiles for five steps. The short dashed curve (magenta) corresponds to the beam at 1.4 mm from the centre of the slit, a condition which gives rise to OTR emission. As the distance decreases the OTR contribution gets lower. The dash curve (black) corresponds to the beam at 150 μm from the centre of the slit: ODR emission is now expected, showing a less pronounced minimum in the angular distribution. A simulation (Fig. JRA1.11.11, right) reproducing the insertion of the slit shows a qualitative agreement with the experimental data.

Signs of ODR.

Only during one of our measurement shifts have we succeeded to have the beam shown in Fig.JRA1.11.12 with a FWHM of 360 μm, but even in this case, when the beam goes through the slit, the tail hits the edges.

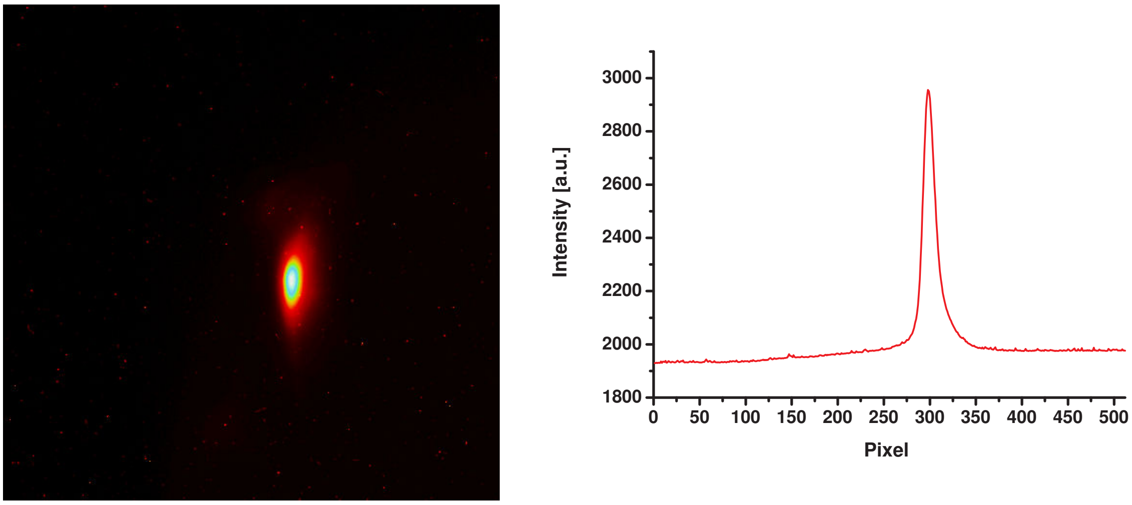


Figure JRA1.11.12: Image of the beam on the OTR screen (left) and its profile (right).

A measurement dedicated to the ODR detection has been performed with this beam transporting 10 bunches, 0.3 nC per bunch through the centre of the 1 mm slit. Several images of both signal and background have been acquired to allow an easier subtraction procedure. The subtracted ODR angular distribution image is shown in Fig. JRA1.11.12 (left), the corresponding profile is plotted in Fig.JRA1.11.12 (right: red dots). A simulation which takes into account an rms beam size of 150 μm, compatible with the given beam, and a negligible angular divergence, shows a good qualitative agreement with the measured ODR profile (Fig.JRA1.11.13, right: straight line).

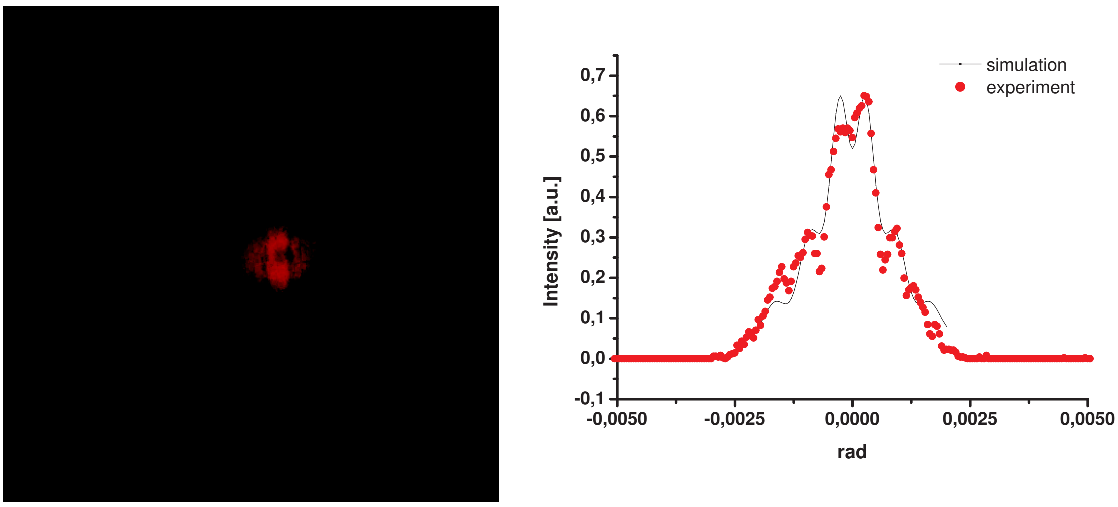


Figure JRA1.11.13: Subtracted ODR angular distribution (left) and its projection in comparison with a simulation (right).

Although these first preliminary measurements do not yet allow us to quantitatively retrieve beam parameters and showed that effort has still be put on improvement of the experimental set-up and background subtraction, they are encouraging and give us confidence to continue the measurements.

Hardware improvements and plans for the next future.
During a FLASH maintenance period in October 2006, a second target, a replica of the first one, was installed. The second target will be used during preliminary adjustment of the beam to avoid damage to the slit used for measurements. In order to reduce synchrotron light we have installed a diaphragm to cut the background in the OTR station before our experimental station. The whole system has been better aligned using a powerful lamp illuminating the back of a screen in a previous station and simulating a far away source. For the next set of measurements, planned in January 2007, we expect to reduce the contribution from X-rays with better shielding of the camera. In addition, an update of the analysis software is planned.

JRA1.11.3: The HOM-BPM Program

The research activity on using the dipolar Higher Order Modes (HOM) of the accelerating superconducting cavities to monitor the beam position along the TTF2-FLASH linac continued with the two main objectives set in 2005:

- to prove the potential of the HOM-BPM instrumentation to monitor the beam orbit through the FLASH cryomodules in order to minimize the bunch emittance growth;
- to measure the cavity centres and relative misalignments within the five TTF cryomodules.

a. Emittance tuning

Wakefields are more harmful for the beam emittance in the low energy part of the linac. An emittance tuning experiment has therefore been conducted when the HOM acquisition electronics was operational in the first module ACC1 of the FLASH linac. A feedback algorithm has been implemented in the control system to steer the beam injection in the ACC1 module (Fig. JRA1.11.14) in such a way that the 16 HOM signals (8 cavities x 2 HOM couplers) are minimized.

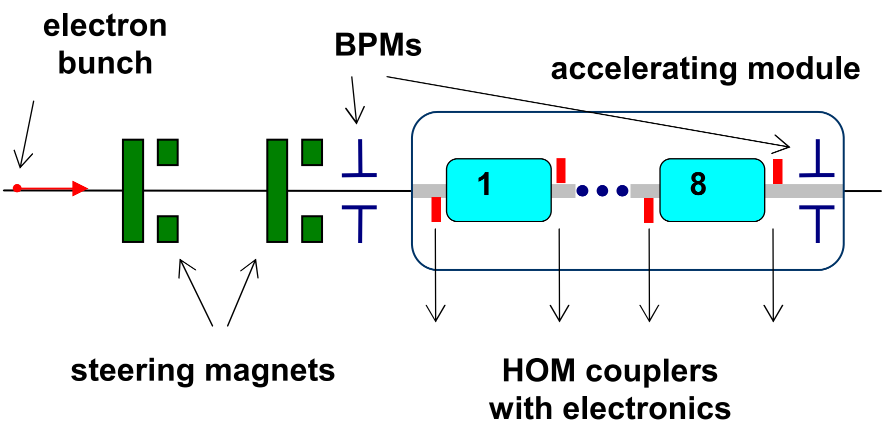


Figure JRA1.11.14: Layout of the beam injection steering in the FLASH ACC1 cryomodule

The result of the feedback experiment is shown in Fig. JRA1.11.15. Remarkably, the 16 HOM signals could be minimized with only 4 free injection steerers. This can be explained by the good relative alignment of the 8 ACC1 cavities. The beam emittance was measured before and after the feedback tuning of the injection trajectory in ACC1: a small decrease of the vertical emittance by 10% was observed after the feedback tuning.

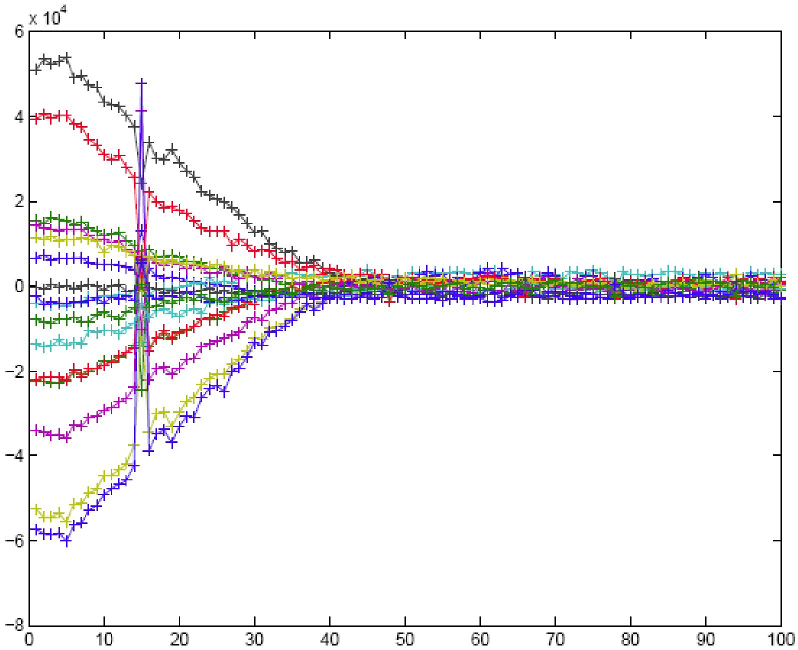


Figure JRA1.11.15: Minimisation of 16 HOM modes (8 cavities times 2 couplers) component amplitudes in ACC1 module during feedback, vs. machine cycles.

1.2 Cavity relative misalignments

The capability of measuring the cavity centres (actually the electric centres of the dipolar HOM) with a precision better than 50 µm was already demonstrated in 2005. With the dedicated SLAC acquisition electronics installed on the FLASH linac since then, the HOM-BPM resolution was improved and measured to be as low as 5 µm, as shown in Fig.JRA1.11.16. The resolution is estimated from the dispersion around a perfect linear correlation of the measurements of the beam position in cavity 2 either directly or as predicted from the beam position in the neighbouring cavities 1 and 8. These measurements have been performed in the ACC4 cryomodule.

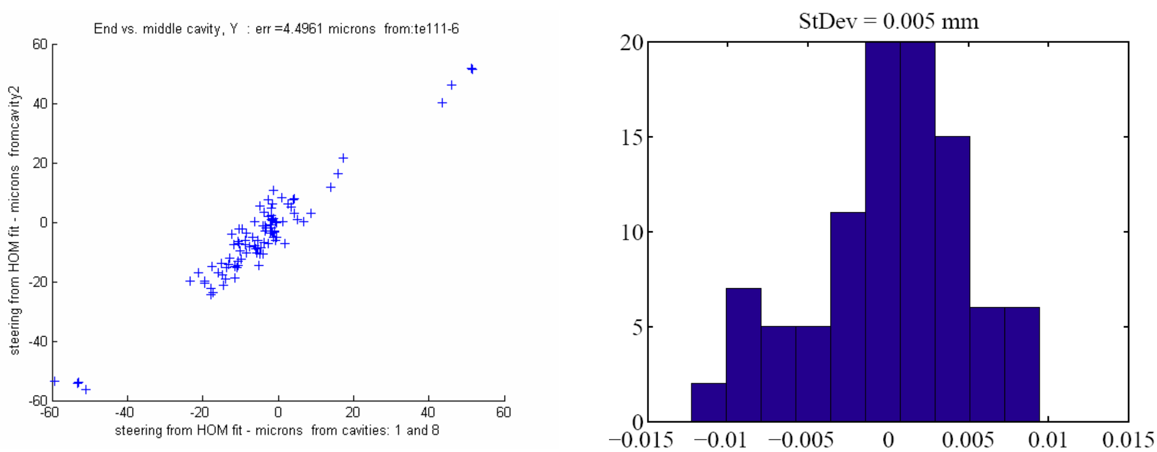


Figure JRA1.11.16: Correlation plot (left) and histogram (left) of the residual of the beam position (in mm) measured in cavity 2 against the prediction from two adjacent cavities 1 and 8, using the TE111-6 mode

Assuming that the measurement precision on the position of the HOM electric centres is also improved to the 5 µm level of the HOM-BPM resolution, the predicted 300 µm cavity relative alignment in a cryomodule can be verified by measuring the relative alignment of the cavity HOM centres with sufficient precision. To avoid RF steering and focussing effects on low energy bunches, this measurement has been carried out at high energy in the ACC4 and ACC5 cryomodules. The relative horizontal and vertical positions of the eight centres of the TE111-6 dipolar polarizations are plotted in Fig.JRA1.11.17: the rms alignment of the cavities with respect to each other is 105 µm and 215 µm (for *x* and *y*, respectively) for ACC4, and 241 µm and 203 µm for ACC5. It is important to note that measurements using other modes are expected to yield different results. According to theses results, the 300 µm pre-alignment specification is fulfilled.

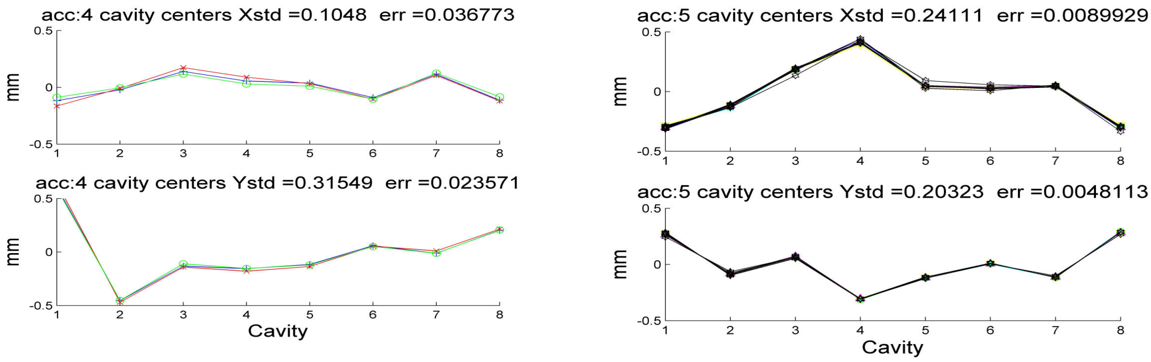
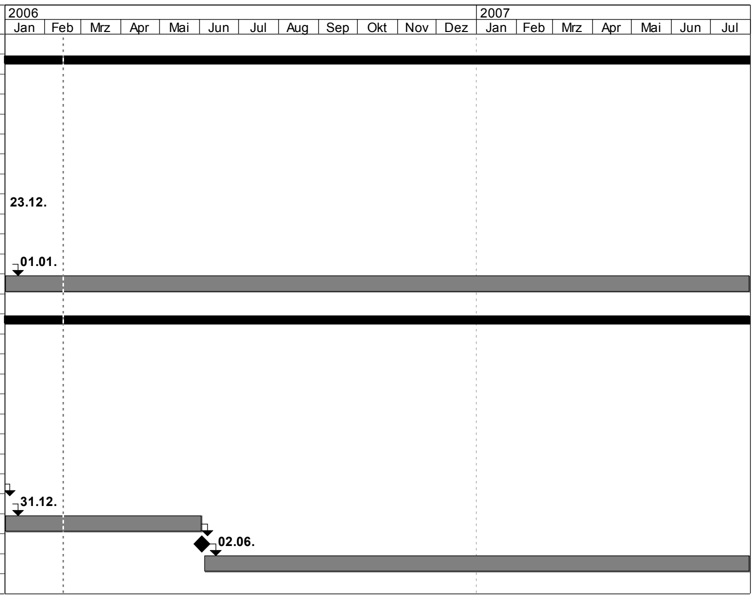


Figure JRA1.11.17: Measurement of cavity misalignments (in mm) in the ACC4 (left) and ACC5 (right) cryomodules (top, horizontal; bottom, vertical), using the TE111-6 mode in every cavity.

JRA1.11.3 Overall Progress of Work Package 11

N°	Task Name
11	**WP 11 BEAM DIAGNOSTICS**
11.1	**Beam position monitor**
11.1.1	**Present BPM installed in TTF module**
11.1.2	Cryogenic measurements on BPM
11.1.3	Beam tests of BPM on TTF
11.1.4	Design of BPM Cavity
11.1.5	Design of BPM cavity ready
11.1.6	Fabrication of BPM Cavity
11.1.7	BMP cavity ready
11.1.8	Development of new hybrid coupler and electronics
11.1.9	Design of Digital Signal Processing
11.1.10	**New BPM ready for Installation**
11.1.11	Beam Tests with new BPM
11.1.12	**Evaluation of BPM operation**
11.2	**Beam Emittance Monitor**
11.2.1	Slit width simulations
11.2.2	Slit design
11.2.3	Optics simulations
11.2.4	Optics appropriations
11.2.5	System assembly and tests
11.2.6	Mechanical assembly at TTF
11.2.7	Optical assembly at TTF
11.2.8	Integration of controls into TTF
11.2.9	**Ready for beam test in TTF**
11.2.10	Beam tests at TTF
11.2.11	Evaluate first beam test result
11.2.12	Successive measurements
11.2.13	**Final evaluation**



JRA1.12 Significant Achievements

Significant progress has been made in all work-packages of SRF during 2005. The following points are noteworthy:

- The construction of a spinning machine for seamless cavity production (WP3) is now complete.
- Improved understanding of the “ageing” of electro-polishing mixtures (WP5) will probably lead to improvements in this important cavity preparation technique. An automated electro-polishing system is now operating at DESY.
- New active tuners (WP8) have been developed at CEA and INFN, using piezo-electric cells, which will be ready for tests with cavities early in 2006. The application of a piezo-electric tuner has been demonstrated to reduce Lorentz force de-tuning from 180 Hz to less than 10 Hz on a TTF cavity operating at 20 MV/m.
- Several advances have been made in Low Level RF development (WP9) where, to give but one example, optimal controlling routines have been developed to provide RF phase stability of 0.03 degrees and amplitude stability of $3x10^{-4}$ on a TTF-VUV module.
- Both the hardware and software for the beam emittance monitor of WP11 are now complete ahead of schedule. The monitor has been mounted on the TTF beam-line and is awaiting allocation of beam time for the first tests.

JRA1.13 List of all milestones and deliverables (D) during the reporting period

	Task	Deliverables	Title	planned end	expected end	Reference	task leader	contractor
1	**2.1.7**	**Final Report (D)**	**Final Report on reliability issue**	**30/12/05**	**29/09/06**	**CARE-Report-06-029-SRF**	L..Lilje	DESY
2	**3.1.3.5**	**Final Report (D)**	**Spinning parameters defined**	**18/05/06**	**31/12/06**	**CARE-Report-07-012-SRF**	E.Palmieri	INFN-Lnl
3	**3.1.4.3**	**Final Report (D)**	**1-cell spinning parameters defined**	**07/12/06**	**31/12/06**	delayed	E.Palmieri	INFN-Lnl
4	**5.1.1.4**	**Final Report (D)**	**Best EP parameters**	**15/01/06**	**15/01/06**	**CARE-Report-06-010-SRF**	C.Antoine	CEA
5	**5.2.1.3.5**	**Final Report (D)**	**Process parameters fixed**	**31/03/06**	**31/10/06**	**CARE-Report-07-013-SRF**	A.Matheisen	DESY
6	**5.3.3.5**	**Final Report (D)**	**Automated EP is defined**	**13/02/06**	**31/12/06**	**CARE-Report-07-010-SRF**	E.Palmieri	INFN-Lnl
7	**5.4.2.4**	**Final Report (D)**	**Cleaning parameters fixed**	**30/06/06**	**30/11/06**	**CARE-Report-07-011-SRF**	D.Reschke	DESY
8	**8.4.8**	**Final Report (D)**	**Report on IN2P3 tuner activities**	**07/08/06**	**31/12/06**	In preparation	M.Fouaidy	CNRS
9	**9.3.3.8**	**Final Report (D)**	**Report on new LLRF hardware comp**	**01/03/06**	**30/11/06**	**CARE-Report-06-013-SRF**	R.Romaniuk	WUT-ISE
10	**9.4.2.5**	**Final Report (D)**	**Report on RF gun control tests**	**06/10/06**	**30/11/06**	**CARE-Report-07-009-SRF**	T.Jezynski	WUT-ISE
11	**11.1.10**	**BPM Protot.(D)**	**New BPM ready for Installation**	**01/01/06**	**finished**	**CARE-Report-06-030-SRF**	C.Simon	CEA
12	**11.3**	**Final Report (D)**	**Evaluation of HOM-BPM operation**	**30/12/06**	**finished**	**CARE-Report-06-034-SRF**	O. Napoly	CEA

JRA1.14 List of major meetings organized under SRF during the reporting period

Date	Title/Subject	Location	Number of attendees	Website address
20-21 Jan 2006	IEEE-SPIE ELHEP-ISE XVII SYMPOSIUM 2006	Warsaw, Poland	40	http://wilga.ise.pw.edu.pl/20061/downloads/program/program.htm
March 28-31, 2006	CARE-JRA1-WP4 (Thin film production) Collaboration Meeting	INFN, Tor Vergata University, Rome	8	None
May 12, 21006	WP 6.3: DC field emission scanning	University of Wuppertal	4	None
May 11, 2006	Parameters of electropolishing / coordination of work task 5.1/5.2	DESY	4	None
May 12, 2006	WP6.3: DC field emission scanning	University of Wuppertal	4	None
May 22-24, 2006	MIXDES 2006, special CARE session	Gdynia, Poland	300	www.mixdes.org
May 22-28, 2006	IEEE-SPIE WILGA Conference of Electronics for HEP	WILGA, Poland	200	http://wilga.ise.pw.edu.pl
June	EPAC	Edinburgh		http://epac06.org/
July 2, 2006	Status of the Project and Future Steps	Frascati	6	-
August	LINAC	Knoxville		http://www.sns.gov/linac06/
Sept 5, 2006	Evaluation of Previous Shift Results	Desy	5	
Sept 7-8, 2006	CARE-JRA1-WP4 (Thin film production) Collaboration Meeting	IJP Swierk, Poland	5	None
Oct 9-12, 2006	Int. Workshop on thin films and pushing the limits od RF superconductivity	Padua/Legnaro	64	http://www.lnl.infn.it/~master/thinfilms
Oct 10, 2006	WP 6.3: DC field emission scanning	DESY	4	None
Nov 14-15, 2006	JRA-SRF annual meeting 2006	Rome/Frascati	45	https://indico.desy.de/conferenceDisplay.py?confId=141
Nov 14-15, 2006	The third annual CARE Meeting	Rome/Frascati	200	http://www.lnf.infn.it/conference/care06/index.htm

1.4.2 JRA2: Charge Production with Photo-Injectors (PHIN)

Main Objectives : rform Research and Development on charge-production by interaction of laser pulse with material within RF field and improve or extend the existing infrastructures in order to fulfil the objectives. Coordinate the efforts done at various Institutes on photo-injectors.

The list of participants and their implication in the PHIN Work Packages (**C**: Coordination, X: Participation) is given in the table below. The overall management is done by INFN-LNF and by CERN.

Number	Participant	WP1 M&C	WP2 CP	WP3 LASER	WP4 GUN	Person-months
3	**CNRS**	X	X	X	X	175
	CNRS-LAL	X	X	X	**C**	111
	CNRS-LOA		X		X	64
9	**FZR**	X			X	16 (3.5)
10	**INFN**	**C**		X	X	59.4 (24.9)
	INFN-LNF	**C**		X	X	39.4 (13.4)
	INFN-Mi			X		20 (11.5)
11	**TEU**		X	X		
17	**CERN**	**C**	X	X	**X**	51 (3)
20	**CCRLC**	X		**C**		8.7
	CCLRC-RAL	X		**C**		

JRA2.1 Work Package 1: Management and Communication

JRA2.1.1 Meetings and Publications

SRF gun collaboration meeting on March 24, 2006 at FZR, Dresden
SRF gun collaboration meeting on July 24, 2006 at BESSY, Berlin
CERN – RAL Visit (technical discussions) 15 to 18/8/2006
CERN – LAL Meeting (technical discussions): 13/09/2006
INFN – LOA Meeting on "Future INFN-LOA collaboration on plasma acceleration: PHIN evolution" Frascati 18 May 2006
CARE Annual Collaboration Meeting Frascati, 15-17 November 2006
PHIN Collaboration Meeting Parallel section of CARE06 Frascati 15-17 November 2006
Annual Photo Injector Collaboration Meeting on December 15, 2006 at MBI, Berlin

JRA2.1.2 list of talks and conference contributions

1- Development of a Superconducting RF Photoelectron Injector
J. Teichert
DPG-Tagung, Vacuum Science and Technology, Dresden, Germany, March 27, 2006

2- Advantages of the superconducting 3 1/2 cell gun at Rossendorf
F.Staufenbiel, A. Arnold, H. Büttig, P. Evtushenko, D. Janssen, U. Lehnert, P. Michel, K. Möller, P. Murcek, Ch. Schneider, R. Schurig, J. Teichert, R.Xiang, J. Stephan, W.-D. Lehmann, T. Kamps, D. Lipka, I. Will, V. Volkov
37th ICFA workshop, Hamburg, Germany, May 15-18, 2006

3- 3-1/2 Cell Superconducting RF Gun Simulations
C.D. Beard, J.H.P. Rogers, F. Staufenbiel, J. Teichert,
EPAC 2006, Edinburgh, Scotland, June 26 – 30, 2006

4- Progress of the Rossendorf SRF Gun Project
D. Janssen, A. Arnold, H. Buettig, R. Hempel, U. Lehnert, P. Michel, K. Moeller, P. Murcek, Ch. Schneider, R. Schurig, F. Staufenbiel, J. Teichert, R. Xiang, T. Kamps, D. Lipka, F. Marhauser, W.-D. Lehmann, J. Stephan, V. Volkov, I. Will,
EPAC 2006, Edinburgh, Scotland, June 26 – 30, 2006

5- Photocathode Laser for the Superconducting Photo Injector at the Forschungszentrum Rossendorf
I. Will, G. Klemz, F. Staufenbiel, J. Teichert,
FEL 2006, Berlin, Germany, Aug. 27 – Sept. 01, 2006

6- Cryomodule and Tuning System of the Superconducting RF Photo-Injector
J. Teichert, A. Arnold, H. Buettig, R. Hempel, D. Janssen, U. Lehnert, P. Michel, K. Moeller, P. Murcek, Ch. Schneider, R. Schurig, F. Staufenbiel, R. Xiang, T. Kamps, D. Lipka, G. Klemz, W.-D. Lehmann, J. Stephan, I. Will,
FEL 2006, Berlin, Germany, Aug. 27 – Sept. 01, 2006

7- First RF-Measurements at the 3.5-Cell SRF-Photo-Gun Cavity in Rossendorf
A. Arnold, H. Buettig, D. Janssen, U. Lehnert, P. Michel, K. Moeller, P. Murcek, Ch. Schneider, R. Schurig, F. Staufenbiel, J. Teichert, R. Xiang, T. Kamps, D. Lipka, F. Marhauser, G. Klemz, W.-D. Lehmann, A. Matheisen, B. van der Horst, J. Stephan V. Volkov,
FEL 2006, Berlin, Germany, Aug. 27 – Sept. 01, 2006

8- Cs_2Te Photocathodes for CTF3 Photoinjectors, R. Losito Workshop on High QE Photocathodes for RF Guns, INFN-LASA, 4 to 6/10/2006

9- Laser plasma accelerators
V. Malka (plénière), Advanced Accelerators Concepts, July 10-14, Lake Geneva, Wisconsin (2006).

10- Desing, test and premise of laser plasma accelerators
V. Malka, (plénière) European Particle Acceleration Conference, June 26-30, Edimbrugh, UK (2006).

11- Compact laser plasma accelerators for science and society
V. Malka, "Many-Particle Dynamics and Precision Spectroscopy: Trends and Applications", March 30-31, Heidelberg (2006).

12- Laser-plasma wakefield acceleration: concepts, tests and premises
V. Malka, J. Faure, Y. Glinec, A. Lifschitz, European Particle Accelerator Conference EPAC, Edimburgh, June 26-30 (2006)

13- Production and applications of quasi mono energetic electron bunches in Laser-plasma accelerator
Y. Glinec, V. Malka, J. Faure, A.F. Lifschitz, Superstrong Fields in Plasma, AIP Conf. Proceedings 827 (2006).

14- Simulations of pre-modulated e-beams at the photocathode of a high brightness rf-photoinjectors
M. Boscolo, M. Ferrario, C. Vaccarezza, I. Boscolo, F. Castelli, S. Cialdi, EPAC Conf. Edinburg UK, 2006 MOPCH025.

15- Production of flat top UV pulse for SPARC photoinjector
C. Vicario, A. Ghigo, G. Gatti, M. Petrarca, P. Musumeci, I. Boscolo, S. Cialdi; EPAC Conf. Edinburg UK, 2006.

16- Commissioning of the laser system for SPARC photoinjector
C. Vicario, A. Ghigo, G. Gatti *(INFN/LNF)*, M. Petrarca, P. Musumeci *(INFN-Roma1)*.
EPAC Conf. Edinburg UK, 2006

17- Cs_2Te Photocathode for the SRF Gun in Rossendorf, J. Teichert, R. Xiang *(FZD)*, Workshop on High QE Photocathodes for RF Guns, INFN-LASA, 4 to 6/10/2006

18- SRF Gun Cavity, **A. Arnold *(FZD)*, CARE06 Annual Meeting, INFN-LNF Frascati, Italy,**
15 – 17 November 2006.

19- Status of the Superconducting 3 ½ Cell Gun in Rossendorf**, F. Staufenbiel *(FZD)*, CARE06 Annual Meeting, INFN-LNF Frascati, Italy,**
15 – 17 November 2006.

20- Laser pulse shaping for high-brightness photoinjector
C. Vicario, CARE06, Frascati, Italy, 2006.

List of Publications

1- Test of the photocathode cooling system of the 3 1/2 cell SRF gun
F. Staufenbiel, H. Büttig, P. Evtushenko, D. Janssen, U. Lehnert, P. Michel, K. Möller, Ch. Schneider, R. Schurig, J. Teichert, R. Xiang, J. Stephan, W.-D. Lehmann, T. Kamps, D. Lipka, I. Will, V.Volkov
Physica C 441 (2006) 216-219

2- Technology challenges for SRF guns as ERL sources in view of Rossendorf work
D. Janssen, H. Buettig, P. Evtushenko, U. Lehnert, P. Michel, K. Moeller, P. Murcek, Ch. Schneider, R. Schurig, F. Staufenbiel, J. Teichert, R. Xiang, J. Stephan, W.-D. Lehmann, T. Kamps, D. Lipka, V. Volkov, I. Will,
Nucl. Instrum. Meth. Phys. Res. A **557** (2006) 80

3- Laser-plasma wakefield acceleration: concepts, tests and premises
V. Malka, J. Faure, Y. Glinec, A. Lifschitz, to be published to PR -STA

4- Absolute calibration for a broadrange single shot electron spectrometer
Y. Glinec, J. Faure, A. Guemnie-Tafo, V. Malka, H. Monard, J.P. Larbre, V. De Waele, J.L. Marignier, M. Mostafavi, to be published in RSI.

5- Ultra short laser pulses and ultra short electron bunches generated in relativistic laser plasma interaction.
J. Faure, Y. Glinec, G. Gallot, and V. Malka, Phys. Plasmas 13, 056706 (2006).

6- Design of a compact GeV Laser Plasma Accelerator
V.Malka, A. F. Lifschitz, J. Faure, Y. Glinec, NIM A 561, p310-131 (2006)

7- Wakefield acceleration of low energy electron bunches in the weakly nonlinera regime
A. F. Lifschitz, J. Faure, Y. Glinec, V. Malka, NIM A 561, p314-319 (2006)

8- Proposed Scheme for Compact GeV Laser Plasma Accelerator
A. Lifschitz, J. Faure, Y. Glinec, P. Mora, and V. Malka, Laser and Particle Beams 24, 255-259 (2006)

9- Radiotherapy with laser-plasma accelerators: application of an experimental quasi-monoenergetic electron beam
Y. Glinec, J. Faure, T. Fuchs, H. Szymanowski, U. Oelfke, and V. Malka, Med. Phys. 33, (1) 155-162 (2006)

10- Laser-plasma accelerator: status and perspectives
V. Malka, J. Faure, Y. Glinec, A.F. Lifschitz, Royal Society Philosophical Transactions A, 364, 1840, 601-610 (2006)

11- High third harmonic flat pulse laser
S. Cialdi, M. Petrarca ,C. Vicario Generation Opt. Lett. 31, 19 (2006) 2885. (selected for the October 2006 issue of Virtual Journal Of Ultrafast Science)

12- Commissioning of the SPARC Photo-Injector
M. Bellaveglia et al., , Proceedings Fel Conference 2006, THPPH031, Berlin Germany.

13- Production Of Temporally Flat Top Uv Laser Pulses For Sparc Photoinjector
Petrarca, C. Vicario et al., , Proceeding EPAC Conference, p. 3152, Edinburgh, Scotland, 2006.

14 Commissioning of the Laser System for SPARC Photoinjector
C. Vicario, A. Gallo et al., Proceeding EPAC Conference, p. 3146, Edinburgh, Scotland, 2006.

15- -Laser Experience at SPARC
C. Vicario, *Drive*, LCLS Injector Commissioning Workshop, http://www-ssrl.slac.stanford.edu/lcls/workshops/lcls_icw_oct06/index.html , SLAC, USA, 2006.

16- Pulse Shaping for the SPARC Photoinjector,
M. Petrarca, C. Vicario et al., *Laser* Workshop on Laser Pulse Shaping http://www-zeuthen.desy.de/~haenel/WSLPS/index.html , DESY Zeuthen, Germany, 2006.

17- Laser Timing and Synchronization Measurements,
M. Bellaveglia, C. Vicario, et al., SPARC Technical Note LS-06/001, http://www.lnf.infn.it/ , 2006.

18- UV-IR Cross Correlator
M. Petrarca, C. Vicario et al., SPARC Technical Note LS-06/002, http://www.lnf.infn.it/, 2006

19 - An optical system developed for target laser pulse generation
S. Cialdi, I. Boscolo, A. Paleari, " Report INFN-BE-05-2

20- Rectangular pulse formation in a laser harmonic generation",
S. Cialdi, F. Castelli and I. Boscolo, Appl. Phys. B 82, 3 (2006) 383-389.

21- Train of micro-bunches for PWFA experiments produced by RF photoinjectors
M. Boscolo, M. Ferrario, C. Vaccarezza, I. Boscolo, F. Castelli,
S. Cialdi, "A " Int. J. Mod. Phys. B. (2006)

22- Laser comb: simulations of pre-modulated e-beams at the photocathode of a high brightness rf-photoinjector
M. Boscolo, M. Ferrario, C. Vaccarezza, I. Boscolo, F. Castelli,
S. Cialdi, "" EPAC Edinburg 2006

Thesis

1- Untersuchung zur Feldverteilung verschiedener Moden in mehrzelligen Beschleunigerresonatoren,
André Arnold,
Diploma Thesis, Technical University of Dresden, January 2006

JRA2.1.3 Web sites

JRA2.1.3 External Scientific Advisory Committee

JRA2.2 Work Package 2: Charge Production

JRA2.2.1 Description of the work

JRA2.2.1.1 FZR

The photocathode preparation system has been installed in the new clean room. The equipment has been assembled without particle contamination. Photo cathodes can now be inserted with the cleanness required in the SRF gun. The preparation system is connected to control electronics and the control PC with National Instruments input-output cards. The software was written in Visual C++. Complete remote-controlled operation (cathode heating, Cs and Te evaporation, deposition rate monitoring, shutter, Q.E. measurement, vacuum) and parameter recording is realized. The preparation system was improved by means of a precise positioning system for the evaporators. Within test measurements the deposition rate sensors were calibrated and the tellurium heater design was optimized.

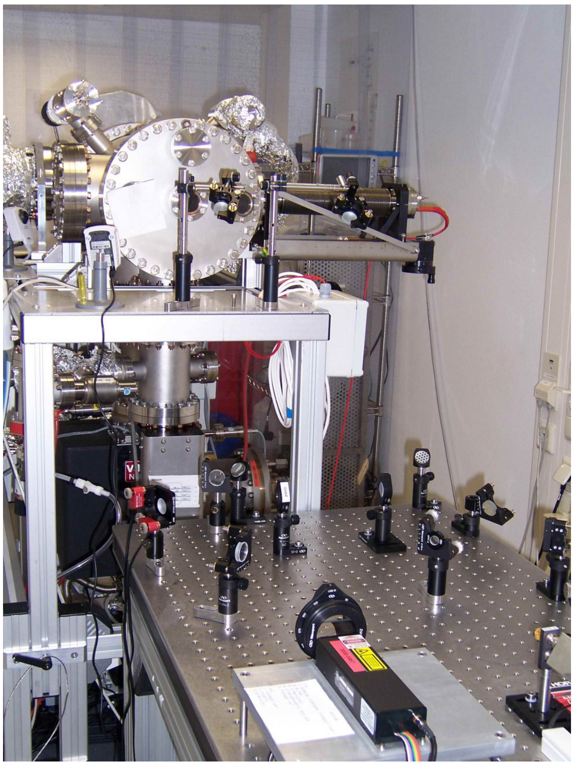


Figure JRA2.2.1: Photograph of the cathode preparation equipment in the clean room at FZD.

The transfer and storage systems for the photo cathodes were assembles, tested and installed in the clean room. As shown in the design figure, the transfer system consists of the exchange chamber with a linear-rotation precision manipulator, the transportation chamber with places for six photo cathodes, and a lock chamber in between. The photograph presents a view in the installed transfer system. In the foreground is the transfer chamber with the head of the transfer root on the right. In the background is the carrier with photo cathodes. A second transfer and storage system is fabricated and will later be installed at the SRF gun.
In spring a delay in photo cathode technology work was happened due to the pregnancy leave of the responsible co-worker. Since July, this work has been continued and the lost time will be regained.

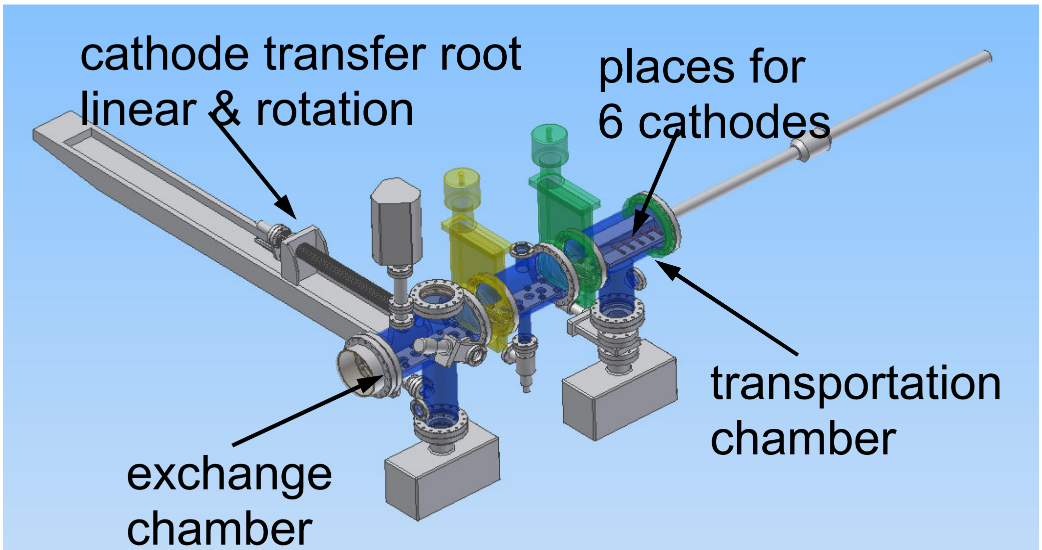


Figure JRA2.2.2: Design of the photo cathode transfer system.

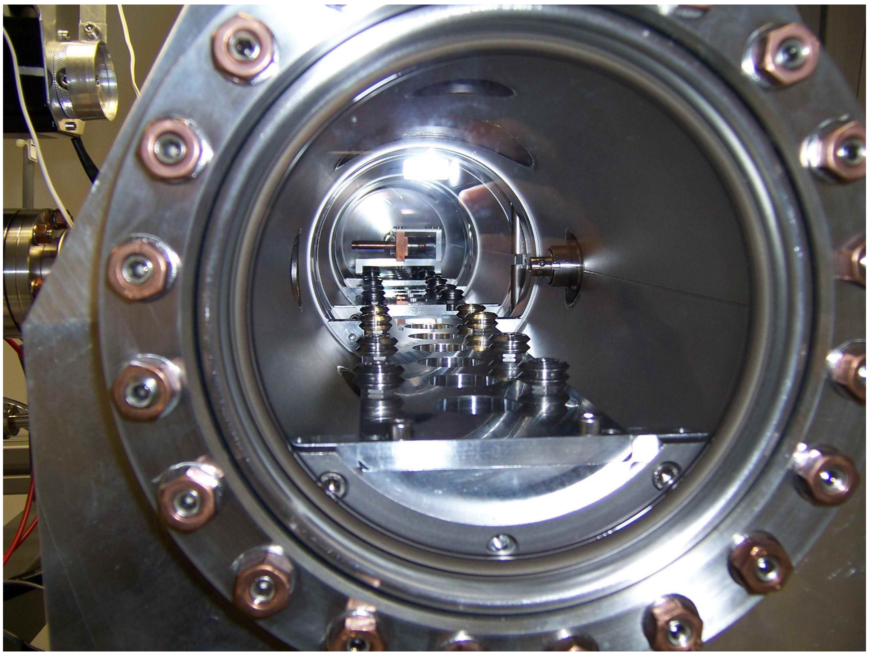


Figure JRA2.2.3: Photograph of photo cathode transfer system.

LOA

The prototype of the low energy electron spectrometer which has been designed last year, has been calibrated and tested during this year. The design and the view of the magnet are presented on Figure JRA2.2.4.

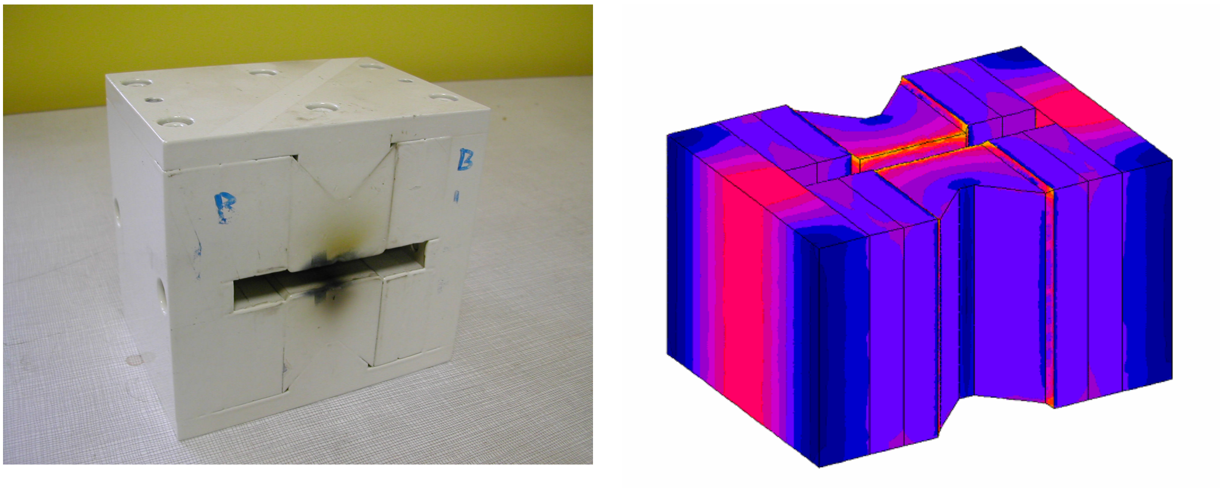


Figure JRA2.2.4: View and design of the low energy electron magnet

The absolute calibration has been performed using the ELYSE accelerator, a laser-triggered radiofrequency (RF) picosecond electron accelerator, located at Orsay. The results are then extrapolated to our experimental conditions. The results of the calibration are represented on figure JRA2.2.5.

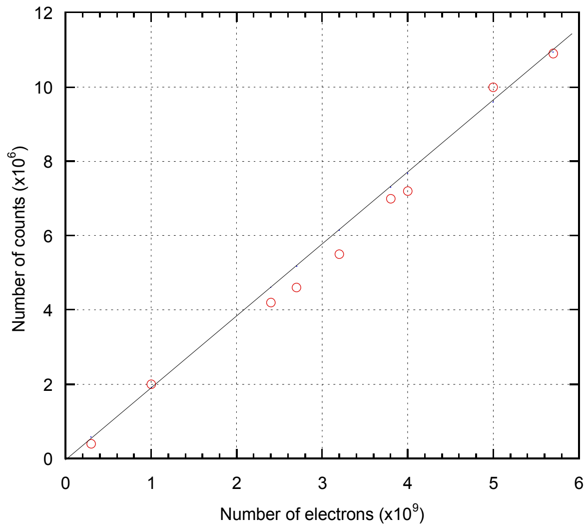


Figure JRA2.2.5: Evolution of the signal intensity with the charge for 3.3 MeV electron energy

The spectrometer has been tested at LOA. On figure JRA2.2.6. and JRA2.2.7., one can see the spectrometer in the vacuum chamber. The spectrometer has been used to measure the electron beam produced in the new “colliding pulse” regime in a wide range of electron energy from 50 to 300 MeV.

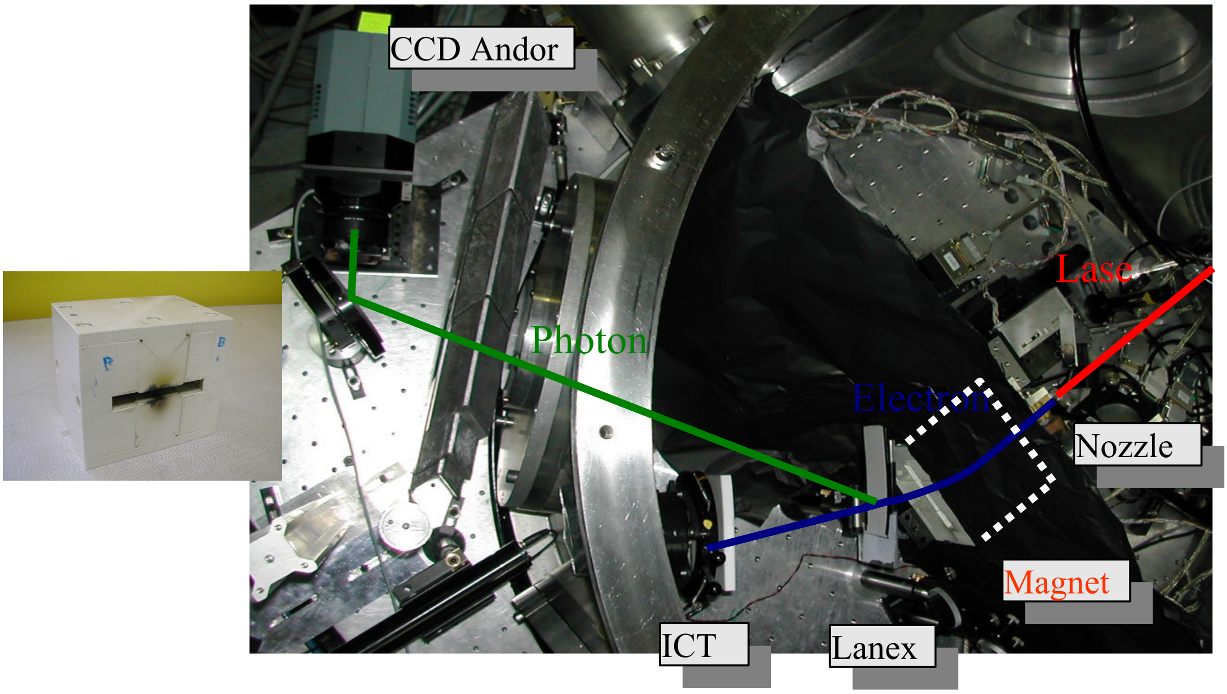
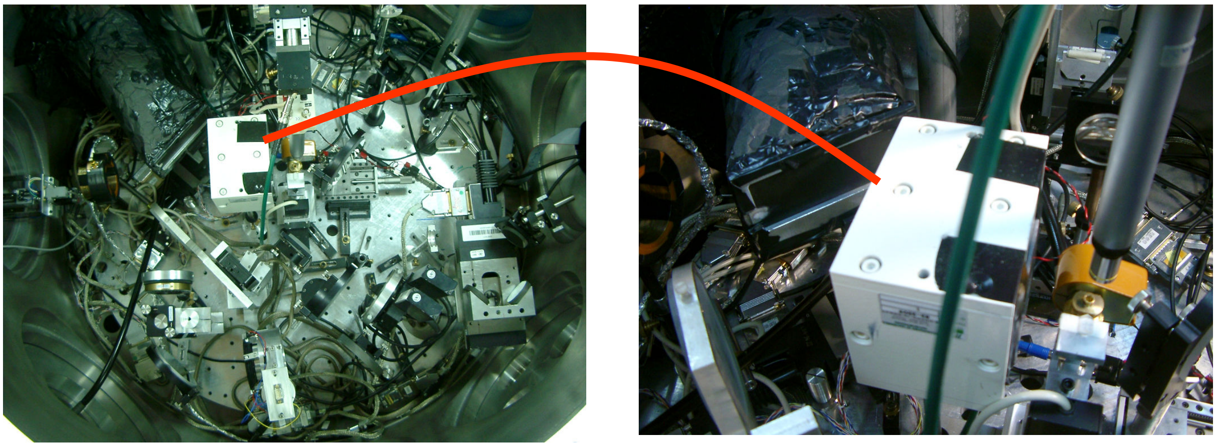


Figure JRA2.2.6: Picture of the experimental chamber.

The back cloth is used to reduce the laser and visible light in the camera. A picture of the magnet is also shown on the following slide. Also indicated in the picture, the high dynamic CCD camera.



Vacuum chamber Magnet

Figure JRA2.2.7: View of the spectrometer used in the colliding pulses experiment

The spectrometer has been used to measure the electron beam produced in the new "colliding pulse" regime in a wide range of electron energy from 50 to 300 MeV. Results are indicated on figure JRA2.2.8.

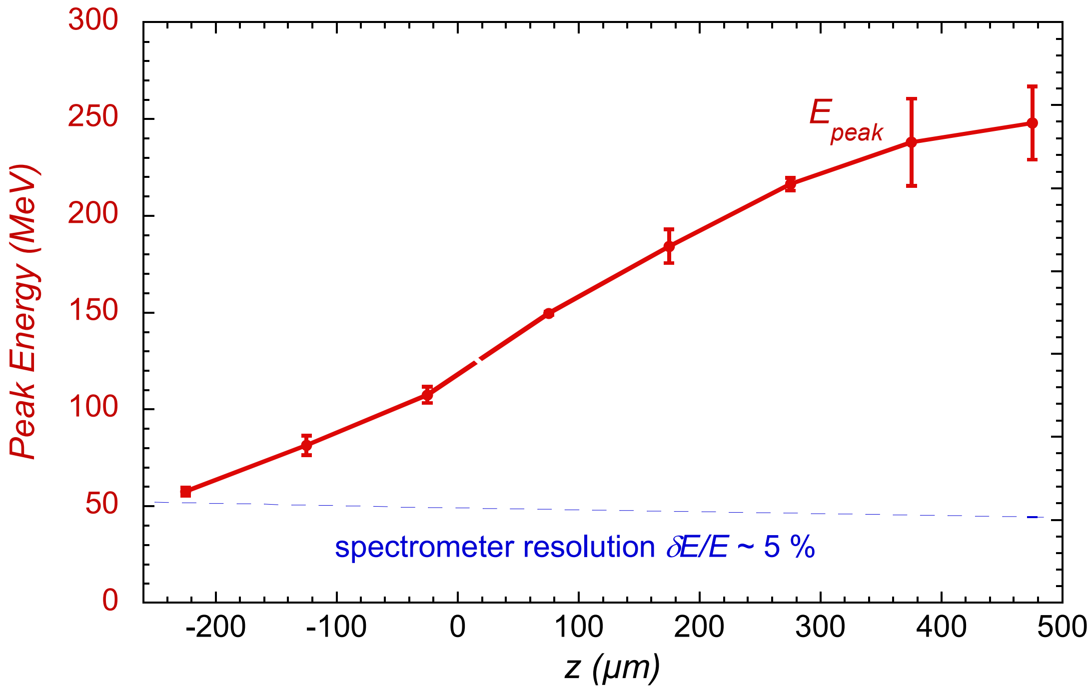


Figure JRA2.2.8: Electron beam energy as a function of the delay of the two laser pulses

For future medical applications of the electron beam for cancer therapy, we have, in collaboration with DKFZ in Germany, calculated the dose deposition in a phantom.

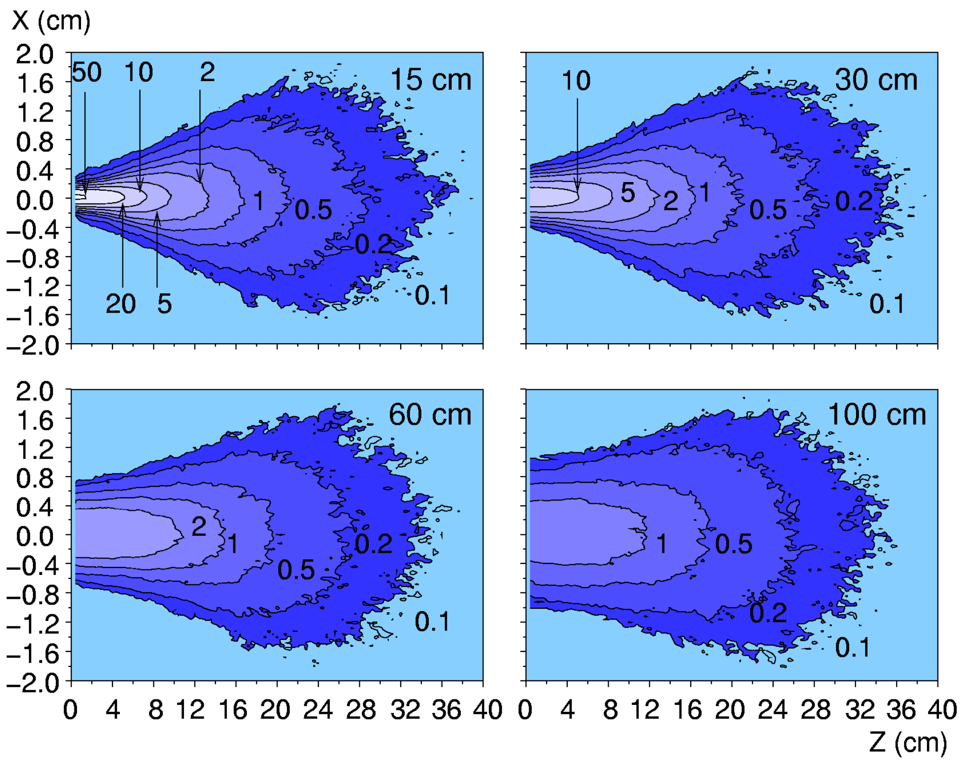


Figure JRA2.2.9: Contour of dose produced in one laser shot
with the parameter of the 170 MeV electron beam..

JRA2.2.1.2 CERN

In the first part of 2006 most of the work for refurbishing the installations of the photocathode laboratory has been completed. Only a few components (i.e. a wall current monitor) and some control software need to be finished.

The DC Gun, used to pre-qualify the photocathode performance was baked out till a pressure close to 10^{-10} mbar was reached. After that operation it was possible to condition the Gun up to its nominal field of 10 MV/m with a copper photocathode (without any photosensitive film). This process was repeated with a photocathode with a bulk quartz substrate to prove that no problems arise with such material, in view of the possible use of Secondary Emission Yield photocathodes. Fig. JRA2.2.10 shows the profile of vacuum level during conditioning.

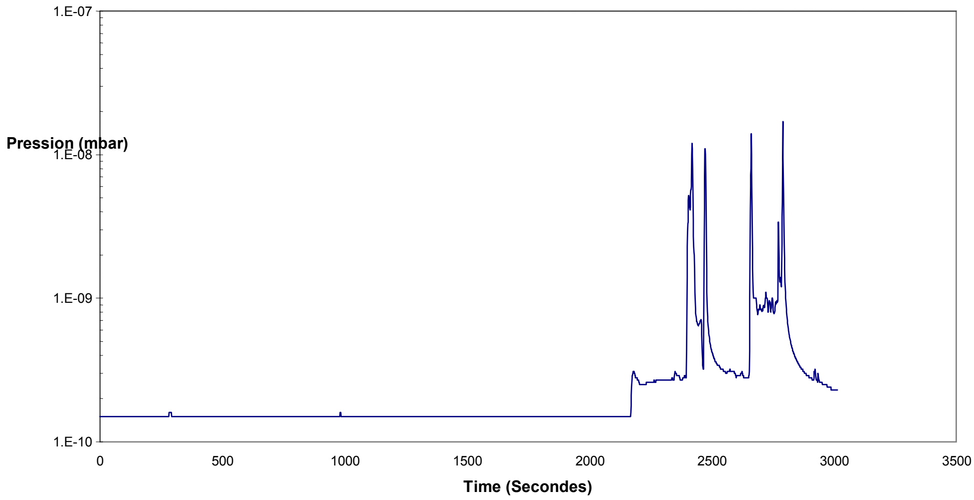


Figure JRA2.2.10: Diagram of pressure inside the DC Gun during conditioning.

The integration of the RF Gun into the layout chosen for the off-line test has been fixed and drawn in 3D to check for interferences (see fig. JRA2.2.11.). Several problems of incompatibility among the different parts of the photoinjector and measurement line have been solve thanks to detailed modelisation.

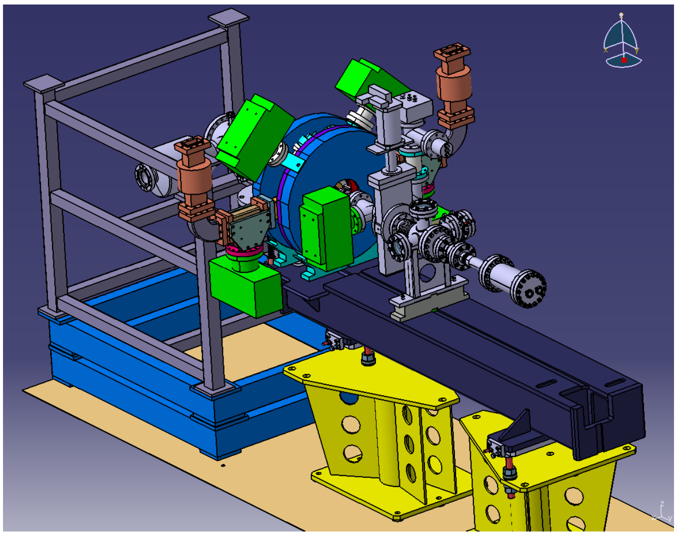


Figure JRA2.2.11: Integration layout of the photoinjector.

With the deposition chamber fully refurbished, and intense campaign of calibration of the different sensors has started, In particular, to ensure a good reproducibility of the Quantum Efficiency of the photocathodes in Cs_2Te an intense campaign of calibration of the different sensors included in the chamber is on-going. The most significative technique in our installation is to read the thickness directly on two independent quartz microbalances positioned in the vicinity of the photocathode during deposition. A 3D study has been carried out to determine convenient masks to apply during the deposition process to protect the Te balance from Cs and viceversa. The masks have been simulated with CATIA and then realized, and according to our first measurements the rejection of the unwanted species is better than a factor 150. The masks are shown in fig. JRA2.2.12. and JRA2.2.15.

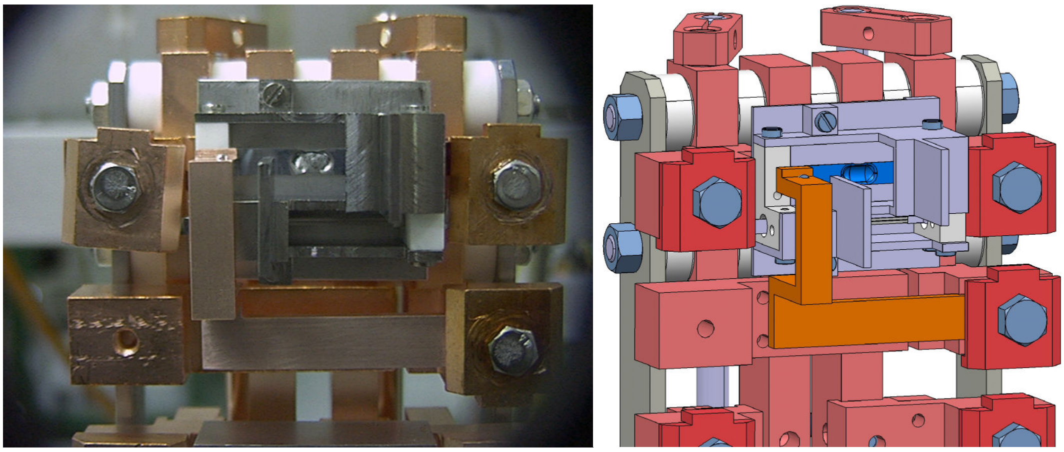


Figure JRA2.2.12: A picture and the 3D drawing of the deposition ovens and the masks to protect the microbalances.

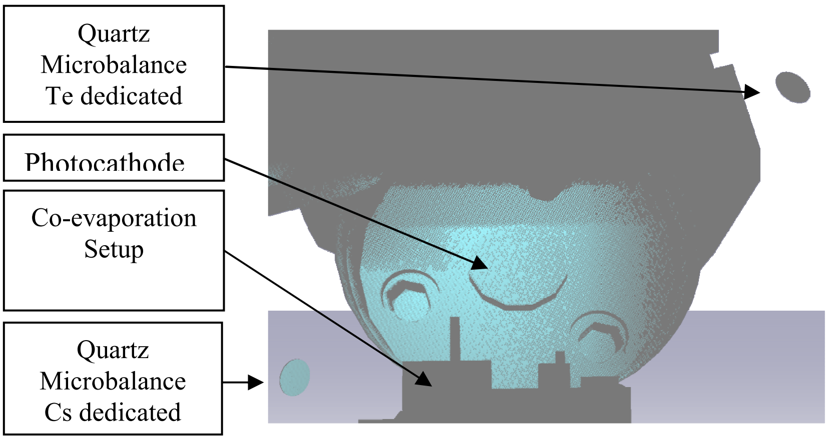


Figure JRA2.2.13: the deposition set-up designed with CATIA in 3D to determine the deposition profile. It can be noticed that only one microbalance is illuminated by the active oven (the one containing Cesium).

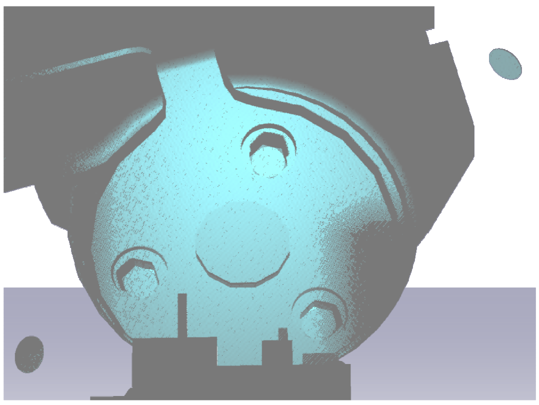


Figure JRA2.2.14: Activating only the oven containing Tellurium, now it is the other microbalance that sees the deposition vapor.

After verification of the independence of the measurements from the unwanted element, the calibration of the measurements given by the microbalances has started. Several photocathodes were deposed with only one element, then the thickness of the thin film measured with different techniques:

1) special photocathodes made of quartz have been deposed to measure the optical transmission of the sample. Though this measurement does not give an absolute measurement of the thickness of the film, it allowed to optimise the shape of the mask to maximize the quantity of elements arriving to the photocathode. In fig. JRA2.2.15 and JRA2.2.16 measurements of Te deposition for two different masks are presented. In the second, the shape of the mask has been modified to increase the quantity of tellurium on the microbalance for a given measurement on the photocathode.

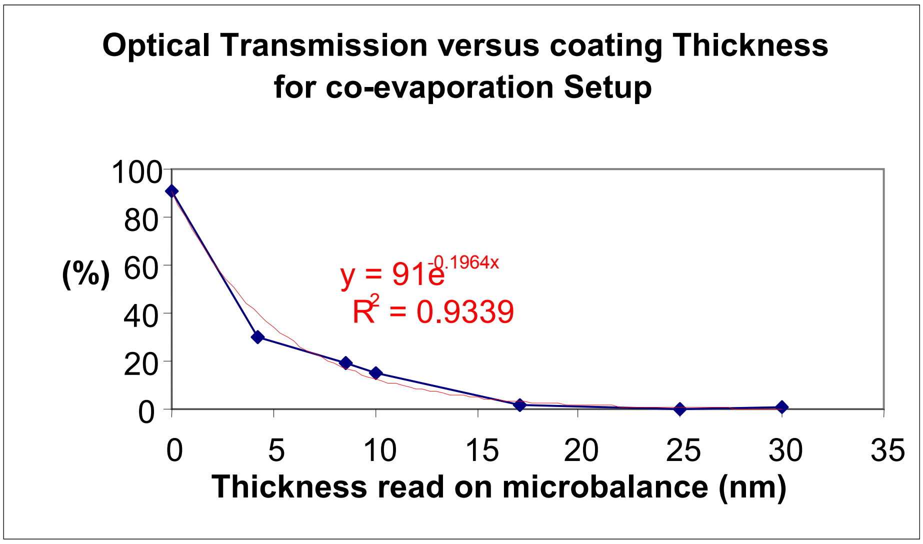


Figure JRA2.2.15

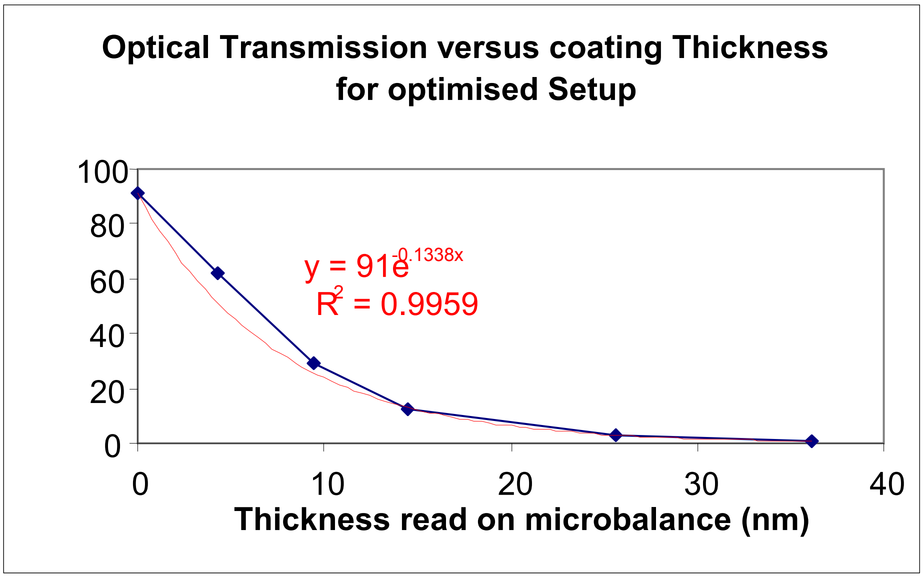


Figure JRA2.2.16

2) Measurement of absolute thickness using a precision rugosimeter. A new rugosimeter has been installed in the CERN metrology department. The theoretical measurement accuracy is 0.1 nm. Some test measurements have already been performed, but several tricks need to be implemented to get a significative measurement with the desired accuracy. Intensive work of measurement will be performed during the second part of the year.

In the second part of 2006 CERN made progress in the understanding of the process of deposition of Cs_2Te photocathodes in the CERN photocathode laboratory. In order to get repeatable results the control of the stoichiometric ratio is fundamental. In CERN's laboratory this is pursued by the control of the thickness of the deposed elements on two quartzes whose change in resonant frequency is monitored and correlated with the film deposed on the photocathode, measured independently with special profilers. During the calibration of this method, we discovered that the quantity of Te deposed on the corresponding quartz was changing with time, and we correlated the integrated thickness deposed on the different samples with the actual measurement from the quartz. Instead of a straight line, as we get on Quartz 1, we have an exponential decrease on Quartz 2. We explained that decrease with geometrical consideration. In Practice, as the boat containing the Te compound empties, the quartz is little by little masked by the boat geometry, therefore the quantity of Te seen by the quartz is changing with respect to the quantity deposed on the photocathode.

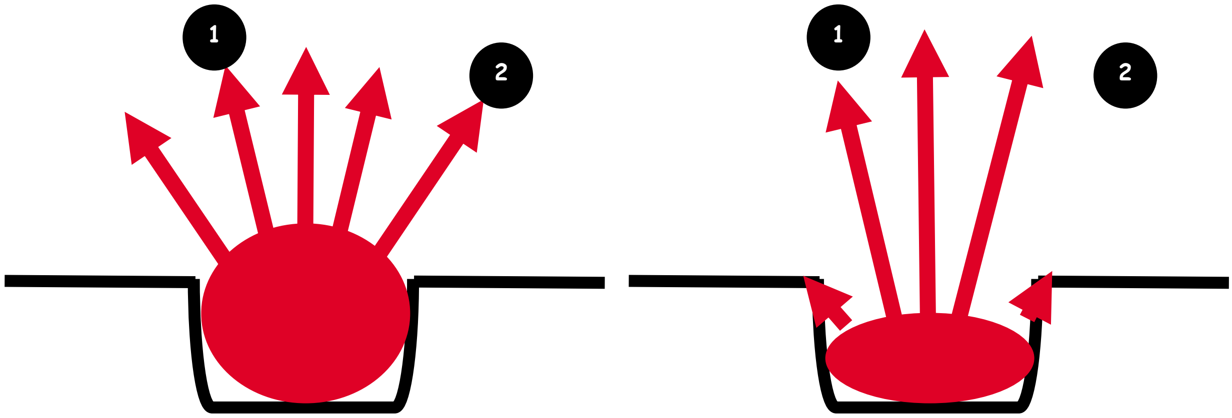


Figure JRA2.2.17: The quantity of Te seen by Quartz 2 diminishes over time due to the geometry of the boat and to the relative position of the quartz with respect to the Photocathode.

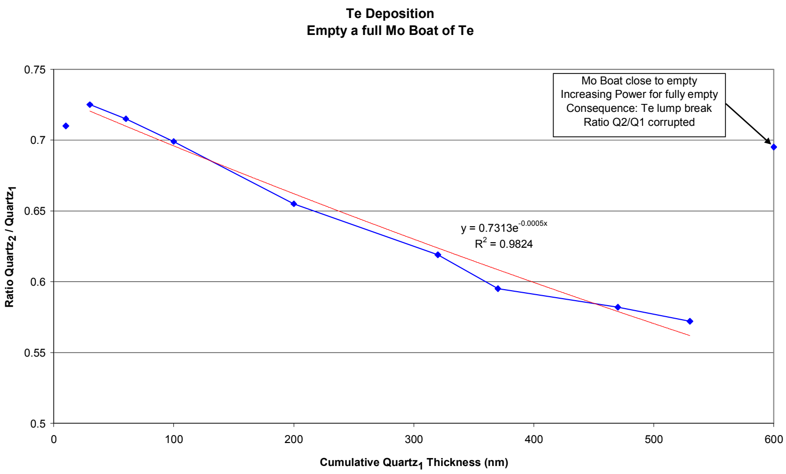


Figure JRA2.2.18: Calibration of Quartz 2 vs Quartz 1. Ideally we should see a line parallel to the abscissa.

In order to further characterize the system and refine and speed –up the thickness measurements, a mechanical stylus profiler with nanometer resolution has been purchased and will be available for operation at the end of the year.

CERN has also extensively collaborated with LAL in order to finalize the integration of the RF Gun into the CTF2 environment. Several technical decisions have finally been taken concerning pumping of the gun and of the waveguides and installation procedures. CERN has also started simulations of the gun to verify the thermal stability of the gun for operation at 50 Hz.

Finally, an important milestone has been reached, with the delivery to CERN of all the components of the laser. Though not all the performances of the laser were proven at RAL, it was decided anyway to transfer the system to CERN (what was done of August 28th) and the assembly is now going on in the CTF2 laser room. An associate previously working on this laser at RAL has been hired for 6 months to complete the installation and commissioning of the laser.

JRA2.2.2 Overall Progress of Work Package 2

WP2	Title	original begin date	End date	Estimated status	Revised end date
2,1	Photocathode know-how	janv-04	mars-06	100%	
2,2	photocathode preparation equipment	janv-04	juin-05	100%	
2,3	photocathode high field	juil-05	mai-07	50%	juil-07
2,4	Cathode high charge SC cavity	mai-04	juin-06	70%	sept-07
2,5	100 MeV monoenergetic beam	nov-05	déc-07	100%	

JRA2.3 Work Package 3: LASER

JRA2.3.1 Description of the work

JRA2.3.1.1 INFN-MI

INFN- Milano worked mostly at the SPARC-Frascati experiment in setting the 4f-system for the generation of the rectangular laser pulse within the laser system of the SPARC project and for comparison with DAZZLER system. The shaping system within the entire laser system has been designed and assembled according the proper spectral configuration and the successive longitudinal modulation via the stretcher for the rectangular pulse generation at the third harmonic of the Ti:Sa laser. The result is quite satisfactory. Within this program we have operated the SPARC rf-gun together with the SPARC team.

The investigation of the spatial shaping of the laser pulse by means of the 4f-system, that is transforming the mask as special movable mirror has been finished.

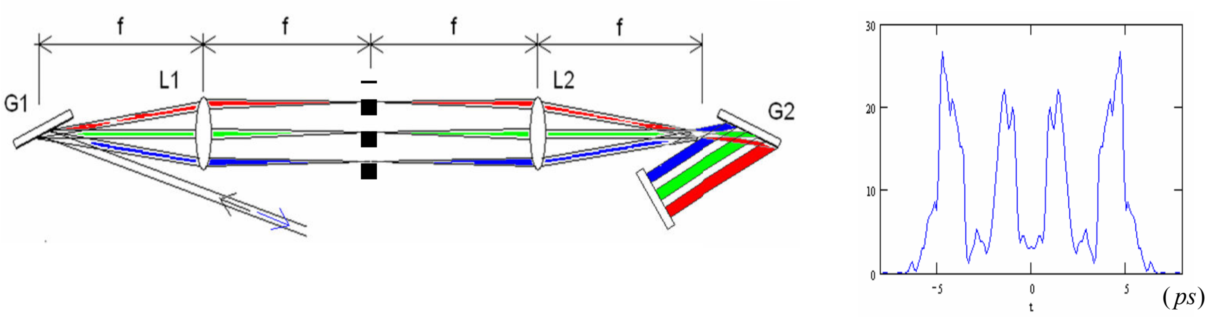


Figure JRA2.3.1.

As third item the problem of the generation of a laser comb beam aiming to produce electron beam trains of THz frequency has been tackled: simulated temporal pulse shape is shown in the picture.

The 4f-asymmetric system with an iris at the Fourier plane has been tested in the Milano laser Lab and afterwards it was implemented in the SPARC Frascati experiment where it operates quite successfully.

JRA2.3.1.2 INFN-LNF

In the frame of the CARE collaboration, strong efforts have been devoted to study the techniques to shape the temporal profile of the drive-laser pulse for the SPARC photoinjector. We recall here that to minimize the emittance in a photocathode RF-gun an uniform UV pulse of 10 ps, with less than 1 ps rise time and with limited ripple (<30% ptp). Beside, other requests are placed on the spot mode, the laser energy and stability.

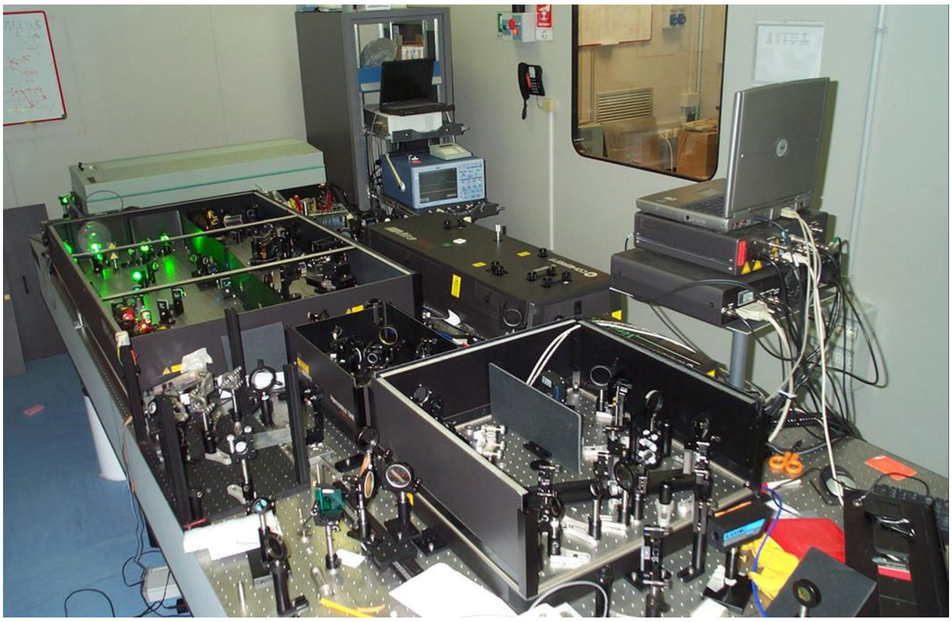


Figure JRA2.3.2: SPARC photoinjector laser system

During this year, the SPARC Ti:SA laser system has been integrated with an active temporal pulse shaper based on a commercial acousto-optic filter, named Dazzler. The filter can modify the spectral amplitude and phase in order to modify the natural Gaussian profile of the laser into the wanted one. The pulse shaper has been installed between the oscillator and the amplification stage. Several measurements have been performed to demonstrate the capabilities and the major limits of the filter. In particular, the alterations on the pulse spectrum, due to the chirped pulse amplification (CPA), have been investigated. It came out that the usual distortions associated with the laser amplifiers, such as the frequency red-shift and the gain saturation, can be effectively pre-compensated by the Dazzler. On the other hand, we observed that the filter can not counterbalance the smoothing of at the spectrum edges introduced by the CPA process.

Also the distortions due to the third harmonic generation (THG) downstream the CPA have been extensively characterized. The spectral intensity in the third harmonic, obviously, influences the temporal profile. In particular we demonstrated that when a large chirp is applied at the UV pulse, as in our system configuration, the intensity time profile reproduces directly the spectral distribution. Therefore the square-like spectrum is necessary to produce a flat top time profile. The correlation between spectrum and time intensity has been studied and experimentally confirmed using two home-built diagnostic tools: a spectrometer and an UV cross-correlator.

To characterize the distortions introduced by the harmonic generation we performed a series of measurements changing the input spectral phase and intensity with the Dazzler. It turned out that the harmonic spectra shape is strongly influenced by different input chirp. A key result is that the harmonic spectra tend to reproduce the IR only for large input chirp and a pulse longer than 600 fs rms. Approaching the transform-limited condition, the harmonic spectral shape becomes triangular with narrow bandwidth and the temporal profile develops into a Gaussian distribution. These distortions cannot be effectively compensated by the acousto-optics pulse shaper. To overcome this problem, we demonstrated that a proper chirp allows UV square-like spectra with enough TGH efficiency.

The shaped spectrum and time profile obtained is reported in the fig. JRA2.3.2. As shown there is a direct correlation between the spectral and the time shape. The rise time results to be less than 2.5 ps, and the ripple is about 20 % ptp. The rise time is worse than the required one.

Optical simulations show that better profile can be achieved by using a spectral filter within the UV stretcher. This solution is going to be implemented.

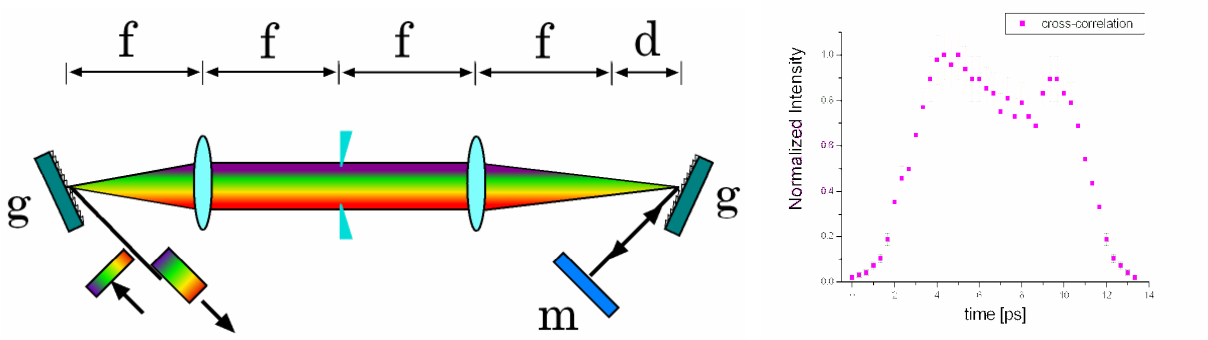


Figure JRA2.3.3

In parallel with the AO filter a pulse shaper, based on a liquid crystal mask in the 4-f configuration, has been installed. The 4-f optical system has been designed and mounted. In the next future the two pulse shaping techniques are going to be compared.
Besides, experimental work is in progress to measure the jitter between the rf clock and the UV laser pulse. The actual results demonstrate a good laser stability within the SPARC specs (0.65 ps rms). This value take into account also the jitter of the measurement equipment and unwanted electrical noise. Further experimental activities are foreseen to quantify the real jitter between the laser and the rf master clock.

JRA2.3.1.3 CCLRC-RAL
All the laser system components have been tested in the final conditions and shipped to CERN for the installation and final test. The two multi-pass amplifiers almost achieved the final energy per pulse and the amplitude stability along the pulse trains.

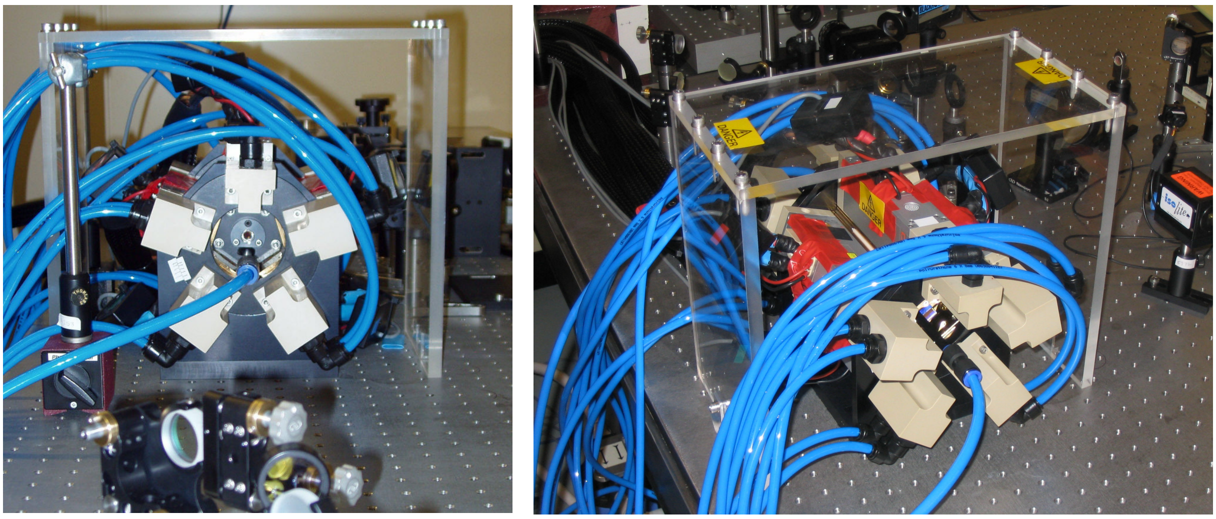


Figure JRA2.3.4

The test of the first amplifier has been performed at 10 and 50 Hz repetition rate and the measured output exceeds target power (3 kW from 3 passes). Output saturates in agreement with model and as shown below the pumping arrangement delivers good uniformity across the rod. Near-field profile is flattened by saturation but shows some effects of rod inhomogeneities

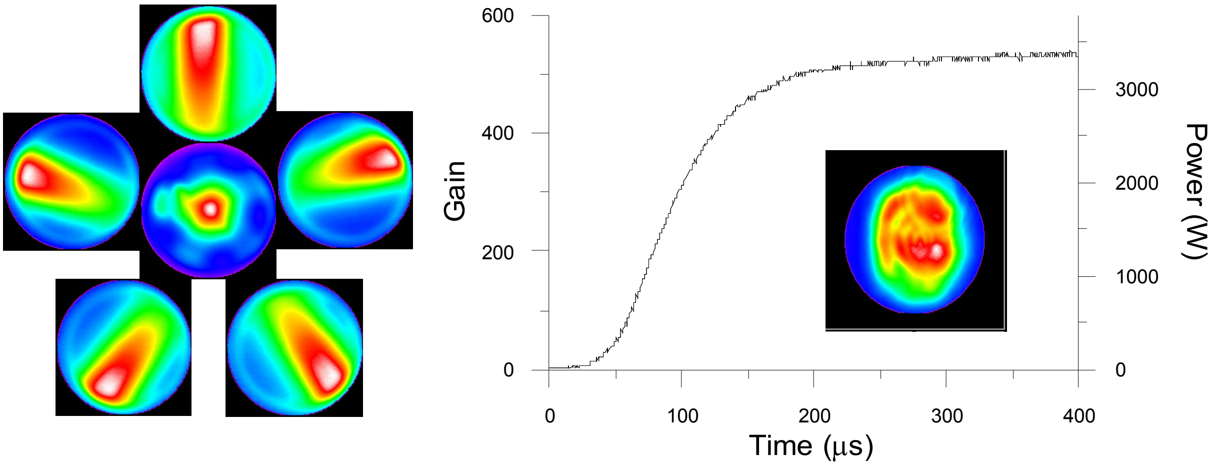


Figure JRA2.3.5

Second amplifier has been tested up to more than 8kW: 10kW from Amp 2 corresponds to 6.7mJ/pulse. Uniformity is good but the rod is underfilled

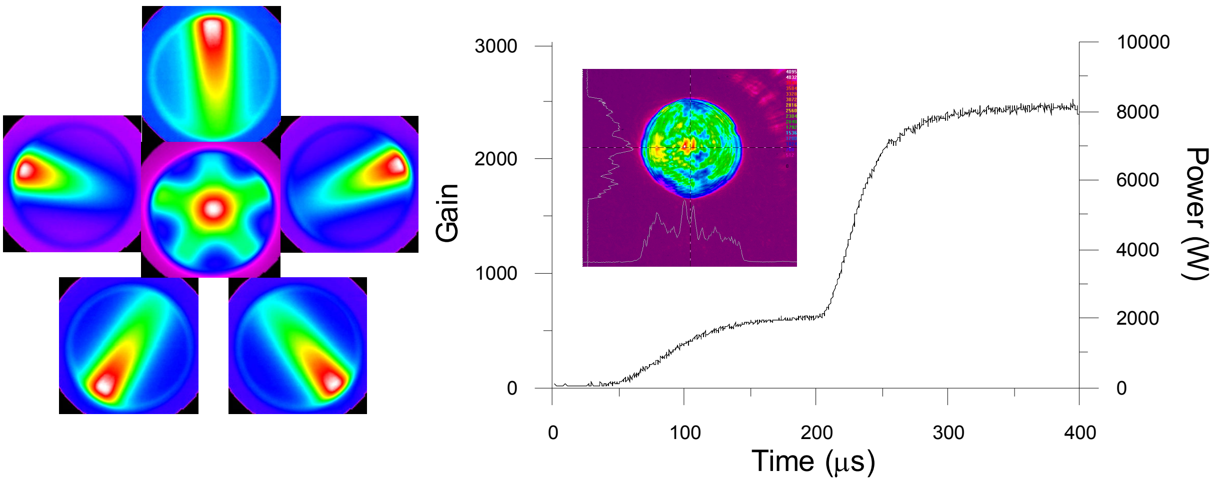


Figure JRA2.3.6

The pulse coding system has been also developed; fibre modulation, based on telecommunication technology, is fast but lossy and limited in average power.
Measurements on the High Q system suggest 10dB loss before the preamp results in <3dB output reduction. Delay can be adjusted by varying the fibre temperature (~0.5ps/°C) Attenuation can be controlled by varying the fibre bending losses Preliminary assembly and tests of temperature tuning were carried out at RAL

JRA2.3.2 Overall Progress of Work Package 3

WP3	Title	original begin date	End date	Estimated status	Revised end date
3,1	**Laser System**				
3.1.1	High power oscillator design	janv-04	juin-04	100%	
3.1.2	High power oscillator construction	janv-04	janv-05	100%	
3.1.3	High power amplifier design	janv-04	sept-04	100%	
3.1.4	High power amplifier construction	sept-04	juin-06	100%	
3.1.5	Oscillator+ampifier test	août-05	mars-06	100%	
3,2	**Pulse Shaping (PS)**				
3.2.1	PS simulation and design	janv-04	juin-04	100%	
3.2.2	Phase mask acquisition and test	juin-04	avr-05	100%	
3.2.3	Dazzler acquisition and test	janv-04	mai-05	100%	
3.2.4	PS comparison	août-05	juin-06	90%	avr-07
3,3	**UV generation and feedback**				
3.3.1	UV generator R&D	janv-04	juin-04	100%	
3.3.2	UV generator test	juin-04	juin-06	70%	juin-07
3.3.3	Laser-RF feedback development	janv-04	mai-06	100%	

JRA2.4 Work Package 4: RF GUN and Beam Dynamics

JRA2.4.1 Description of the work

JRA2.4.1.1 FZR

In January 2006, a new helium transfer line was installed which allow the connection of the srf gun to the ELBE helium refrigerator. The transfer line consists of a new He line from the main distribution box in the accelerator hall to cryomodule 1, a valve box above the cryomodule and an additional He line to the srf gun. Later in 2006 the liquid nitrogen pipeline was installed.

In the summer shut-down 2006, the currently used thermoionic injector of ELBE was modified and components moved in order to obtain the space for the installation of the new SRF photo injector. In the driver laser room the clean room installation is finished. For the RF power connection the waveguide has been installed. One of the 10 kW spare klystrons of the ELBE accelerator can be used. The laser room was reconstructed and clean room techniques were installed. A new hutch for the streak camera of the bunch length measurement system was built.

The warm tuning of the two cavities was finished and they were sent to DESY for treatment (buffered chemical polishing, backing, cleaning). The RRR300 cavity was measured in the vertical test stand at DESY two times. The results of these measurements and of warm rf measurements performed at FZR were published at the FEL 2006 conference. Unfortunately, a failure happened during high pressure rinsing. Thus the cavity had to be sent to ACCEL for mechanical treatment. At ACCEL the cavity was BCP etched and HPR cleaned. A third test in the vertical test stand was carried out with insufficient results due to strong field emission. As presented in the picture, a maximum peak field of about 15 – 20 MV/m was obtained whereas the goal is 50 MV/m.

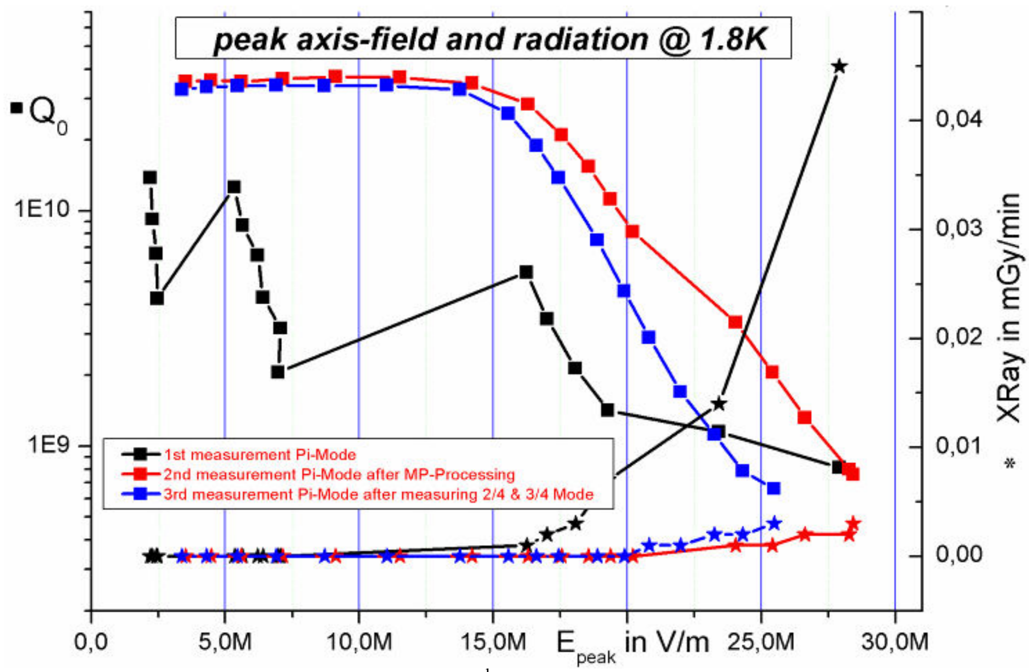


Figure JRA2.4.1: Results of the 3rd vertical test at DESY, November 2006.

It turned out that the envisaged acceleration gradient will only be obtained if the high pressure rinsing system is modified according to the needs of the geometry of the 3 ½ cell cavity. Therefore a contract with the company ACCEL was placed for modification of their HPR system. This modification will be finished till end 2006. In January the next treatment (BCP

and HPR with the modified system) and the measurement in the vertical test stand will be performed. Then the helium tank welding can be finished in February 2007 and the cavity will be at Rossendorf for assembly in the cryostat begin March 2007.
In 2006 the assembly of the SRF gun cryomodule has been carried out in the workshop. This work includes the vacuum vessel, the liquid nitrogen thermal shield, magnetic shield, tuning systems, rf power coupler, cathode support and cooling system and cavity support. The standard vacuum components like pumps and gauges, and the diagnostic components (temperature sensors, He level meters) were delivered. All the subsystems were tested. In November tests of the isolation vacuum of the cryostat and of liquid nitrogen cooling system were performed. A second photo cathode transfer system was fabricated and assembled. The tuning system was tested and its parameters measured in a test bench.

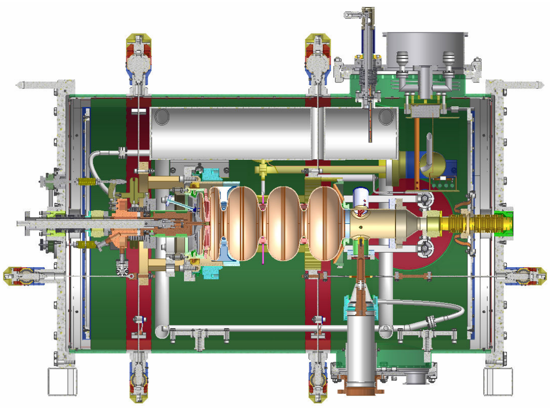


Figure JRA2.4.2: Cut drawing of the SRF gun cryostat.

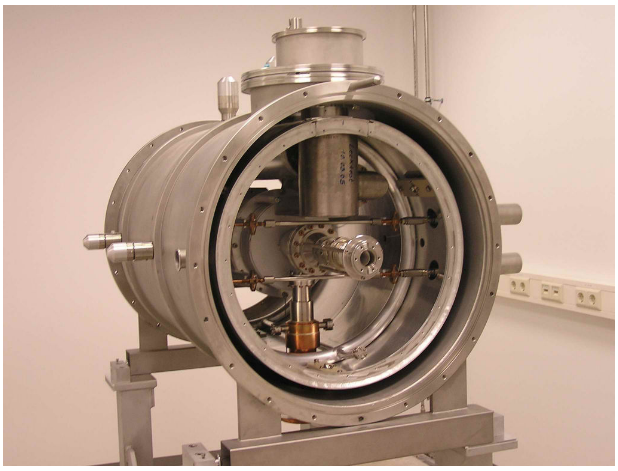


Figure JRA2.4.3: Assembly of the SRF gun cryomodule at FZD

MBI Berlin developed the driver laser and FZD is responsible for the laser beam line set-up which transports the laser beam from the laser room to the photo cathode of the SRF gun in the ELBE accelerator hall. The design of the laser beam line is finished. The mechanical components are delivered and fabricated. Most of the mechanical components are already installed. The remaining work will be carried out in winter shut-down of ELBE.

JRA2.4.1.2 LAL

Status of the RF gun: the last copper pieces of the RF cells have been received just in half September instead of the end of July as it was foreseen. Yet, at this date, the two couples of end-caps (water box) have not still received. But, fortunately it is not necessary for the RF adjustment of cells. RF measurements started in September, 25th. We need at least one month to achieve a good adjustment of the cavities. From a point of view of the RF physics, a big step of cell dimensions occurred between the prototype and the definitive gun, one had to correct the resonant frequency by more 30 MHz. From the measurements on the definitive gun, it appeared that these corrections were reasonable for the coupler and central cavities. But, in the half cell, it seems that the "local resonant frequency" is too low. One possible way to overcome this difficulty that we are studying is to machine another cathode holder. According to the previous planning, LAL was supposed to deliver the cavities to CERN in the end of September for a brazing at the end of the year. Now, it seems the planning will be shifted by at least one month.

About the tapered waveguides, technical drawings are finished and approved by the CERN brazing specialist in early September. A selection of a tender is under way, a first quotation gives 2 weeks of machining. So, theses pieces should be fabricated by the end of the year and brazed at CERN. The last operation should take place before the brazing of the gun cells. Moreover the waveguides one brazed must come back at LAL for adjusting the RF flanges.

Vacuum pumping ports connected to the waveguides are in fabrication in the LAL workshop and should be finished also by the end of the year.

Thermal/vacuum model :

Big troubles occurred during the brazing of the model. Due to some defects of the oven, there was a leak which polluted the oven preventing the brazing process during summer. Once the problem fixed, the model was brazed but the solder between the model and the waveguide did not catch and the model showed a big leak. The latter has been fixed using a UHV high temperature glue. At room temperature, vacuum tests showed a pressure limit down to 10^{-8} mbar. To reach UHV, one had to bake out and, unfortunately during the process, around 100 °C a new leak has been detected. One thinks it is probably due to the difference in thermal expansion coefficient between copper and the resin. Alternative solutions are being studied. For the definitive brazing a "bell" has been designed to test a possible leak before the TIG soldering of the NEG envelop. The construction of this device is now under way.

Integration drawings:

Drawings of the gun have been updated as shown in figure 1. Support of the gun is designed and will be machined in the LAL workshop. We had a meeting in September, 13th with E. Chevallay from CERN about the integration of the gun into the beamline. He asked the help of LAL to install the gun as it is not possible to put it directly with its girder into the tunnel because of the smallness of the chicane aperture. Moreover, CERN discovered that the gun must be pumped from two points: at the output and on the NEG chamber. E. Chevallay told us he did not know and therefore it was not foreseen. Recently, CERN people asked to us to bring several changes to the pumping system in order to reduce the need of primary pumping. It represents a new effort for LAL and can eventually lead to further delay.

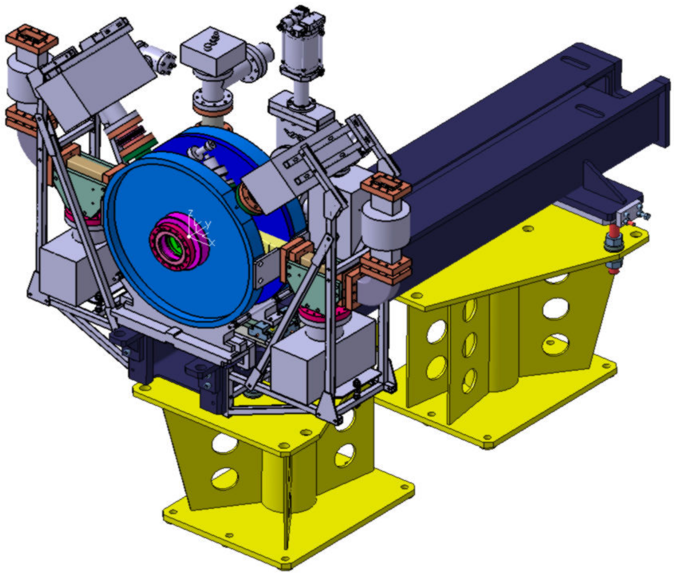


Figure JRA2.4.4: 3D CATIA drawing of the gun.

Nepal station:

Civil engineering begun in September, pillars are drilled into the floor (see figure JRA2.4.5.). Then, it must be left to dry for one month. After, a concrete floor is coated at the top of the pillars and again left to dry one month. Finally, walls made of concrete blocks are mounted. Before to set up the roof, all heavy elements of the machine will be installed with the crane. The end of civil engineering is foreseen for the end of January

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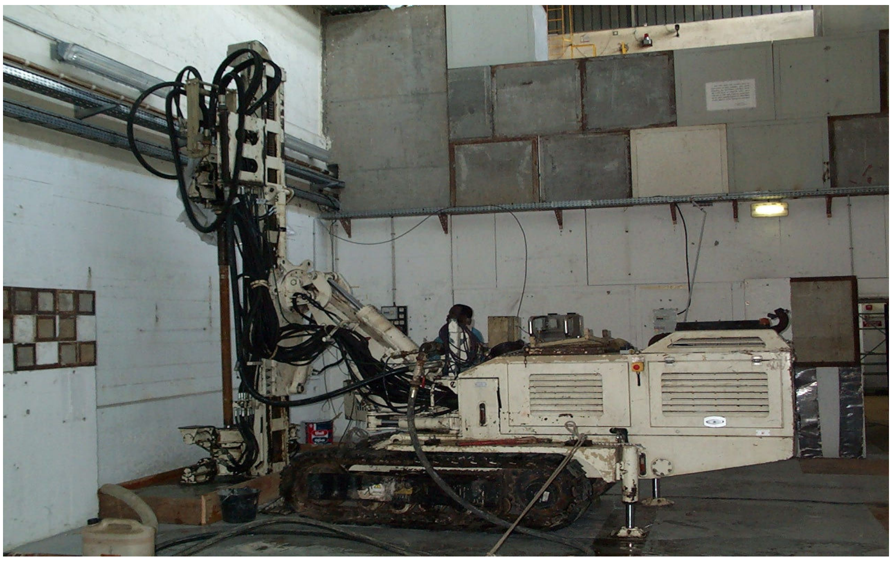


Figure JRA2.4.5: view of NEPAL room with a machine which drills a hole into the floor.

The laser came back from the manufacturer, HighQ, in September. It has been installed in the laser hutch close to the Nepal room. Our specialist checked its performances. For instance, the energy of the pulse exceeded the specifications; the external synchronization of the laser with the RF pilot generator is operating but the external trigger was forgotten by the manufacturer. Measurements of the laser pulse duration have been performed with a streak camera. One typical example is shown in figure JRA2.4.6.

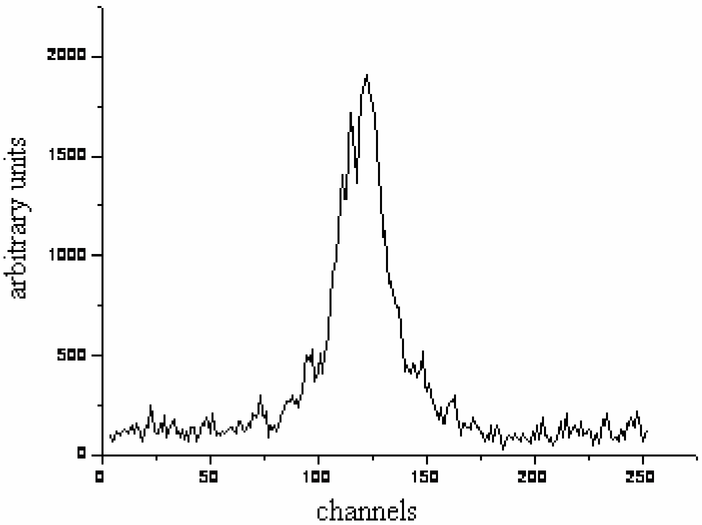


Figure JRA2.4.6.: streak camera measurement of the laser after the frequency quadrupling, the abscissa axis stands for the picosecond time scale, i.e. 250 channels = 90 ps.

In this example, the width (FWHM) is 14.4 ps which is roughly the average value. Unfortunately it is 40 % bigger than the specified limit. As a consequence, the laser has again been sent back to the manufacturer to fix this problem. The latter gave one month for a new delivery.

JRA2.4.2 Overall Progress of Work Package 4

WP4		Title	original begin date	End date	Estimated status	Revised end date
	4,1	**SC RF gun**				
4.1.1		Technology development	janv-04	déc-04	100%	
4.1.2		RF gun simulation optimisation	janv-04	déc-04	100%	
4.1.3		SC RF gun realization	janv-05	févr-07	80%	juil-07
4.1.4		SC rf gun test	mars-07	déc-07	0%	
	4,2	**3 GHz RF gun**				
4.2.1		3 GHz RF gun design	janv-04	janv-05	100%	
4.2.2		3 GHz RF gun construction	janv-05	juin-06	80%	juil-07
4.2.3		3 GHz RF gun test	juil-06	oct-07	0%	déc-07
	4,3	**Spectrometer for e- beam**				
4.3.1		1-250 MeV spectrometer design	janv-04	oct-04	100%	
4.3.2		1-250 MeV spectrometer construction	oct-04	juin-06	100%	

JRA2.5 Significant Achievements

- Production of photocathode with quantum efficiency above CTF3 specifications (CERN)
- CTF3 laser amplifiers full power tested at RAL (RAL)
- CTF3 laser system shipped from RAL and installed at CERN (CERN)
- First production of low emittance electron beam with square laser pulse in the SPARC 3GHz RF gun. (INFN-LNF)
- Production of “comb shape” laser pulse with phase mask pulse shaping. (INFN-Mi)

- Photocathode preparation chamber, transfer and storage system installed and tested in the new clean room (FZR)
- Warm tuning of 3 ½ SC cavities finished and the cavities treatment at DESY started. (FZR)
- All part of SRF gun cryomodule assembled and tested including all vacuum and diagnostics components. (FZR)
- Electron beam spectrometer (0- 300 MeV) installed tested and calibrated @ ELYSE facility (LOA)
- Spectrometer used to measure electron beam produced in the new “two colliding pulse” regime (LOA)

JRA2.6 List of all milestones and deliverables (D) during the reporting period

JRA2.7 List of major meetings organized under PHIN during the reporting period

CARE Doc	Title	Authors and Labs	Journal and date	
	Test of the photocathode cooling system of the 3 1/2 cell SRF gun	F. Staufenbiel, H. Büttig, P. Evtushenko, D. Janssen, U. Lehnert, P. Michel, K. Möller,Ch. Schneider, R. Schurig, J. Teichert, R. Xiang, J. Stephan, W.-D. Lehmann, T. Kamps, D. Lipka, I. Will, V.Volkov	Physica C 441 (2006) 216-219	
	Technology challenges for SRF guns as ERL sources in view of Rossendorf work	D. Janssen, H. Buettig, P. Evtushenko, U. Lehnert, P. Michel, K. Moeller, P. Murcek, Ch. Schneider, R. Schurig, F. Staufenbiel, J. Teichert, R. Xiang, J. Stephan, W.-D. Lehmann, T. Kamps, D. Lipka, V. Volkov, I. Will,	Nucl. Instrum. Meth. Phys. Res. A 557 (2006) 80	
	Ultra short laser pulses and ultra short electron bunches generated in relativistic laser plasma interaction	J. Faure, Y. Glinec, G. Gallot, and V. Malka	Phys. Plasmas 13, 056706 (2006).	
	Design of a compact GeV Laser Plasma Accelerator	V.Malka, A. F. Lifschitz, J. Faure, Y. Glinec	NIM A 561, p310-131 (2006)	
	Wakefield acceleration of low energy electron bunches in the weakly nonlinera regime	A. F. Lifschitz, J. Faure, Y. Glinec, V. Malka	NIM A 561, p314-319 (2006)	
	Proposed Scheme for Compact GeV Laser Plasma Accelerator	A. Lifschitz, J. Faure, Y. Glinec, P. Mora, and V. Malka	Laser and Particle Beams 24, 255-259 (2006)	
	Radiotherapy with laser-plasma accelerators: application of an experimental quasi-monoenergetic	Y. Glinec, J. Faure, T. Fuchs, H. Szymanowski, U. Oelfke, and V. Malka	Med. Phys. 33, (1) 155-162 (2006)	

	electron beam			
	Laser-plasma accelerator: status and perspectives	V. Malka, J. Faure, Y. Glinec, A.F. Lifschitz,	Royal Society Philosophical Transactions A, 364, 1840, 601-610 (2006)	
	High third harmonic flat pulse laser Generation	S. Cialdi, M. Petrarca ,C. Vicario	Opt. Lett. 31, 19 (2006) 2885. (selected for theOctober 2006 issue of Virtual Journal Of Ultrafast Science)	
	Commissioning of the SPARC Photo-Injector	M. Bellaveglia et al	Proceedings Fel Conference 2006, THPPH031, Berlin Germany.	
	Production Of Temporally Flat Top Uv Laser Pulses For Sparc Photoinjector	Petrarca, C. Vicario et al.,	Proceeding EPAC06 Conference, p. 3152, Edinburgh, Scotland, 2006.	
	Commissioning of the Laser System for SPARC Photoinjector	C. Vicario, A. Gallo et al.,	Proceeding EPAC Conference, p. 3146, Edinburgh, Scotland, 2006.	
	Laser Experience at SPARC	C. Vicario	Drive LCLS Injector Commissioning Workshop, SLAC, USA, 2006.	
	Pulse Shaping for the SPARC Photoinjector,	M. Petrarca, C. Vicario et al.,	*Laser* Workshop on Laser Pulse Shaping DESY Zeuthen, Germany, 2006	
	Laser Timing and Synchronization Measurements,	M. Bellaveglia, C. Vicario, et al.,	SPARC Technical Note LS-06/001	
	UV-IR Cross Correlator	M. Petrarca, C. Vicario et al.,	SPARC Technical Note LS-06/002	
	An optical system developed for target laser pulse generation	S. Cialdi, I. Boscolo, A. Paleari	Report INFN-BE-05-2	
	Rectangular pulse formation in a laser harmonic generation"	S. Cialdi, F. Castelli and I. Boscolo	Appl. Phys. B 82, 3 (2006) 383-389.	

	Train of micro-bunches for PWFA experiments produced by RF photoinjectors	M. Boscolo, M. Ferrario, C. Vaccarezza, I. Boscolo, F. Castelli, S. Cialdi	Int. J. Mod. Phys. B. (2006)	
	Laser comb: simulations of pre-modulated e-beams at the photocathode of a high brightness rf-photoinjector	M. Boscolo, M. Ferrario, C. Vaccarezza, I. Boscolo, F. Castelli, S. Cialdi,	Proceeding EPAC06 Conference, Edinburgh, Scotland, 2006.	
	Untersuchung zur Feldverteilung verschiedener Moden in mehrzelligen Beschleunigerresonatoren,	André Arnold,	Diploma Thesis, Technical University of Dresden, January 2006	

1.4.3 JRA3: High Intensity Proton Pulsed Injector (HIPPI)

The list of participants and their implication in the HIPPI Work Packages (**C**: Coordination, X: Participation) is given in the table below. The overall management is done by CERN.

Number	Participant	WP1 M&C	WP2 NC	WP3 SC	WP4 CHOP	WP5 BD	Person-months
1	**CEA**	X	X	**C**	X	X	62.93
3	**CNRS**	X	**C**	X	X	X	12.4
	CNRS-IPNO			X			9.4
	CNRS-LPSC	X	**C**	X	X	X	3
4	**GSI**	X				**C**	43.5
5	**IAP-FU**		X	X		X	51 (39)
7	**FZJ**			X		X	38.3
10	**INFN**			X		X	9 (1)
	INFN-Mi			X		X	9 (1)
17	**CERN**	**C**	X		**C**	X	75 (25)
20	**CCLRC**		X		X	X	33.58
	CCLRC-RAL		X		X	X	33.58

The year 2006 was particularly important in the progress of the HIPPI JRA. The Activity has passed its half lifetime, most of the tasks have started and have reached critical steps, the recruitments foreseen in the workplan have been made, and scientific papers, milestones and deliverables have to follow at the required rate. At this stage of the Activity, the main management efforts went into the follow-up of deliverables, from the administrative as well as from the scientific point of view. Administrative follow-up requires an accurate tracking of the deliverables status and in case of delays the definition of a new deadline. More scientific interventions were required in some cases, in order to make sure that the scientific objective had been achieved and, in case of excessive delays, to try finding an alternative solution preserving the scientific content of the deliverable.

An example of the latter type of management interventions was the reorganisation of the CERN chopper tests, which could have been seriously compromised by the delay in the construction of the IPHI RFQ (built in France by CEA and IN2P3). After some meetings and discussions, the solution of moving the tests from the CERN test stand, where the RFQ will be ready only in 2009, to the CEA Saclay test stand, where the RFQ will be installed at mid-2008. The entire CERN chopper line will be mounted on a temporary support and shipped to Saclay, in order to finish the tests inside the duration of the HIPPI programme.

The meetings organised by HIPPI continued at the usual rate, with one meeting per Work Package organised in spring, and a general HIPPI meeting in fall. To improve communication between the Work Packages, WP3 and WP5 (Superconducting RF and Beam dynamics) have joined their Work Package meetings, in order to exchange information and competence, in the direction suggested by the External Scientific Advisory Committee (ESAC).

A particular effort went into the follow-up of the ESAC recommendations and in the preparation of the Annual Meeting, which is the most important event in the JRA during the year. This year the format of the meeting was slightly modified, introducing some general presentations in an attempt to summarise the common goals and objectives of the JRA and to prepare for the comparison of alternative accelerator designs that is one of the main expected outcomes of HIPPI. The meeting took place at the end of September, hosted by the Forschungszentrum Jülich in the small German town of Jülich. All participating laboratories were represented as well as the complete External Scientific Advisory Committee. Although focused on the review of the scientific and technical activities, the meeting was also used for discussing management issues like the preparation of CARE06 and the planning for the next 18 months and for a presentation on the preparation of proposals for the FP7 Programme.

At the level of the JRA, regular contacts took place between the members of the HIPPI steering committee (WP coordinators, HIPPI coordinator and his deputy). Two Quarterly Reports were prepared and communicated to the CARE management. These documents and more detailed information are available on the HIPPI web-site (http://mgt-hippi.web.cern.ch/mgt-hippi/) and on the CARE web site.

JRA3.1 Work Package 1: Management and Communication

Two Quarterly Reports and one Annual Report have been prepared, as well as the 4 Work Package meetings and the Annual HIPPI meeting.

A new schedule for the chopper line tests (WP4) has been jointly defined by CERN, CEA and IN2P3. Because of the delay in the construction of the IPHI RFQ, the tests of the CERN-made chopper line would have been delayed after the official end of the HIPPI programme (2008). In order to keep the foreseen date for the end of HIPPI and to profit as soon as possible from the important information expected from this beam test, a window for the chopper line tests has been agreed during the preliminary testing of the RFQ at Saclay, foreseen for the second half of 2008. Only a reduced version of the line will be shipped to Saclay, although sufficient to achieve the scientific results required for HIPPI.

JRA3.1.1 Overall Progress of the Activity

The detailed HIPPI planning for 2006, corresponding to the general planning presented in the Technical Annex, is presented in the following planning. The task numbers are those used in the Section Description of work. Progress bars indicate the progress in each task at beginning of December 2006. The resources used by the participants during the year 2005 are summarised in the table (Chapter D : Detailed Implementation Plan for the next 18 months).

ID	Task Name	Resources
1	**WP2: NORMAL CONDUCTING STRUCTURES**	
2	**2.1 Drift Tube Linac**	
3	2.1.1 DTL design	CEA,CERN,LPSC
4	2.1.2 Decision on prototyping	
5	2.1.3 DTL coupler prototype design	CEA,LPSC
6	2.1.5 DTL coupler prototype construction and testing	CEA,LPSC
7	2.1.4 DTL beam dynamics design	RAL
8	**2.2 H-mode Drift Tube Linac**	
9	2.2.1 RF model CH tank1 RF design	
10	2.2.2 RF cold model design & construction	IAP-FU
11	2.2.3 RF model construction	
12	2.2.4 Beam dynamics design CH tank1	
13	2.2.5 CH model cavity tests	IAP-FU
14	2.2.6 CH-prototype design	IAP-FU
15	2.2.7 CH-prototype construction, tests	IAP-FU
16	2.2.8 CH-DTL beam dynamics study	IAP-FU
17	**2.3 Side Coupled Linac**	
18	2.3.1 RF model RF design	
19	2.3.2 RF model mechanical design	LPSC
20	2.3.3 RF model construction	LPSC,CERN
21	2.3.4 RF model testing	LPSC,CERN
22	2.3.5 SCL module design	INFN-NA
23	**2.4 Cell Coupled Drift Tube Linac**	
24	2.4.1 Pre-prototype construction	
25	2.4.2 Pre-prototype high-power RF tests	CERN,LPSC,CEA
26	2.4.3 Contribution to ISTC prototype construction	CERN
27	2.4.4 Revision of design after prototype testing	CERN
28	2.4.5 Testing of ISTC prototype	CERN
29	**WP3: SUPERCONDUCTING STRUCTURES**	
30	**3.1 ELLIPTICAL CAVITIES**	
31	3.1.1 Cavity A vertical tests	
32	3.1.2 Tuner design	INFN-MI
33	3.1.3 Integration of piezo design	INFN-MI
34	3.1.4 Tuner construction	INFN-MI
35	3.1.13 Cavity A assembly with tuner	INFN-MI
36	3.1.5 Design cavity B	CEA
37	3.1.6 Construction cavity B	CEA
38	3.1.13 Preparation, vert. test & welding cavity B	CEA
39	3.1.7 Power coupler design & engineering	CEA
40	3.1.9 RF couplers construction & preparation	CEA,LPSC
41	3.1.8 RF source order & construction	CEA
42	3.1.10 Modulator preparation for 700 MHz test stand	CEA
43	3.1.11 RF source testing	CEA
44	3.1.12 High power pulsed tests	CEA,INFN-MI
45	**3.2 SPOKE CAVITIES**	
46	3.2.1 Test stand preparation at FZJ	
47	3.2.2 Evaluation of 760 MHz resonator in vertical cry	FZJ
48	3.2.3 Evaluation of 352 MHz 2-gap res. in vertical cr	IN2P3-Orsay
49	3.2.4 Design of coupler prototype	IN2P3-Orsay
50	3.2.5 Construction of coupler prototype	IN2P3-Orsay
51	3.2.9 Test of coupler prototype	IN2P3-Orsay

ID	Task Name	Resources
52	3.2.6 RF design of 352 MHz multi-gap resonator	J
53	3.2.7 Engineering of resonator, coupler and tuner	FZJ,IN2P3-Orsay
54	3.2.8 Final design of 352 MHz multi-gap prototype	FZJ,IN2P3-Orsay
55	3.2.10 Manufacturing of 352MHz multi-gap prototype	FZJ
56	3.2.11 Evaluation of 352MHz multi-gap prototype	
57	**3.3 CH RESONATOR**	
58	3.3.1 Design of tuning system	IAP-FU
59	3.3.2 Construction of CH tuning system	IAP-FU
60	3.3.3 Measurement of tuning system	
61	**WP4: CHOPPING**	
62	**4.1 CHOPPER STRUCTURE A**	
63	4.1.1 Pre-prototype construction	
64	4.1.2 Pre-Prototype testing	CERN
65	4.1.3 Driver construction, testing	
66	4.1.4 Full scale prototype design	CERN
67	4.1.5 Full scale prototype construction	CERN
68	4.1.6 Prototype testing w/o beam	CERN
69	**4.2 CHOPPER LINE**	
70	4.2.1 Dump design	
71	4.2.2 Dump construction	CERN,CEA,LPSC
72	4.2.3 Beam line assembling	CERN,CEA,LPSC
73	**4.3 CHOPPER STRUCTURE B**	
74	4.3.1 Pre-prototype design and test	RAL
75	4.3.2 Prototype design	RAL
76	4.3.3 Prototype construction	RAL
77	**WP5: BEAM DYNAMICS**	
78	**5.1 Code development**	
79	5.1.1 3D space charge routines development, testing	RAL
80	5.1.2 LORASR development	IAP-FU
81	5.1.3 Neutralization and ECR source modelization st	CEA
82	5.1.4 Improvement, modelling high current	GSI
83	5.1.5 Code preparation for 3 MeV test stand	CERN
84	5.1.6 Code preparation and analysis for SC linacs	FZJ
85	5.1.7 Code comparison and benchmarking	GSI,RAL,IAP-FU,CEA,CERN,LPSC
86	5.1.8 Code benchmarking with experiment	GSI,RAL,IAP-FU,CEA,CE
87	**5.2 Experiment at UNILAC**	
88	5.2.1 Preparation, simulations	GSI
89	5.2.2 First experiment campaign	GSI
90	5.2.3 Second experiment campaign	GSI
91	**5.3 Diagnostics and collimation**	
92	5.3.1 Profile measurement prototype des., constructi	
93	5.3.2 Profile measurement testing	GSI
94	5.3.3 Non-interceptive bunch measurement design	GSI
95	5.3.4 Non-interceptive bunch measurement const., te	GSI
96	5.3.5 Halo monitor design, construction	CERN
97	5.3.9 Test and improvement of halo monitor	
98	5.3.6 On-line transmission control	GSI
99	5.3.7 Beam profile monitor design	FZJ
100	5.3.8 Collimators study	CERN
101	**5.4 Experiment at CERN**	
102	**5.5 Comparative assessment of dynamics and meas.**	

JRA3.2 Work Package 2: Normal Conducting Accelerating Structures

JRA3.2.1 Drift Tube Linac (DTL)

JRA3.2.1.1 Activities at Rutherford Laboratory (RAL) (WBS 2.1.4)

An important part of the activity at RAL was made on the chopper line, and is described on the WP4 section.
A second part of the work done at RAL is in conjunction with the RAL Front End Test Stand (FETS).
A comparative study of the beam dynamics in LINAC 4 using CERN and RAL MEBT (Medium Energy Beam Transport) lines has been made using TraceWin. Although CERN and RAL have adopted different chopping schemes, end-to-end simulations indicate that they are similar in many respects. The main difference is in emittance growth which seems to be a bit higher for the CERN case. This is due to the fact that there are more constraints in the CERN MEBT optics design, so at the output of the MEBT the emittances are already bigger in the CERN case, and this difference is more or less preserved in the downstream linac. A full report is in preparation.

Bunching cavities

Two design options have been considered: the space efficient DTL-type cavity derived from the Drift Tube Linac (Figure JRA3.2.1) and the power efficient CCL-type cavity derived from a Coupled Cavity Linac cell (Figure JRA3.2.2).

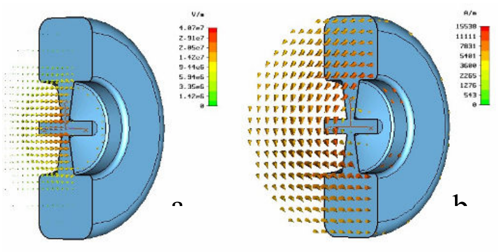


Figure JRA3.2.1: Microwave Studio 3D model of a DTL type cavity:
a) Electric Field Vector, b) Magnetic Field Vector.

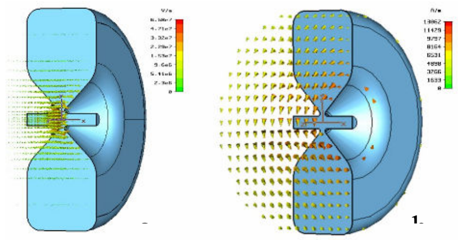


Figure JRA3.2.2: Microwave Studio 3D model of a CCL type cavity:
a) Electric Field Vector, b) Magnetic Field Vector.

The preliminary RF design of the two cavity types has been performed using 2D (Poisson SuperFish) and 3D (Microwave Studio) codes. The 3D simulation is appropriate for designs that lack cylindrical symmetry, and can include the effects of tuning elements and vacuum pumping ports. A comparison of the preliminary 2D and 3D simulations shows good agreement between codes. Representations of the 3D electric and magnetic field vectors can be seen in Figures 1 and 2, respectively for both cavity types.

Considering the space restrictions in the MEBT line, the DTL-type cavity is desirable, because it allows EMQs to be integrated inside the drift tube, whereas the CCL structure is larger and due to its geometry, the nose cone cannot easily accommodate bulky EMQs. To overcome this limitation, a special combination of quadrupoles is proposed, that will be discussed in the next section. The main advantage of the CCL buncher cavity is its power efficiency, as shown in Figure JRA3.2.3, where the effective shunt impedance for both structures is plotted for different combinations of cavity lengths and gaps. The Kilpatrick factor variation with gap length for an effective cavity gap voltage of 160 kV is also shown. A region of high shunt impedance is highlighted, allowing an optimal choice for cavity geometrical parameters to be made.

Considering the arguments given above regarding the CCL cavity's power efficiency (about 3 times more efficient than the DTL-type) and also practical considerations concerning ease of manufacture, we can conclude that this cavity type is a good candidate for a buncher cavity for the FETS project.

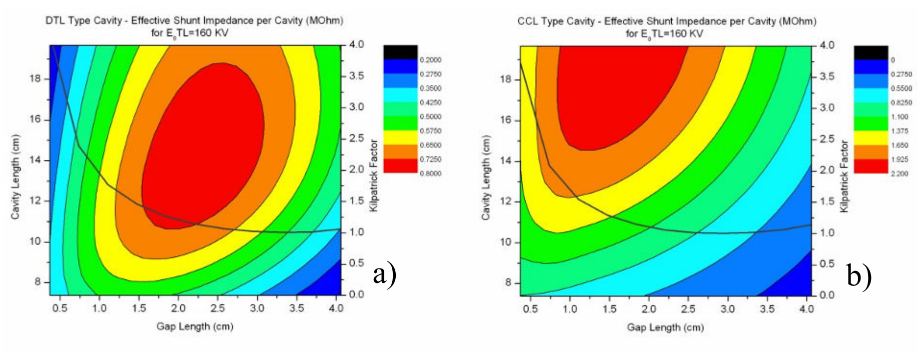


Figure JRA3.2.3: Effective shunt impedance (MΩ) and the Kilpatrick curve for a DTL-type cavity (a) and a CCL-type cavity (b).

3D simulations have continued and were aimed at problems that lack cylindrical symmetry, like the effects of tuners (tuning range and dissipated power distribution on tuners) or vacuum pumping ports.

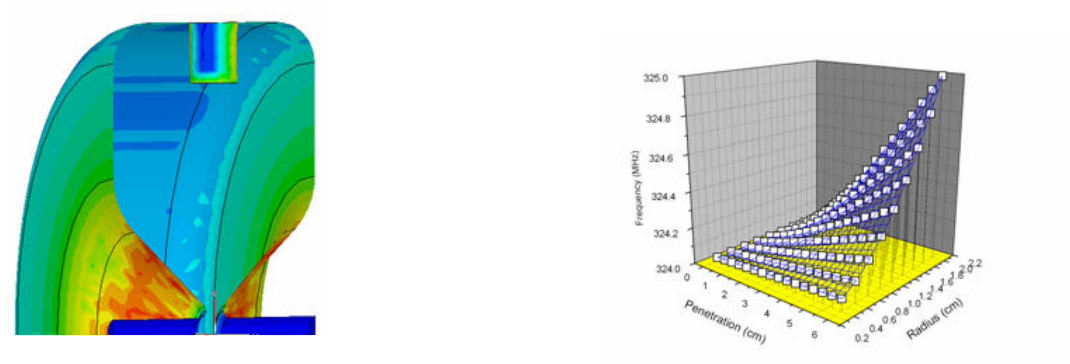


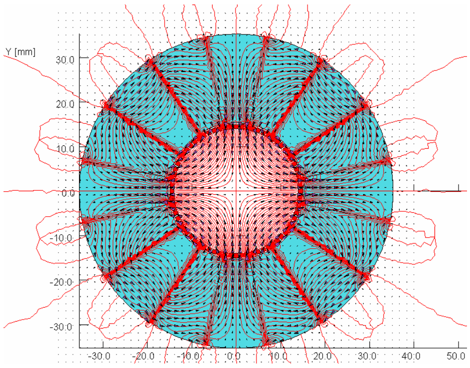
Figure JRA3.2.4: Cavity simulations

Hybrid quadrupoles

The two hybrid quadrupole designs address the requirement for a compact design, able to efficiently utilise the space inside a DTL drift tube or a CCL nose cone, combined with a (limited) ability to adjust the field gradient. The proposed "tandem" combination of PMQ and EMQ where the smaller PMQ fits inside the nose of the cavity, makes good use of the previously 'wasted space'. As a consequence of the more efficient utilisation of space, the MEBT line length can be reduced by ~ 11% when using the tandem design, and the reduction in beam-line length is expected to provide a corresponding reduction in MEBT emittance growth.

The second hybrid quadrupole design for the MEBT is a combination of PMQ with integrated cylindrical laminar conductor EMQ (Lambertson quadrupole), utilising flexible printed circuit techniques, and capable of producing modest field gradients. Integration of this structure in the bore of a PMQ should result in the summation of magnetic fields from both elements. As a consequence, the effective field gradient of the PMQ can be adjusted over a limited range, by varying the current in the laminar winding element. Preliminary magnetic field simulations using 2D codes (Pandira SuperFish and Opera 2D – Vector Fields) have been made. A 3D finite element analysis model is in preparation as well as arrangements to measure the achievable range of field adjustment, and field homogeneity of an existing PMQ – laminar quadrupole, combination.

For the laminar EMQ alone, a maximum current density of 10 Amm^{-2} allows a maximum field gradient of 0.45 Tm^{-1}. This is approximately 1% of the FETS MEBT quadrupole gradient of 40 Tm^{-1}, and provides only 10% of the required range of adjustment. To achieve the required ±10% range of adjustment, multiple circuit board layers or conductors capable of carrying larger current densities must be utilised.



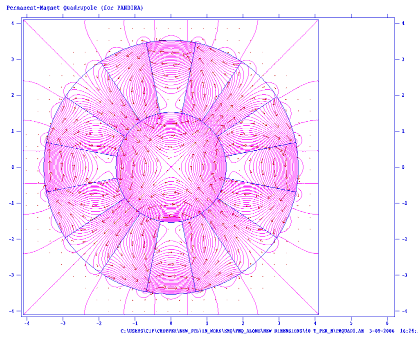


Figure JRA3.2.5:

Left:OPERA 2D plot of a PMQ with 16 wedges of material, and an integrated printed-circuit quadrupole

Right: OPERA 2D plot of a PMQ with 16 wedges of material, and an integrated printed-circuit quadrupole

Arrangements are being made to measure the achievable range of field adjustment, and field homogeneity of an existing PMQ – laminar quadrupole, combination using an SNS type quadrupole recently purchased from Aster.

JRA3.2.1.2 DTL general design at CERN, LPSC, CEA (WBS 2.1.1 to 2.1.4)

The 3D simulations of post-coupler stabilization of the DTL Tank1 have been completed, and design has started of a scaled (500 MHz) Aluminum cold model, intended specifically to test the different stabilization schemes devised in the simulations. The model will be built in Saudi Arabia during the first half of 2007, as Saudi Arabia contribution to the Linac4 R&D and to the Thesis project of Mr. N. Alharbi.
The VNIIEF Institute (Sarov, Russia), intended to build with ISTC funds a prototype of Linac4 DTL Tank1 has announced a delay in the construction of more than 6 months. Although this prototype is not part of HIPPI, the testing of critical DTL components (drift tube parts, power coupler) designed and built in HIPPI for this prototype will be delayed by the same amount of time.
In order to save time and to investigate a simpler alternative design to the Sarov prototype, the mechanical design of DTL drift tube supports and alignment has started in December at CERN.

JRA3.2.1.3 DTL and coupling port design at CEA Saclay and LPSC (part of WBS 2.1.3)

The 1MW coupling port is now completed and available at LPSC Grenoble. After a final control to be done by CERN experts, it will be sent at CERN for copper plating. As said previously, the coupling port has to be ready for the tank reception, during the first quarter of 2007.

JRA3.2.2: H-mode DTL (IAP Frankfurt)

JRA3.2.2.1 Beam dynamics design (WBS 2.2.4)

Beam dynamics design of GSI Proton Injector was completed and a dedicated HIPPI Note was published on this topic.

JRA3.2.2.2 RF cold model design & construction (WBS 2.2.2)

The cold model has been completed and the copper plating (see Fig. JRA3.2.6) was successfully performed at the Galvanic Workshop of GSI: this proofs definitely the feasibility of CH-DTL's in terms of mechanical construction.

With respect to the original idea of a "cold model" it was decided to push further this project and to include a complete water cooling system which allows high power RF tests. A picture of this complete model is presented in Fig. JRA3.2.7 where all the water pipes are visible.

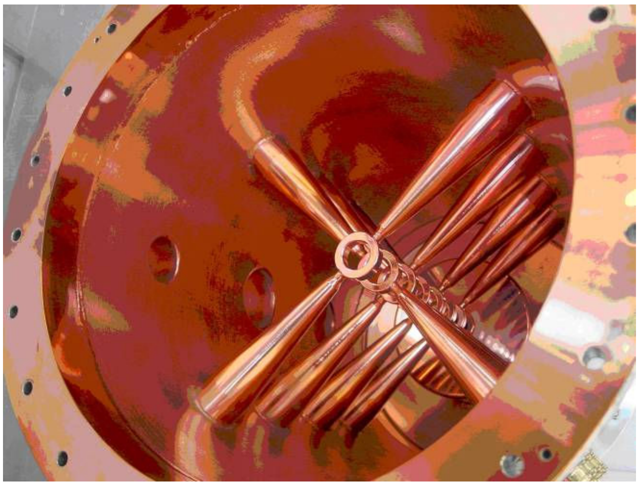


Figure JRA3.2.6: The Copper Plated CH

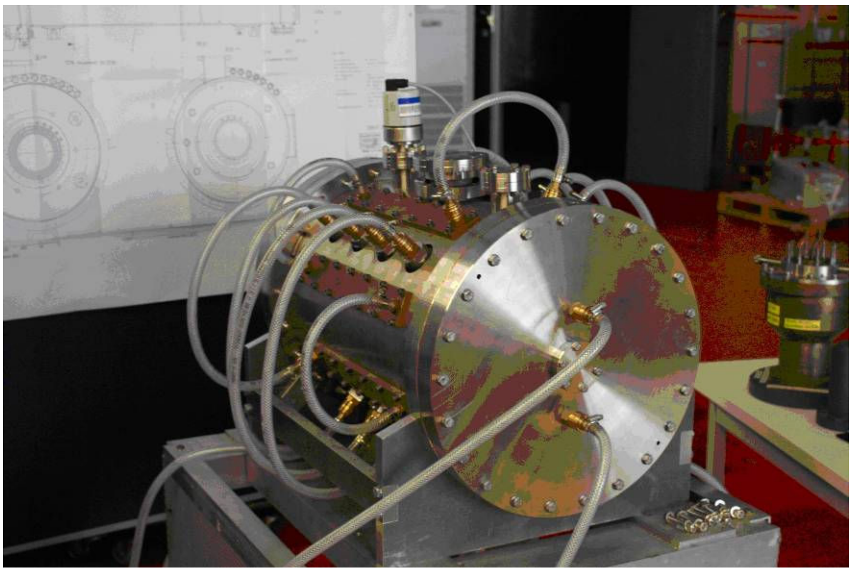


Figure JRA3.2.7: The water cooling system of the CH

In a first test a 1 kW CW power was achieved without any multipacting and the total voltage inside the cavity was 364 kV. New cables, which can stand higher power, were already ordered and a further test up to 2 kW CW is foreseen before the end of the year. A dedicated HIPPI paper is in preparation which will summarise the R&D results on this first room temperature CH.

JRA3.2.2.2 RF cold model design & construction (WBS 2.2.2)

After the LINAC06 Conference, it was decided to change the operating frequency of the GSI Proton Injector from the original 352 MHz to new 325 MHz.

There are several reasons which justify this joice:

- Large availability of 325 MHz 2.5 MW Klystrons on the market
- Most of the recent Linac projects such as ISIS, KAERI, JPARC, BSNS, FNAL Proton Booster are based on 325 MHz resonators
- Update based on CH cavities of the GSI Unilac (108.4 MHz) is foreseen in the next future (108.4) * 3 = 325.2
- Design of RFQ gets easier at lower frequency.

With respect to the original design, based on 1.1 MW CERN Klystrons, the higher power of the senders pushed us in the direction of a coupled structure: for this reason, a complete new design based on Coupled CH cavities was proposed.

The basic idea is to couple the H_{211} resonators by an intertank section which hosts the magnetic lens needed by the KONUS dynamics and which oscillates in E110 Mode. An example of this solution is presented in Fig. JRA3.2.7 where 2 CH tanks are coupled in this way. MWS Simulations (see Figs. JRA3.2.8 and JRA3.2.9) have confirmed the validity of such a new concept that will be adopted for the new GSI Proton Injector.

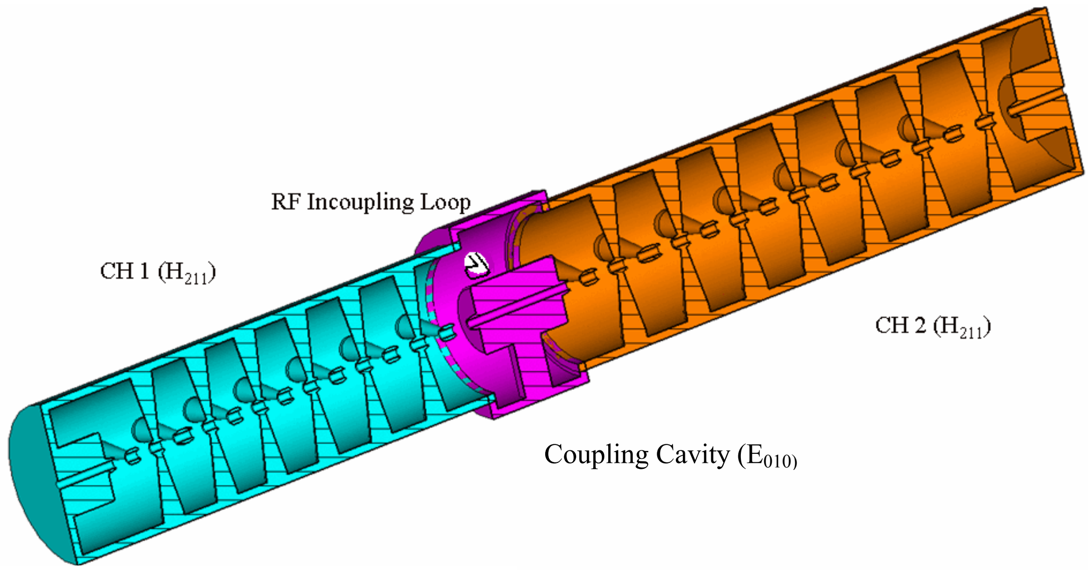


Figure JRA3.2.7: the coupling scheme for the GSI Proton Injector: two CH resonators are connected with an intertank section which host a magnetic triplet and resonates in E_{010}

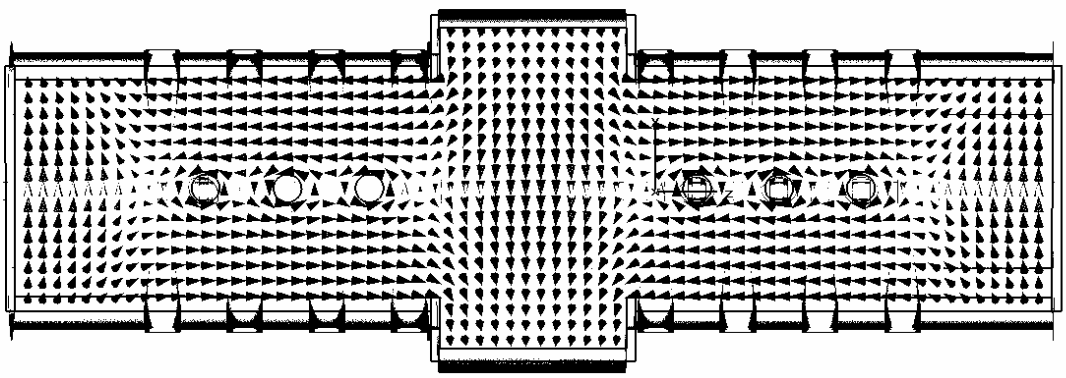


Figure JRA3.2.8: Magnetic Field lines at half radius

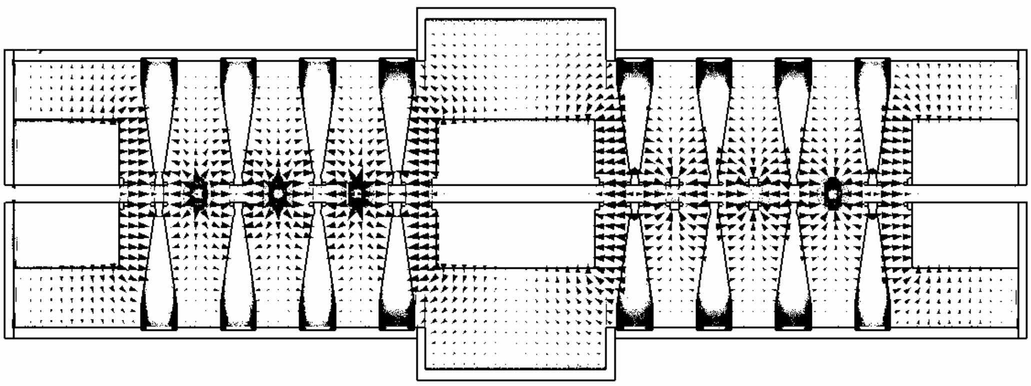


Figure JRA3.2.9: Electric Field along the cavity axis.

GSI has already approved the construction of a half scale model of tank 3 and 4 of the new Proton Injector: the design was completed with Microwave Studio and materials are already ordered. Meanwhile, the design of the full scale prototype is in progress: it is foreseen to finish its production in 2008. More details will be published at the PAC 07 Conference.

JRA3.2.3 Side Coupled Linac (LPSC and CERN) (WBS 2.3.1 and 2.3.2)

We have compared SCL layouts with and without water cooling for SPL and Linac4 duty cycle. The result is that removing the cooling channels for a structure operating only for Linac4 the shunt impedance could be improved by 14%, a value considered too low to justify the construction of an SCL for Linac4 only. The position of coupling cells has been re-optimized with the 3D program GdfidL to have smaller coupling slots. The overlapping length is now 17mm and the additional losses due to the coupling slots are 4.6%. It is considered that the slots will be remachined at 45º angle in order to equalize the slots dimensions. The peak loss density at the slots is about 300W/cm^2 when 40kW are dissipated in each accelerating cell. Figure 3 shows the new cell layout, with arrows representing the electric field.
The 2nd nearest neighbor coupling coefficients have been investigated. For 3% coupling between accelerating and coupling cells, the 2nd nearest neighbor coupling between accelerating cells is about 0.3% and between coupling cells about 0.03%.
Furthermore, the power flow droop has been studied. The relative voltage difference is 1.3% from the feeding point to the longer end of the SCL structure. This effect might be compensated by detuning the bridge coupler central cells by 100 to 400 kHz. Further simulations have been performed for tuning the SCL structure with tuners in the bridge couplers. A 5 degrees temperature change will lead to a frequency decrease of about 60 kHz and could be compensated by increasing the central bridge coupler cell frequencies by 900 kHz, which can easily be achieved.
Voltage and phase data exchanges have been prepared for beam dynamic simulations to find strategies for compensating the power flow phase shift of 4 degrees - if needed.
A comparative analysis of stability for long SCL modules and losses due to the coupling slots suggested increasing the cell-to-cell coupling from 3% to 5%, which can be realized with less than 3% reduction in Q-value.
Moreover, alternative coupled-structure designs (ACS= Annular Coupled Structure, OCS= On-Axis Coupled Structure) have been compared to the "nominal" Side-Coupled Structure. While the OCS is interesting only in case of linacs at very low duty cycle, the SC Structure presents efficiency slightly higher than that of an ACS and its construction requires about 40% less copper. These reasons are considered as sufficient to justify the choice of the Side-Coupled for the Linac4 project.

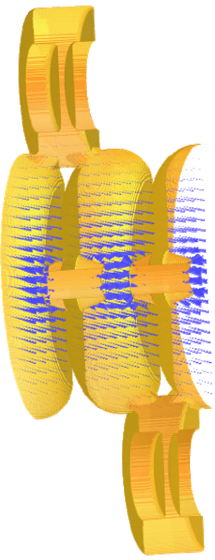


Figure JRA3.2.10: New SCL cell and slot design (with electric field arrows)

The aluminium prototype is now ready at LPSC for measurement and tuning. It is made of 11 accelerating cells and 10 coupling cells, for a 1 GHz resonant frequency. First measurements are under way since December to get the resonant frequency of each individual cell. The second step will be the fine machining of the tuning rings located both in the accelerating and coupling cells. A third and very important step will be the fine measurement of the coupling coefficients.

Figure JRA3.2.11: View of the prototype half accelerating cell (left) and coupling cell (right)

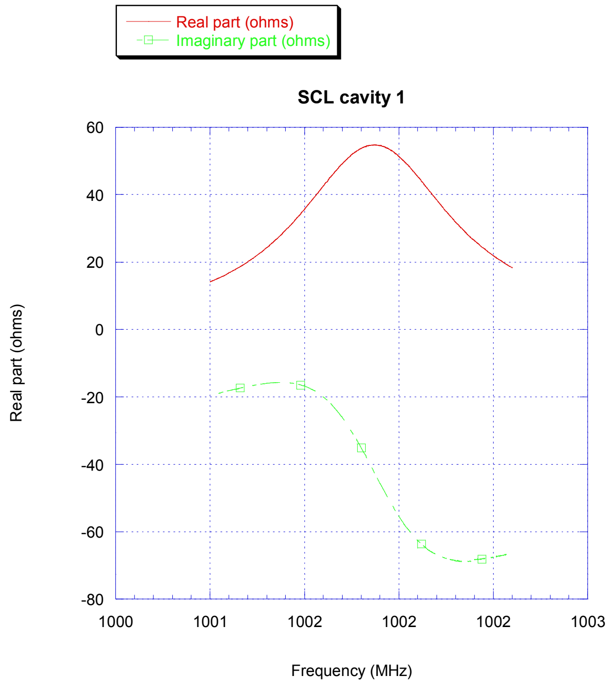


Figure JRA3.2.12: Preliminary resonant frequency measurement of an accelerating cell

JRA3.2.4 Cell Coupled DTL (CERN) (WBS 2.4.1 to 2.4.3)

After the low-level measurements on the pre-prototype, some effort has been devoted to understanding the reason for the low Q-value (65% of the theoretical one) measured. Finally, computer simulations indicated that the decision not to copper plate the surface of the vacuum (and RF) joints was at the origin of the low Q-value. From the vacuum point of view, it is considered easier to seal if the joint sits on stainless steel. However, in many systems at CERN the joints are placed on copper-plated surfaces, without particular problems. Now the simulations have indicated that the very small path that the RF current makes into the stainless steel is sufficient to reduce the Q-value by a substantial amount, and for this reason in the continuation of the project the joint surfaces will be copper plated.
After measurements, the pre-prototype went to vacuum testing. After some delays due to the CERN machine shut-down occupying all the vacuum experts, the testing started in earnest only in April. An important leak was found at the level of one of the pick-up ports. Finally, the origin of the leak was traced to a too weak external reinforcement, with the consequence that a stress during transportation or handling could have affected the internal vacuum welding. Repairing of the leak took a long time, because of the difficult access to the weld region, but was finally successful. Another smaller leak was detected on the rectangular flange for the waveguide connection. Some repair attempts failed, and the reason was finally attributed to the bad surface finishing of the rectangular flange. However, the leak level is low and the vacuum could reach the 10^{-7} mbar range. For this reason it was decided to continue the test of the prototype even in presence of this small leak, the vacuum being more than sufficient for starting the RF conditioning, but preparing at the same time a small test model of the rectangular flange, in order to vacuum test different surface finishing. The pre-prototype was finally transported at the high-power test area at the beginning of July, and connected to the klystron and to the cooling circuit. In Figure JRA3.2.13, are visible the cooling circuitry and the coupling cell, while Figure JRA3.2.14 shows the other side, with the waveguide coupler on the bottom. High power tests have started in September, the RF conditioning being particularly easy, with no sign of multipacting. The maximum power level in the cavity was

measured to be 305±10% kW at the Linac4 duty cycle of 0.1%, corresponding to an effective voltage of 1.2MV and a maximum field on the drift tubes of 1.93 Kilpatrick.
Achieving higher duty cycles was prevented by an obstruction on the cooling circuit of a drift tube, which has been dismounted and sent to the workshop for repair. The tests are foreseen to resume in March 2007.

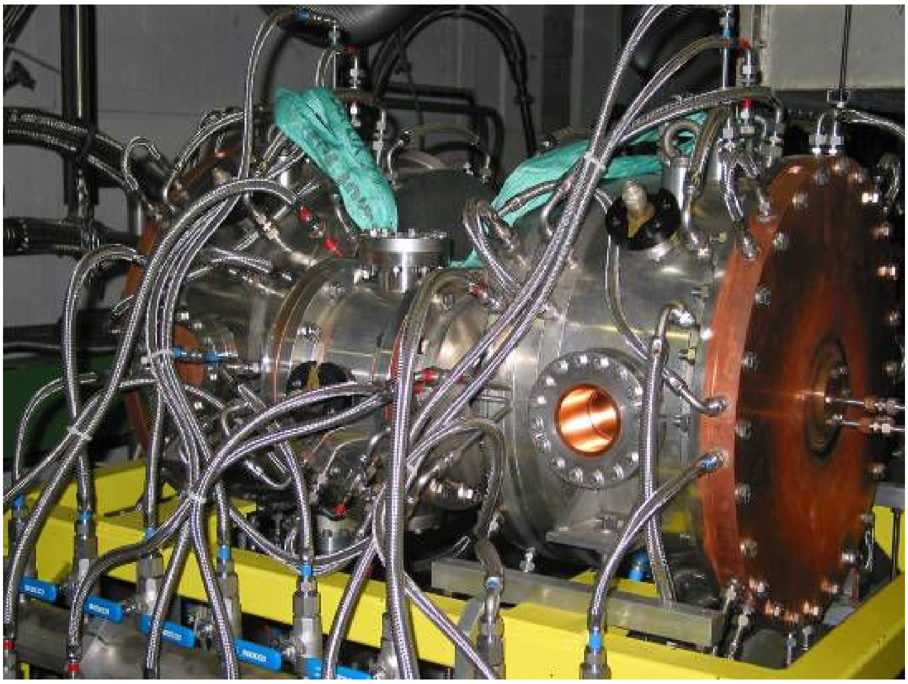


Figure JRA3.2.13: CCDTL pre-prototype at the high power test stand (cooling side).

Figure JRA3.2.14: CCDTL pre-prototype at the high power test stand (waveguide side).

JRA3.2.5 Overall Progress of Work Package 2

WBS #	Title	Original begin date (Annex 3)	Original end date (Annex 3)	Estimated Status	Revised end date
2.1	**Drift Tube linac**				
2.1.1	DTL Design	July 2004	June 2007	On time	
2.1.5	DTL Coupler prototype construction	July 2005	June 2007	On time	
2.1.4	DTL beam dynamics design	January 2004	June 2008	On time	
2.2	**H mode DTL**				
2.2.2	RF cold model design & construction	January 2004	January 2005	100%	April 2006
2.2.3	RF model construction	December 2004	June 2005	50%	December 2006
2.3	**Side Coupled Linac**				
2.3.2	RF model mechanical design	July 2004	December 2004	100%	June 2006
2.3.3	RF model construction	January 2005	December 2005	100%	October 2006
2.3.4	RF model testing	January 2006	June 2006	10%	End 2006
2.3.5	SCL module design	January 2006	June 2007	On time	
2.4	**Cell Coupled DTL**				
2.4.2	Pre-prototype high power RF tests	July 2004	March 2005	delayed	December 2006
2.4.3	Prototype mechanical design	January 2005	December 2005	100%	
2.4.4	Revision of design	October 2005	October 2006	30%	June 2007
2.4.5	Prototype high-power RF tests	August 2006	June 2007	Delayed	December 2007

Status with respect to the interim reports and deliverables due in 2006 according to the MS project breakdown

WBS #	Title	Due date in Annex 1	Status	Revised delivery date
2.2.7	CH Prototype design, construction, tests: prototype ready (deliverable)	December 2006	Delayed	Spring 2008 (see text)
2.4.4	CCDTL Prototype design, construction, test: design report (deliverable)	December 2006	Delayed	April 2007
2.4.3	CCDTL Prototype ready	June 2006	Achieved	September 2006
2.4.1	CCDTL Intermediate Report	June 2005	Achieved	August 2006

JRA3.3 Work Package 3: Superconducting Accelerating Structures

The annual HIPPI-WP3 meeting took place at Jülich (Germany) on April 27 and 28. The programme (http://www.fz-juelich.de/ikp/hippi/spring2006/AgendaWP3.pdf) included a total of 8 presentations, one of them specifically for the joint session with WP5. A copy of the slides is available on the workshop web site:
http://www.fz-juelich.de/ikp/hippi/spring2006/talks.html

JRA3.3.1 Activities at INFN-Milano

JRA3.3.1.1 Mechanical design of tuner (subtask 3.1.2) and Integration of piezo design (task 3.1.3)

These tasks for the design of a fast/slow coaxial tuner have been completed, with the emission of the construction drawings and the delivery of the intermediate report on the tuner design (CARE-Note-2006-003-HIPPI).

JRA3.3.1.2 Construction of cavity B (subtask 3.1.6)

The niobium material (sheets, disks and tubes) is supplied. Two of the 10 disks necessary for the cavity cells fabrication show scratches. However, we got confirmation from industries that these sheets can be used all the same, since depth of the scratches is lower than 15 microns. The “cavity B” order has been placed in May 2006 to the ACCEL company which proposed to fabricate the cavity in seven months (Dec. 2006). Unfortunately, we learnt last November that this fabrication, which is also a CARE deliverable, will be delayed to end of February 2007, because the supplier needed to redesign the area of a special piece (the H-ring) and introduced a weld very close to the braze. In order to prove that the weld close to the braze is allowable, samples were produces whose results demonstrated the feasibility of this approach. Moreover, the procurement of the 1.4429 (316 LN) steel took longer as expected. This material has now a very long delivery time (more than three months) due to the very tense steel market situation.
So far, the supplier has produced all tooling for turning and welding (also for the cells), have designed and fabricated the tooling for the stiffening rings. The tooling for deep-drawing and spinning are complete. Nipple pulling and spinning are in progress, as well as the brazing of all flanges and the H-ring to the pipes.

In parallel with the cavity fabrication, we prepared the mechanical set-up for cavity field flatness adjustment. This set-up is now delivered and will be installed and operational at cavity delivery.

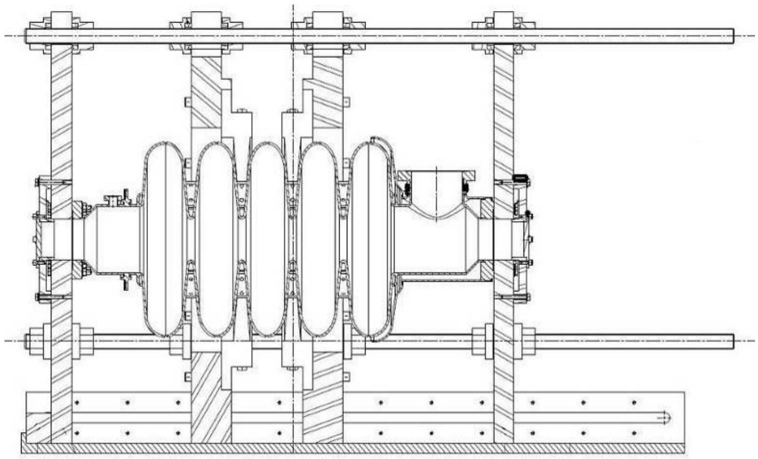


Figure JRA3.3.1: Set-up for cavity field flatness adjustment

JRA3.3.1.3 Power coupler design and engineering (subtask 3.1.7)

The coupler drawings have been completed, taking into account all the installation procedure in CryHoLab. Modifications of the original coupler flange have been necessary to ensure a safe handling of the coupler when assembled on the cavity and transported from the clean room to the cryostat. A technical exchange with the Toshiba Corporation started in early September. They have now reviewed our design for manufacturability and are ready to propose a technical and commercial offer.

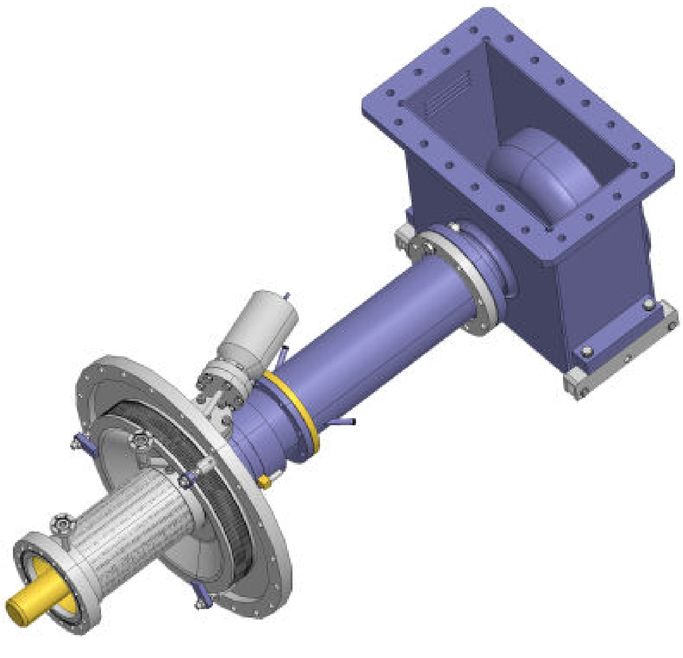


Figure JRA3.3.2: The 704 MHz power coupler

The prototype window built by Toshiba was measured using special RF adapters. The reflection coefficient is very low at 704.4 MHz (S_{11} = -42 dB), and the bandwidth is very wide, more than 200 MHz at -30dB (see next figure).

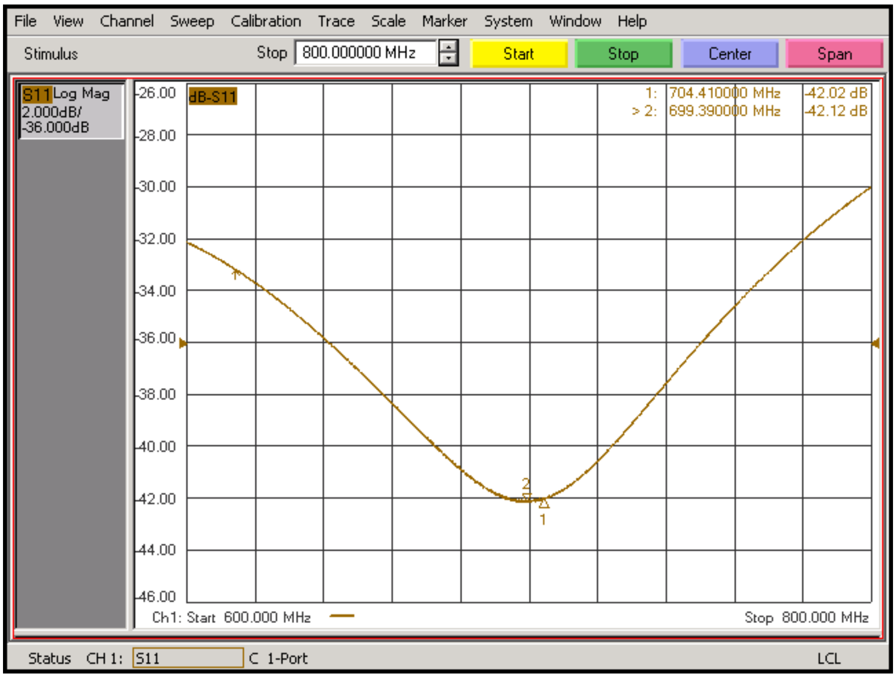


Figure JRA3.3.3: 704 MHz prototype window RF measurement

The final analysis of the modified coupler that will be installed on the INFN cavity ("cavity A") is under way. The diameter reduction of the outer conductor from 100 mm to 80 mm is located on a short taper very close to the coupler/cavity flange. With this configuration, the helium cooling channels of the outer conductor are left unchanged with respect to the standard 100 mm coupler.

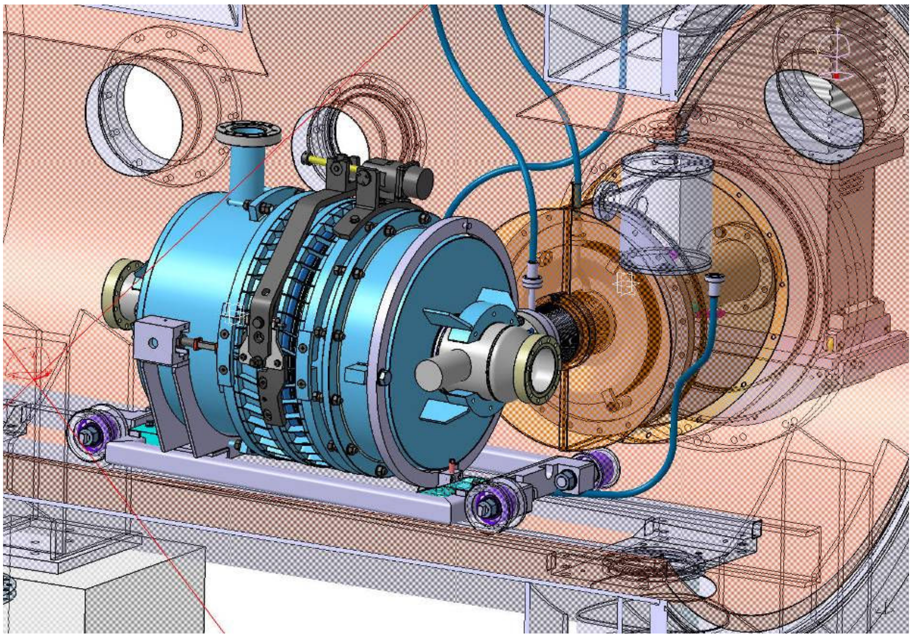


Figure JRA3.3.4: INFN cavity ("cavity A") integrated in CryHoLab

JRA3.3.1.4 RF source order and preparation (subtask 3.1.8)

The 1MW klystron (VKP-7952C) has been ordered to CPI (Communications & Power Industries) in August 2005 and has been delivered in September 2006, after the qualification tests performed by CPI.

The fabrication of the 1MW peak circulator has been delivered after low power measurements (VSWR measurements at all the phases and matching conditions). It has been delayed with regards to the original schedule due to some difficulties encountered for the procurement of the ferrites and because the system compensating the temperature fluctuation based on the adjustment of the magnetic polarization in order to stabilize the center frequency of the circulator bandwidth, was not fully operational. After some efforts, all the problems have been successfully solved.
In summary, the main RF components of the 700 MHz power test stand were delivered in time. We studied the implantation of all these components in the RF area of our new hall. Definition of the wave guides elements as well as the water cooling circuit is now completed, but we still have to order and install these last components. Our goal is to perform high power tests of the equipments before April 2007 in order to end the RF connections in May 2007.

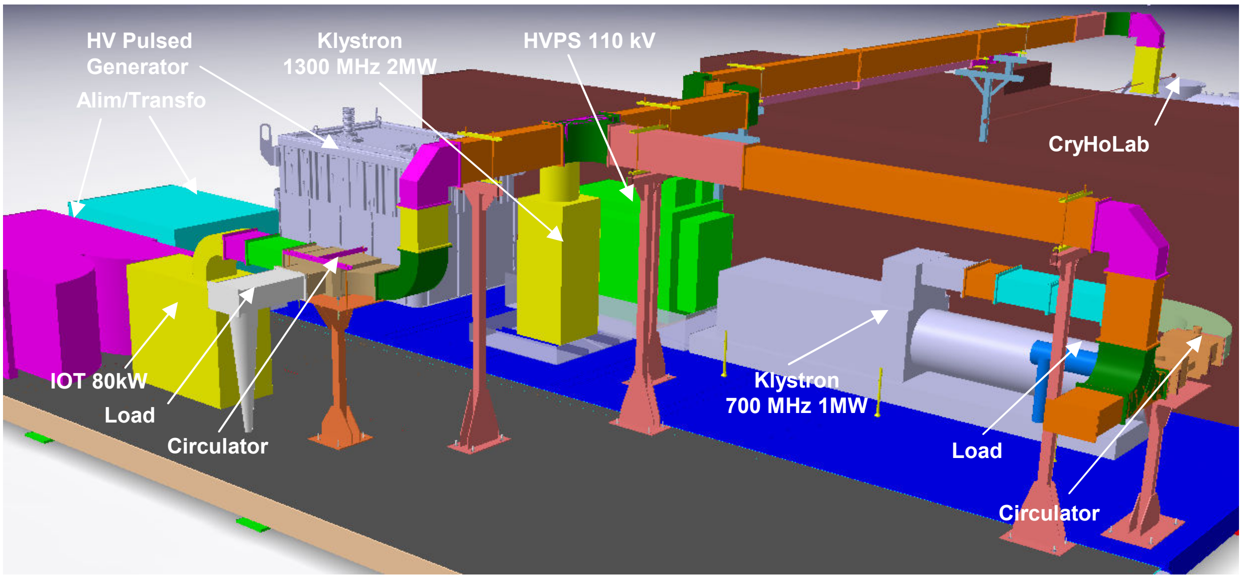


Figure JRA3.3.5: Sketch of RF area with the new 700 MHz components

JRA3.3.1.5 Modulator preparation for the 700 MHz test stand (subtask 3.1.10)

The 110kV power supply has been ordered to Transfo-Industries last February. They completed the study in April, and delivered it in November 2006 after successful qualification tests.
Modifications of the existing HV pulsed generator are progressing well. All mechanical parts are ready, and the assembly of the new HT components is almost finished. The pulsed generator should be ready for January 2007.

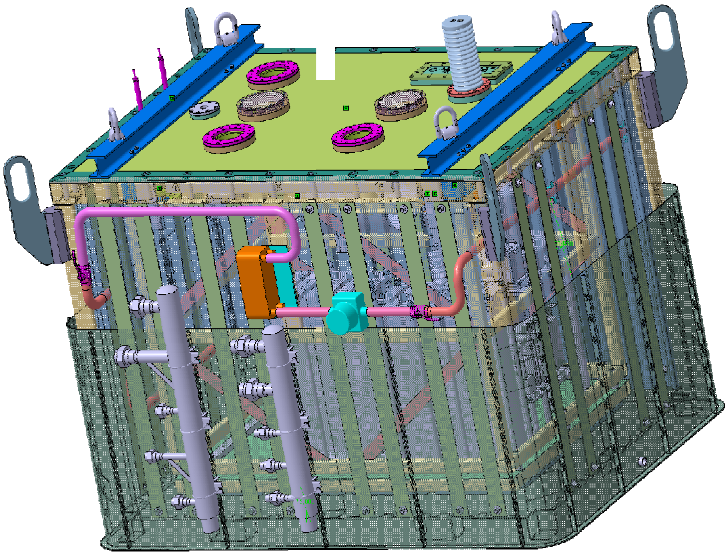


Figure JRA3.3.6: 3D model of the HV pulsed generator

JRA3.3.3 FZJ Activities

JRA3.3.3.1 Evaluation of 700 MHz resonator (task 3.2.2)

All deliverables are delivered

JRA3.3.3.2 RF design of 352 MHz multi-gap resonator (task 3.2.6)

The RF design of the 352 MHz resonator was frozen. It was decided to build the resonator without He cover for use in a bath cryostat. Two different scenarios for cavity stiffening have been worked out: (i) rings welded onto the cylindrical surface and ribs welded onto the end caps and (ii) rings welded onto the cylindrical surface and copper sputtering of the end caps. Both scenarios are being investigated for suitability. The best one will be chosen for the HIPPI resonator.

JRA3.3.3.3 Final mechanical design of resonator (subtask 3.2.7)
Drawings of the mechanical design of all resonator parts are finished. Little activity remains to account for the choice of stiffening of the end caps (cf. subtask 3.2.6).

JRA3.3.3.4 Integration of coupler. Tuning options (subtask 3.2.8)
Coupler is contributed by IPN-Orsay. Integration of the coupler is in progress. Tuning option and coupling scenarios are discussed in the Design Report. Coupler ports are prepared. All ports include a ring to allow easy addition of a He cover for possible later use outside a bath cryostat.

JRA3.3.3.5. Preparations for electron beam welding (subtask 3.2.9 – new sub task)
RRR values of EB welded niobium seams can be measured in-house now. Fig xxx shows the set-up with probe detail. Extensive welding studies were performed for 4 mm niobium, with the result that conduction welding provides the best seam quality on the inner surface.

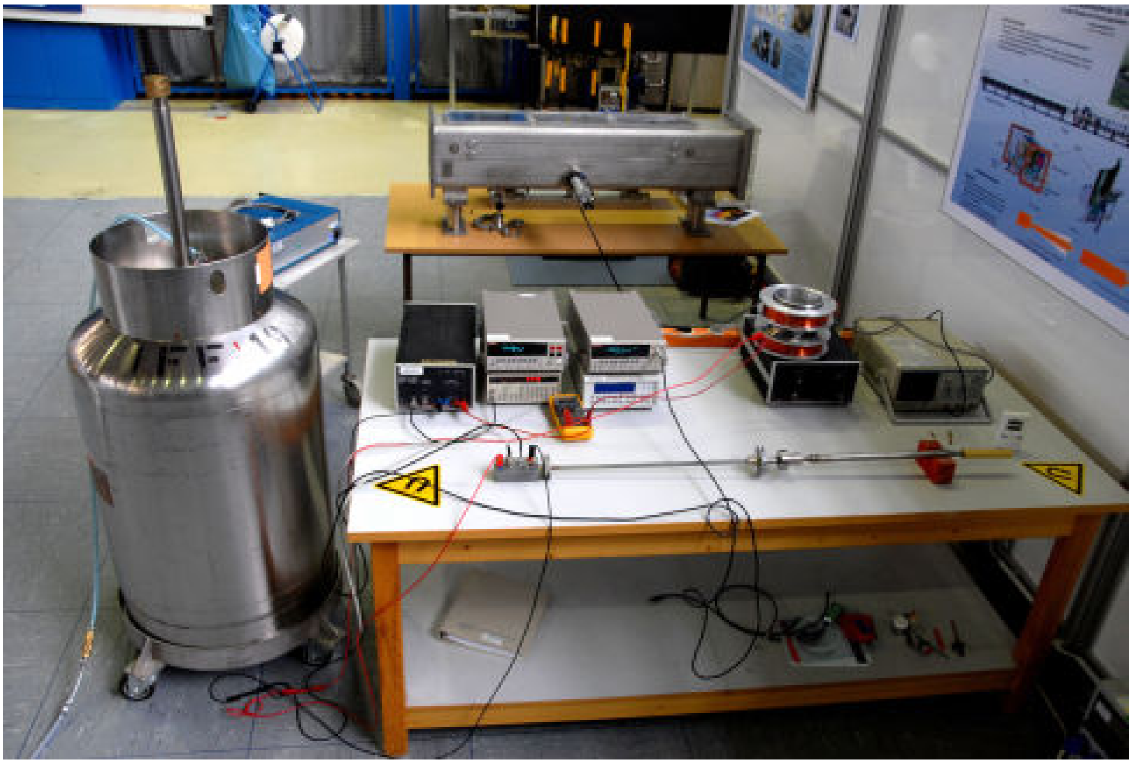


Figure JRA3.3.7: RRR measuring set-up

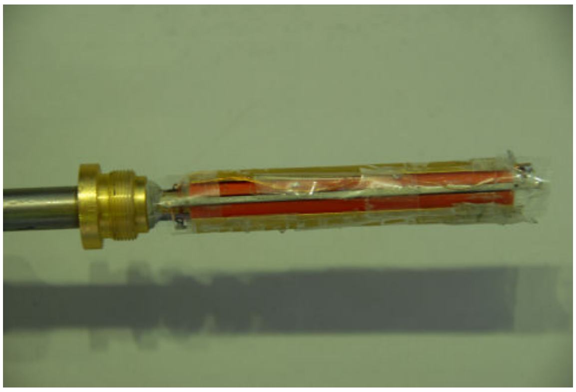


Figure JRA3.3.8: RRR measuring probe detail

Manufacturing of 352 MHz Multigap Resonator (subtask 3.2.10)

Sheets for all relevant parts of the cavity are on site right now. Delivered surface quality forced us to check the surfaces of the sheets for defects. Eddy current scans are complete now. Sheets for spokes and end caps entered the forming process.

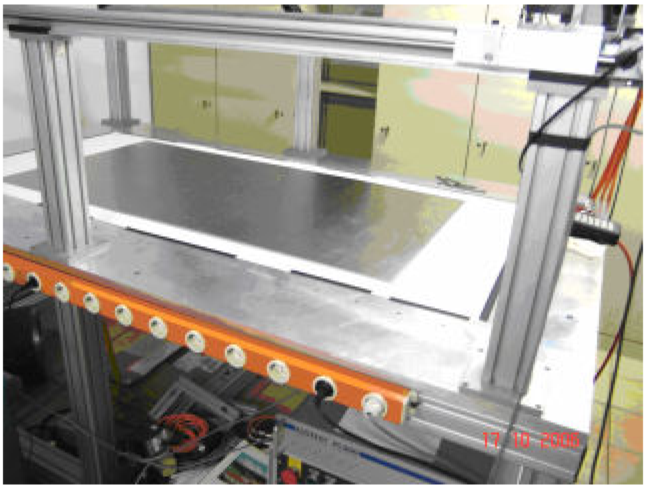


Figure JRA3.3.9: Eddy current testing of the sheets at ROHMANN company

All niobium sheets delivered by Wha Chang have now been checked via eddy current scans. Spokes could be formed successfully. 4 niobium sheets for end caps were tested, giving 3 samples with sufficient surface quality to start the forming process. The big sheets of the cavity body are measured now. Interpretation of results has started.

Figure JRA3.3.10: Formed niobium spoke half

JRA3.3.4 CNRS-Orsay Activities

JRA3.3.4.1 Evaluation of 352 MHz 2-gap prototypes (task 3.2.3)

A Stainless Steel helium vessel has been added to the beta 0.15 spoke cavity body in December 2005.

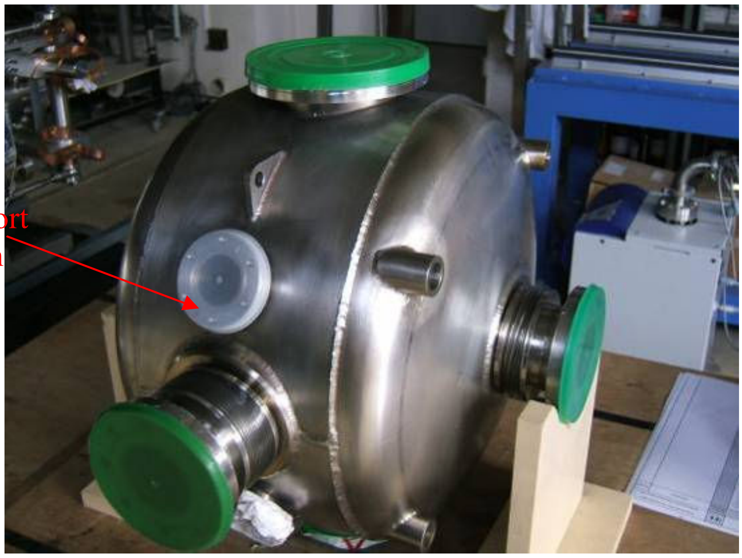


Figure JRA3.3.11: Beta 0,15 spoke cavity with its helium vessel

A test was performed in June 2006, in our vertical cryostat, at 4.2K. The preparation of the cavity has been made in the clean room at the CEA/Saclay:

- BCP chemistry : 120 µm removed
- 2 hours of High Pressure Rinsing through the 4 ports

Figure JRA3.3.12: Chemical polishing (left) and Spoke cavity on the HPR set-up (right)

The main goal of this test was to test the “cavity + Helium vessel” as a whole and the coupling by the dedicated RF port. No leak was observed and, as expected, no extra-losses on the antenna while coupling by the ∅56 mm RF port. Thus, we are able to use the beta 0.15 spoke cavity inside our horizontal cryostat CM0, which is going to be assembled before the end of this year.

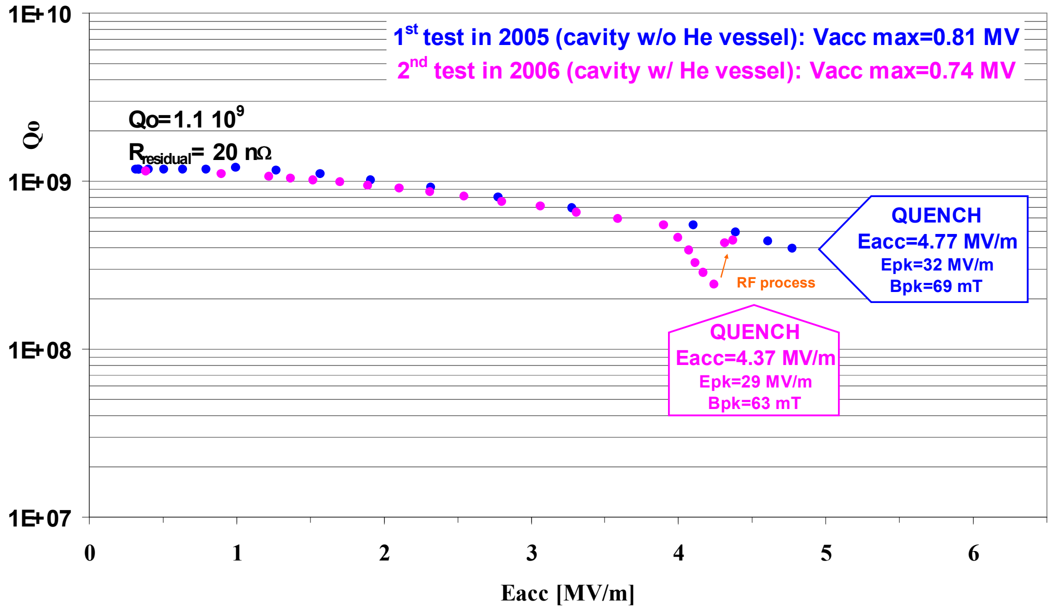


Figure JRA3.3.13: Cavity performances in vertical cryostat (Eacc is normalized with respect to βλ=0.17 m with β=beta optimal=0,20).

With the new preparation described above, we have hoped to reach a better gradient, as compared with the one achieved in May 2005 (the gradient was limited to 4.77 MV/m ⇔Bpk=69 mT, see blue curve). This new "heavy" chemistry was done in order to remove suspected "big" defect(s) on the surface. As shown on the graph, we did not see any improvement (Eacc max=4.37 MV/m). The cavity performances were again limited by a thermal quench at, more or less, the same peak surface magnetic field level.

The main goal for 2007/2008 is to test this cavity fully equipped with its power coupler and tuning system within our horizontal cryostat CM0.

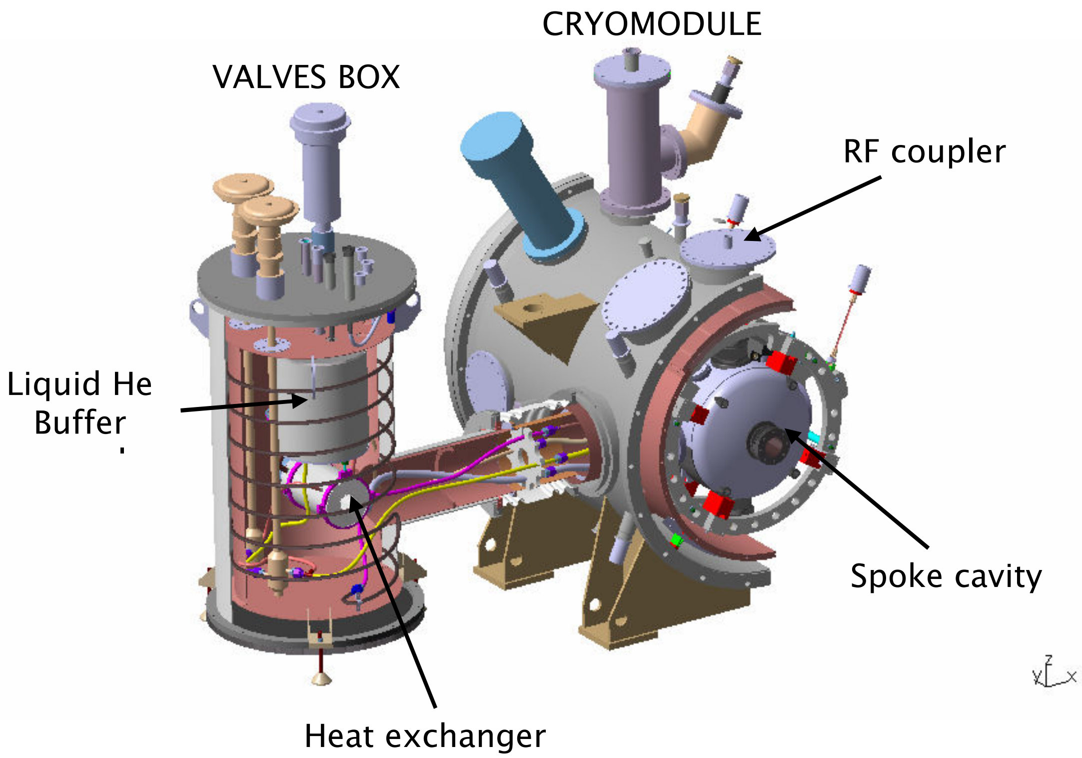


Figure JRA3.3.14: Sketch of the cryostat CM0 prepared for the test of spoke cavities

JRA3.3.4.2 Design of coupler prototype (task 3.2.4)

At the beginning of May 2006, two RF windows have been ordered to the French company SCT. The delivery is foreseen the first week of December 2006 and first measurements, at low power, should follow to validate their RF design (i.e. measurements of S parameters).
Completion of these couplers (by adding the antenna) should take place in January/February 2007.
In parallel, we are designing the RF test bench for the high power conditioning of these couplers. Couplers are intended to be tested at 10 kW at the end of 2007. For that purpose, we also started the fabrication of a 10kW solid-state amplifier in close collaboration with INFN Legnaro.

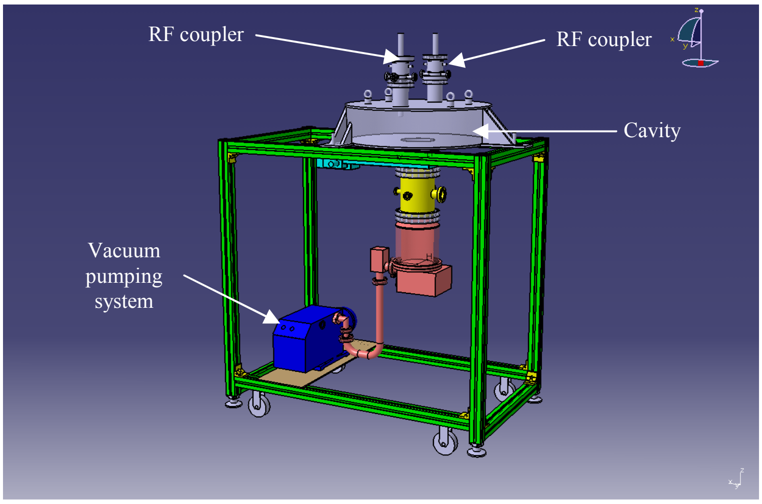


Figure JRA3.3.15: Sketch of the 10 kW RF coupler test bench

RF design of 352 MHz multi-gap resonator (subtask 3.2.6)

Following the results on Lorentz forces detuning factor performed with SOPRANO, CAST3M and CATIA, new calculations has been done on multi-gap spoke sensitivities.
About the cavity's tuning: the resonance frequency sensibility versus an imposed longitudinal displacement has been evaluated. The value of 136 kHz/mm is obtained by the simulations.
The frequency shift due to the fluctuation of the bath's pressure has been also calculated. The results show 5 Hz derivation of the frequency for 1 mbar variation of the bath's pressure. FJZ Jülich has obtained 2-10 Hz/mbar for this factor.

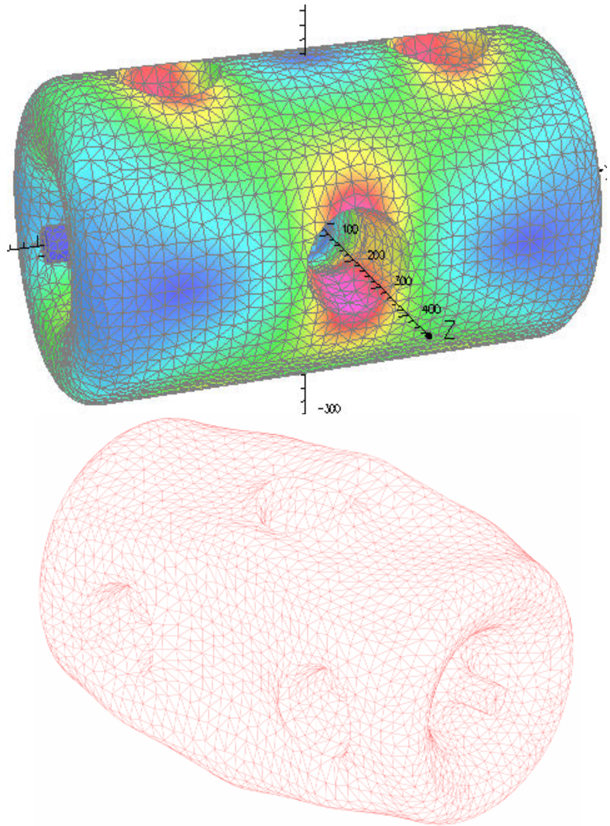


Figure JRA3.3.16: H field distribution (Soprano) and deformation due to Lorentz forces (Cast3m)

JRA3.3.5 IAP-FU Activities

JRA3.3.5.1 Conceptual study of tuning system (subtask 3.3.1)

The following mechanical analysis forms the basis of a conceptual study of a tuning system for the 19-cell superconducting prototype cavity that consists of a slowly acting mechanical device and fast piezo elements.

The mechanical analysis of the CH-structure is focused on the description of the deformation under loads at liquid helium temperatures. Mechanical loads are either applied uniformly on the surface like the hydrostatic vacuum pressure inside the cavity or are applied locally by controlled external forces. Every deformation results in a change of the eigenfrequency and can be used to tune the cavity. All loads have to be limited by fracture criteria to avoid a mechanical damage of the structure. The first experimental evidence of a frequency shift is observed by the cooling of the structure which results in a homogeneous contraction. If the cavity is unconstrained no additional stresses occur in the material. The measured changes in frequency can be compared with calculated values, obtained by uniformly scaling the model for the CST Microwave Studio analysis according to temperature dependent contraction data for niobium. The next figure shows the comparison, where the data points with error bars are related to the experiments and the black data squares show the simulation results. Relatively large temperature differences along the cavity occurred during the rather fast cooling procedure. The experimental temperatures are averaged values of all sensor outputs.

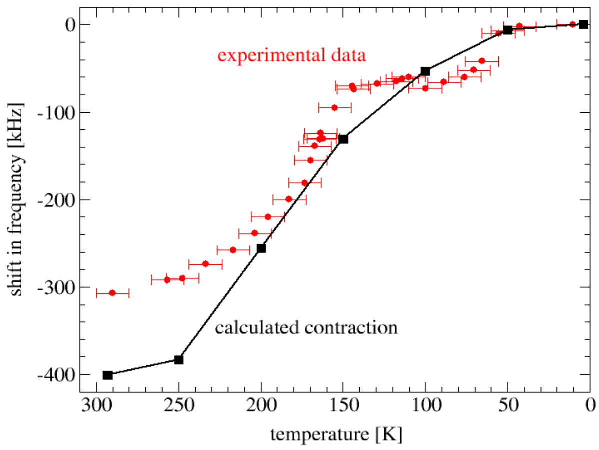


Figure JRA3.3.17: Shift in resonance frequency during cooling to liquid helium temperatures

For the tuning of the cavity the effect of an external force applied on the outer half drift tubes parallel to the beam axis is analysed. Since the body of the structure is quite rigid only the deformation of the end caps is considered. The FEM tool COMSOL Multiphysics has been used to investigate the structure mechanical behaviour. An applied force of 4 kN pushing at the drift tubes of the cavity leads to a maximum displacement of 0.59 mm.

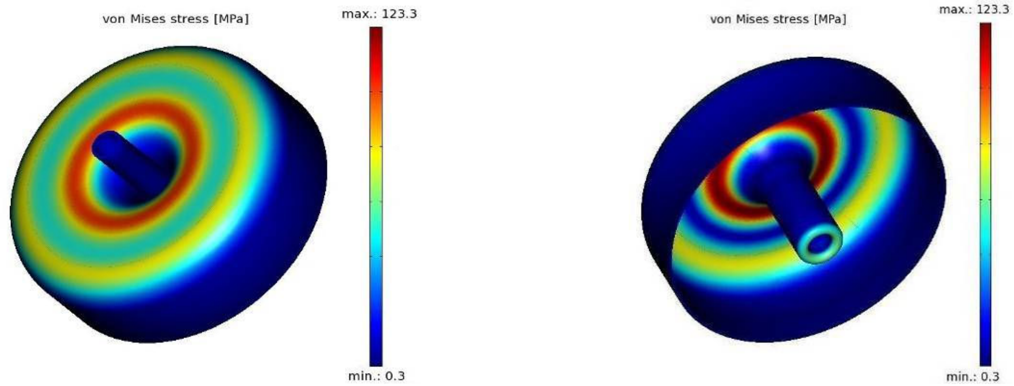


Figure JRA3.3.18: Deformed end cap at an external force of 4 kN from outer (left) and inner (right) side of the cavity

The red shaded regions depict the maximum values of the von Mises stress that are plotted in the next figure. A negative external force is obtained by pulling both ends of the structure. The minimum of the von Mises stress is not reached at zero external force, because it is assumed that the cavity is under vacuum and the atmospheric pressure applies on the outer surface.

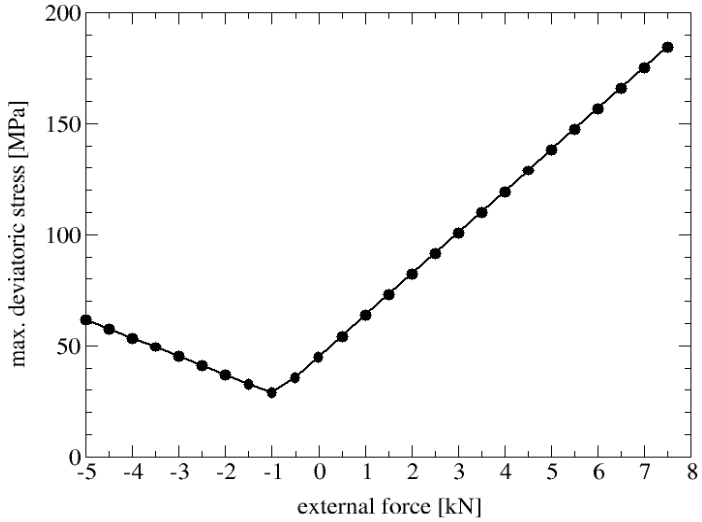


Figure JRA3.3.19: Maximum values for the von Mises stress

In order to calculate the shift in frequency we replace the undeformed end caps in the model for the CST Microwave Studio simulation by the deformed ones for several values of the external force and redo the eigenmode analysis with the same mesh parameters. The main effect that causes tuning is the change in capacity due to a variation of the end gaps.

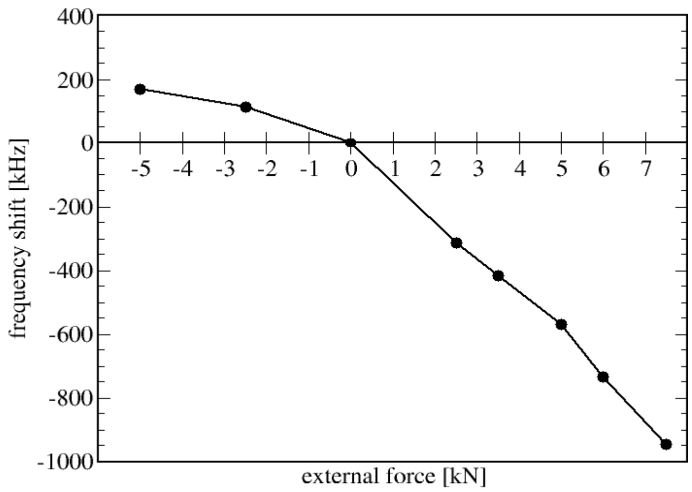


Figure JRA3.3.20: Shift in frequency due to external force

The electric field distribution along the axis of the cavity changed, mainly caused by a reduction of the end gaps (see next figure: The black coloured line corresponds to the undefomed structure. The effect at the position of the first gap, where the displacement reaches its maximum value is depicted on a larger scale). Each end gap length was reduced by 0.73 mm, the frequency was shifted by 600 kHz, corresponding to an external force of about 5 kN.

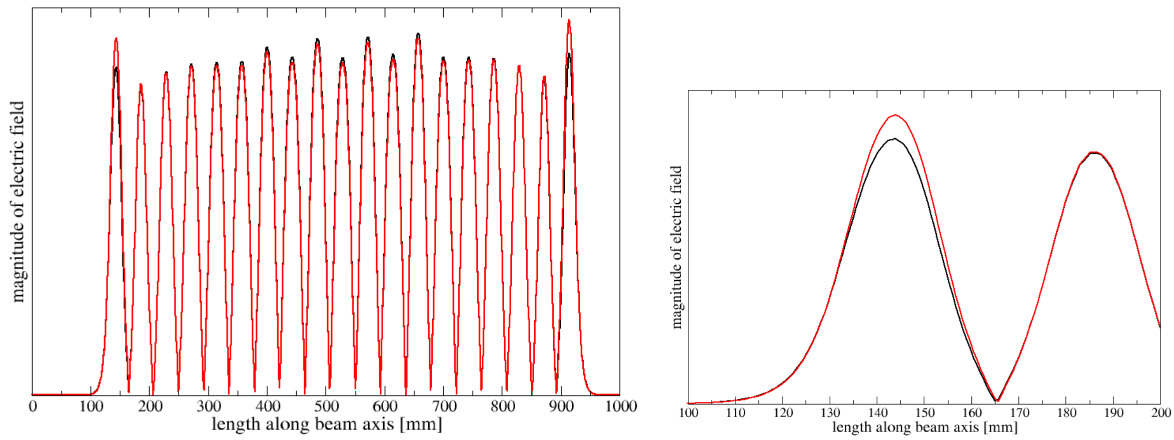


Figure JRA3.3.21: Simulated change in electric field distribution along the axis of the cavity (left) and change in electric field distribution across the first and second gap (right).

Vacuum pressure and Lorentz detuning

There is further experimental evidence for a shift in frequency due to a change in external pressure and a variation of the squared electric field strength.

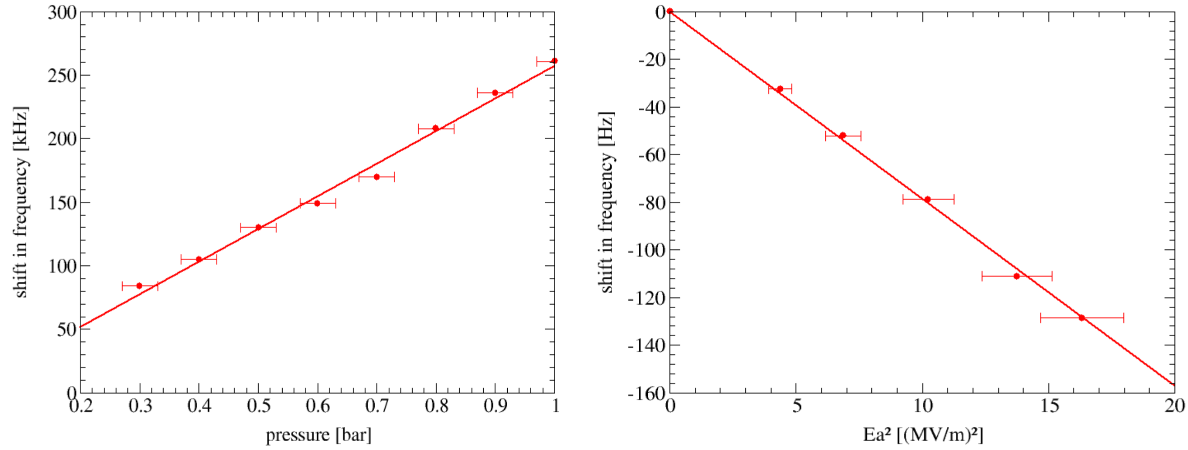


Figure JRA3.3.22: Shift in frequency due to change in external pressure (left) and due to the Lorentz detuning (right)

Mechanical Cavity Vibrations (Microphonics)

For the simulation of the vibrational eigenmodes of the system we take a connection between the outer drift tubes and the corpus of the cavity into account, which had not been implemented in the model from the very beginning. Next figure shows a picture of this detail, which has a strong influence on the characteristics of the vibrational modes at low frequencies.

Figure JRA3.3.23: Connection between outer drift tube and cavity body

In addition new symmetry boundary conditions have been applied, which make it now possible to describe the whole length of the cavity. The advantage of this description is that a variation of the geometry of the inner structure of the cavity along the longitudinal axis can be taken into account in the future.

The ends of the drift tubes are fixed in space during the simulation, which explains why the minima of displacement are settled there (next figure). The vibrational modes in the area of frequencies < 100 Hz should be avoided (coupling to background noise and vibrations at the power supply frequency of 50 Hz). The first mode has no transverse displacement and shows a movement along the longitudinal axis only. The cavity is assumed to be fixed in a horizontal position under the impact of gravity. The second mode shows transverse displacement. In the new testing facility these modes will be damped by an accordingly designed mechanical support between cavity and cold mass of the horizontal cryostat.

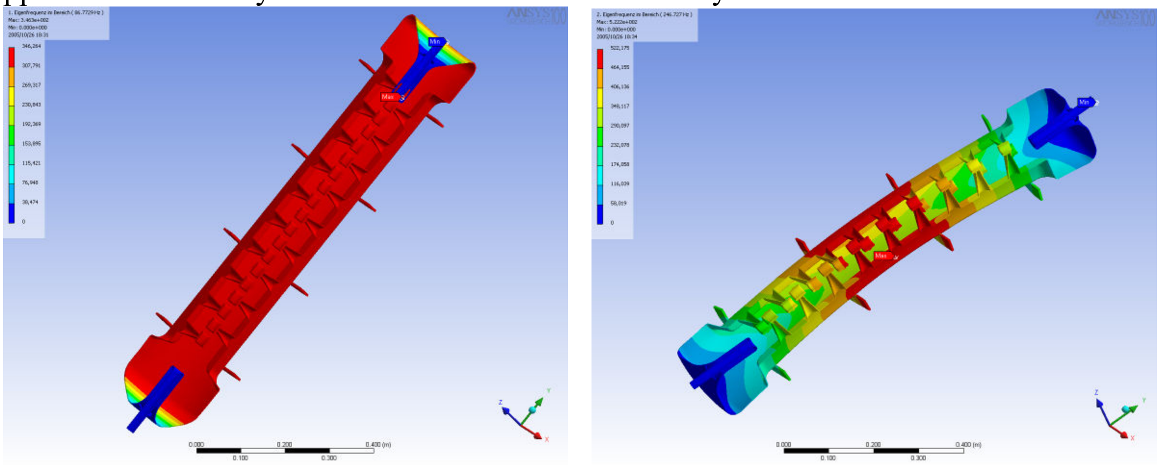


Figure JRA3.3.24: First vibrational mode of the CH prototype at a frequency of 87 Hz (left) and second vibrational mode of the CH prototype at a frequency of 247 Hz (right)

The vacuum chamber and the thermal shield

In order to prepare the due work, an important part of the activity was dedicated to the fabrication, measurement and development of components which are strongly linked to the tuning system. For testing purposes a cyromodule has been supplied, which offers the possibility to operate the cavity in horizontal position.

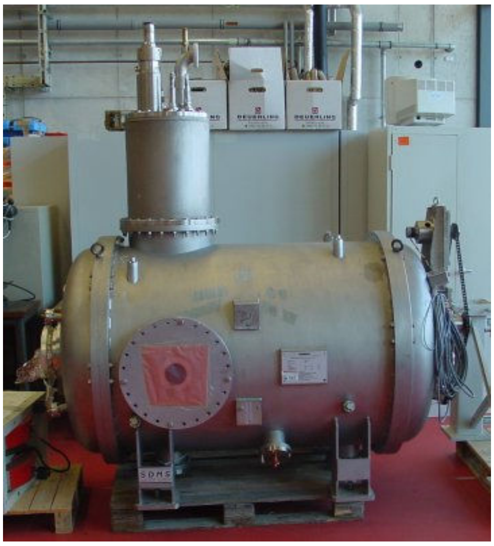


Figure JRA3.3.25: Cyromodule with tuning possibility for operation in horizontal position

The copper thermal shield is cooled by LN2. So there are two supplies on the top tower of the cryostat, one for nitrogen and one for helium. In its original set-up also the vacuum for thermal isolation was applied from the top. The supply tower of the cryomodule has to be reconstructed, especially with respect to the helium supply in order to fit with the standards of the already existing equipment. Additionally a new vacuum pump has to ordered that can handle the large volume of the chamber for thermal isolation purposes. Many of the sealings have to be replaced. In the vacuum chamber mainly Viton sealings are used, while in the cold mass HelicoFlex sealings have been applied.

Figure JRA3.3.26: Center part of the vacuum chamber and the copper thermal shield inside

Coarse Mechanical Tuning

On one end of the module the mechanical tuning unit is located, that is driven by a chain and a stepping motor. A new stepping motor has to be selected and there is a need for a controlling unit. The tuning range of this tuner is about 600 kHz for a displacement of the drift tube of the cavity of 0.73 mm. A force of 5 kN is necessary to achieve this.

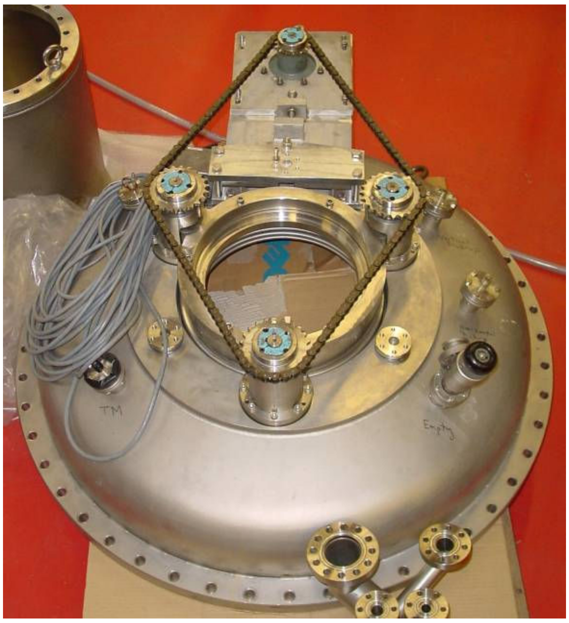


Figure JRA3.3.27: Mechanical tuning unit on one end of the cryostat

Incorporation of the cavity in the cold mass

The open cold mass acts as a liquid helium tank and incorporates the cavity. The magnetic shielding is inside of this cylinder.

Figure JRA3.3.28: Main part of the cold mass with magnetic shielding inside

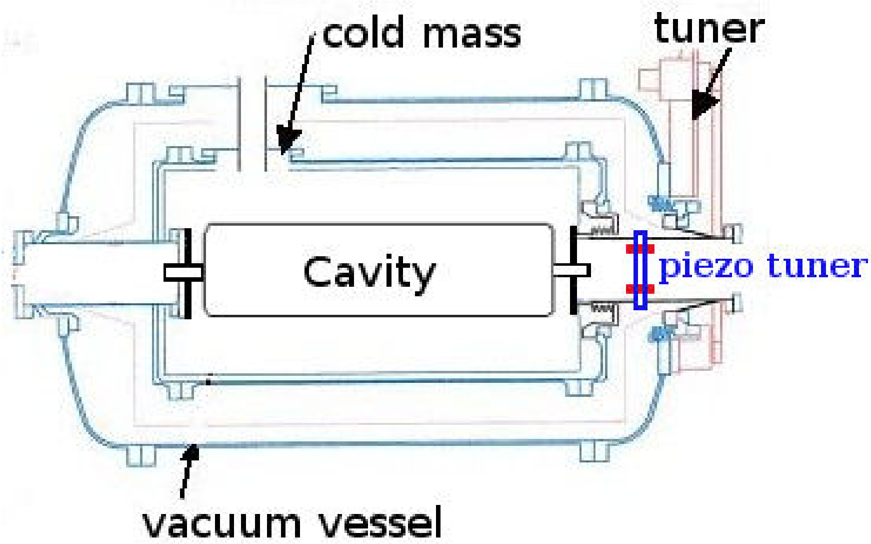


Figure JRA3.3.29: Cross sectional view of the cryostat showing the position of piezo tuner and mechanical tuner

Two flanges are designed to position the cavity in the cold mass. One flange insures a connection between the left side of the cavity and the end flange of the cold mass. This connection is stiff against axial motions, but it allows free choice of the angular position of the cavity. The inner ring with 6 drill holes settles the position, where the ends flange of the cavity will be fixed. In addition to the end flanges, the corpus of the cavity is fixed within the cold mass by 2 rings that are connected to the welded stiffening rings of the cavity near the end caps. These rings are connected to the cold mass by 8 threaded rods that fix the horizontal position of the cavity. The outer ring has the same radius as the cold mass and is introduced for simulation purposes. The rods have been chosen to adjust the horizontal position of the cavity. The advantage of this construction is that there is only a small resistance against the tuning forces along the beam axis. The rods are strained at the operation temperature of 4 K and therefore contribute to the damping of mechanical vibrations.

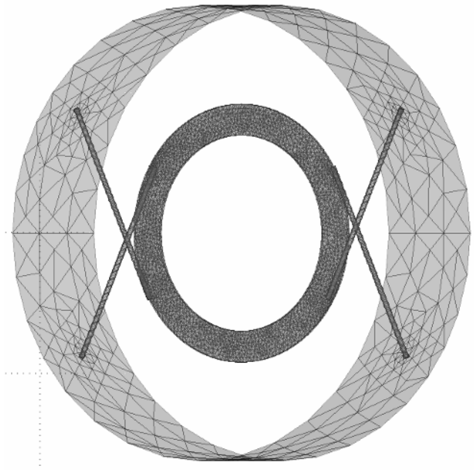


Figure JRA3.3.30: Fixation of the cavity within the cold mass

The fast piezo tuner

The axial drive of the cryomodule will incorporate the fast piezo tuner with a tuning range of about 1 kHz corresponding to a total length change of the cavity by 1.15 µm. The operation temperature of this fast tuner is at the liquid nitrogen level. Important is the mechanical coupling of the forces between piezo elements, chain drive of the cryostat and response of the cavity. For the analysis of this complicated situation we perform a FEM simulation. In order to get a more realistic picture of the situation of an operating cavity, three elements out of the beam line are used. Any misalignment leading to shear stresses above the allowed upper limit will break the brittle piezo crystals. For this design study the characteristics and measures of the piezo actuator P-242.20 from the company Physik Instrumente is taken into account. A maximum elongation of 20 µm at room temperature is presumed. A cold test has to be performed in order to measure the true maximum elongation at LHe temperature. The low temperature version of this element is delivered without a jacket and preloading mechanism.

In principle it is possible to use a concept similar to a blade tuner to operate the superconducting CH cavity. Figure 20 shows a typical example of this type of tuner, the piezo-assisted tuner of a TTF- module at DESY. The testing of the CH prototype cavity in the new horizontal facility with fast piezo and slowly acting mechanical tuner will provide the necessary experience and data needed for the design of a dedicated CH-tuner. When all the necessary forces and the response of the cavity are known for the above mentioned tuner, the most important step to the stabilization of the frequency is done.

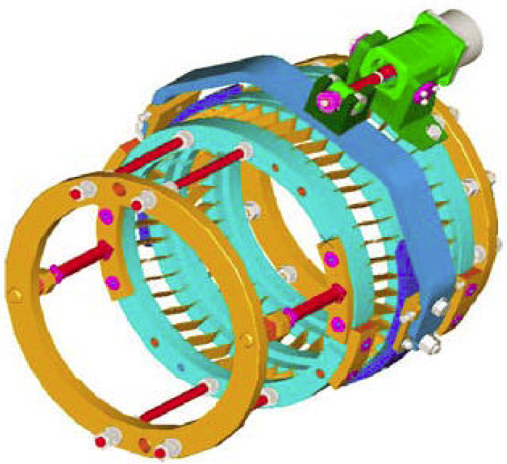


Figure JRA3.3.31: Detailed 3D-drawing of a blade tuner frame with piezo-assisted tuner of a TTF-module at DESY (Courtesy of DESY TTF-facility).

JRA3.3.6 Overall Progress of Work Package 3

WBS	Title	Participants	Original begin date	Original end date	Estimated Status	Revised end date
3.1	**Elliptical cavities**					
3.1.2	Tuner design	INFN	07 / 2004	12 / 2005	100%	
3.1.3	Integration of piezo design	INFN	07 / 2004	12 / 2005	100%	
3.1.4	Tuner construction	INFN	01 / 2006	06/2006	80%	02/2007
3.1.6	Construction cavity B	CEA	11 / 2005	06/2006	60%	02/2007
3.1.7	Power coupler design & engineering	CEA	01 / 2005	04/2006	100%	
3.1.9	RF coupler construction	CEA	05 / 2006	05/2007	10%	08/2007
3.1.8	RF source order and preparation	CEA	07 / 2004	12/2006	100%	
3.1.10	Modulator preparation for test stand	CEA	01 / 2005	12/2006	85%	01/2007
3.1.11	RF source testing	CEA	01 / 2007	04 / 2007		
3.1.12	High power pulsed tests	CEA	05/2007	06/2007		
3.1.13	Cavity A assembly with tuner	INFN	06/2006	03/2007		
3.1.14	Vert. test & final welding of cavity B	CEA	07/2006	03/2007		
3.2	**Spoke cavities**					
3.2.2	Evaluation of 700 MHz prototype	FZJ	09 / 2004	09 / 2005	100 %	
3.2.4	Design of coupler prototype	IPNO	01 / 2004	12 / 2005	100%	
3.2.5	Construction of coupler prototype	IPNO	01 / 2006	06 / 2006	90%	12/2006
3.2.8	Final design of 352 MHz multigap res.	FZJ-IPNO	07 / 2005	06 / 2006	100 %	
3.2.9	Test of coupler prototype	FZJ-IPNO	07/2006	07/2007	0%	12/2007
3.2.10	Manufacturing of 352 MHz multigap res	FZJ-IPNO	04/2006	09/2007	50%	12/2007
3.3	**CH resonators**					
3.3.1	Design of tuning system	IAP-FU	01 / 2004	06 / 2006	70 %	
3.3.2	Construction of tuning system	IAP-FU	01/2006	12/2006		
3.3.1	Measurements of tuning system	IAP-FU	01/2007	06/2007		

Status with respect to the interim reports and deliverables due in 2006 according to the MS project breakdown

WBS #	Title	Due date in Annex 1	Status	Revised delivery date
3.1.6	Cavity B ready (deliverable)	June 2006	Delayed	Feb. 2007 (see text)
3.3.1	Report on CH tuners (milestone)	June 2005	Delayed	March 2007

JRA3.4 Work Package 4: Beam Chopping

The web-site, http://lombarda.home.cern.ch/lombarda/WP4/WP4main.htm, is used for exchanging useful information within the work-package. It contains the link to the presentations of the work-package yearly meetings.

The year 2006 has been a quite fruitful year for WP4 as several key components (chopper, dump) were delivered and hardware test could start.

The working package annual meeting took place on the 4-5 May at CERN with 10 participants. The topics for this workshop were the calculations and measurements of the field coverage factor as well as the status of the key components and the possibility to test the chopper elsewhere than CERN. All the talks can be downloaded from the WP4 website.

Animated discussion has revolved around the theme of the field coverage factor. This factor, which represents the loss of field due the fact that the meander structure does not provide 100% coverage of metal, depends on the geometry of the meander, on the thickness of the dielectric and it has a mild dependence on the distance from the axis. All the factors were debated and trade-off between coverage factor and dispersion were highlighted. Simulations have been done both at RAL and CERN. At CERN also measurements, confirming the simulations, have been recently done. The field coverage factor measured on axis at CERN is around 80%. It is estimated to decrease radially down to about 75%.Unfortunately there is not enough manpower to investigate whether a higher field coverage factors can be achieved with the meander line geometry. At RAL simulation of the CERN and RAL chopper predict 75% and 82% respectively. The simulation has been done with an approximate geometry which describes the edge of the meander structure. More refined simulations have been done after the workshop and are reported below. With respect to the more general theme of the effective deflecting voltage it has been accepted by everybody that there are other sources of loss of effective field (e.g. scatter in the delay between the top and bottom plates ...) and therefore a conservative factor of 70% should be taken from now on between the amplifier voltage and the voltage used in the beam dynamics simulations.

Another important topic of discussions has been the measurement set-up and strategy. At the last annual meeting the possibility of testing the RAL chopper in the CERN 3 MeV test stand was mentioned. This is important in view of the completion of the HIPPI program in 2008 as the RAL test stand (FETS) will not be operational before 2009. This year it was agreed that the RAL driver will be shipped to Saclay for testing in the HIPPI@Saclay test stand. Possibly a RAL chopper could be tested in the 3MeV line by taking out the CERN chopper and replacing it with a quadrupole and one chopper units. Details for this option are still under discussion because an extra quadrupole from CERN is not presently available and the RAL chopper is not ready as well. The possibility of using the chopper electrodes as longitudinal pick-up to measure the beam phase spread has been mentioned. This feature, together with the measurement of the current lost on the chopper plates, could be a very helpful diagnostic mean for the setting up phase. This scope is outside the HIPPI commitments.

The workshop was very useful, especially as in this phase of hardware production and measurement planning the live discussion amongst experts helped to clarify and rectify some measurement strategy needs.

The participants of WP4 had the occasion to meet formally again at HIPPI06, where a status report of the two choppers was given by CERN and RAL representatives for the benefits of the ESAC. The discussion during the working package section was dedicated to the preparation of the chopper beam tests for 2008: in order to minimize the risk of surprises during beam tests it has been decided to test each component as thoroughly as possible before being set-up in the beam line. In particular tests of electromagnetic interference between the chopper driver and the diagnostics equipment will be done during 2007.

Two milestones and one deliverables have been reached during 2006. They are supported by the following documents: CARE-Note-2006-004-HIPPI, CARE/HIPPI Document-06-0001 and CARE-Report-06-033-HIPPI.

For completeness we report the table with the chopper characteristics

	Chopper A (CERN)	Chopper B (RAL)	
	Fast	Fast	Slow†
Rise/fall time	< 2 nsec	≤ 2 nsec	≤ 12 ns
Max. rep rate	50 MHz	2.6 MHz	1.3 MHz
Max. voltage/target	± 0.5 - 0.75	± 1.4	± 2.0
Flexibility	8 ns (min.)	7 - 15 ns	0.1 - 100 μs
Chopping effectiveness (calculated)	99.7%	99.9 %	
Emittance growth ‡ of the un-chopped beam	8%	8%	

† Simulation only. ‡ Effect of residual chopper fields not included

JRA3.4.1 CERN Activities

In general the woks advanced steadily and low power measurements have been performed on the chopper plates. The key components for the chopper are in house.

JRA3.4.1.1 Chopper structure (task 4.1.1)

1. Chopper structure (subtask 4.1.4): The chopper structure is fully assembled since December 05. Because of the workload of the AT/VAC group, vacuum tests could start only in the second part of 2006 and are now just completed. The results of the out-gassing test on the chopper deflecting structure were successful without in situ bake-out. In particular this test cleared any doubts related to vacuum out-gassing pockets (the space between the ceramic plate and the alumina plate). The second vacuum test, related to the cooling needed to cope with electrical heating and beam losses has been performed in the fall 2006. It shows that the thermal resistance between the ceramic plate and the cooled ground plate is below 1 degree K/W in vacuum, which allows for 100W of dissipated power on each of the chopper plates. This figure is in excess of what is foreseen in the most demanding scenario. Next year high power tests on the chopper will be performed. A picture showing test results can be seen in Fig 4.4.1. A measurement of the field coverage factor has confirmed the value of 75% taken in the simulations. See picture JRA3.4.2 for the measurement set-up.

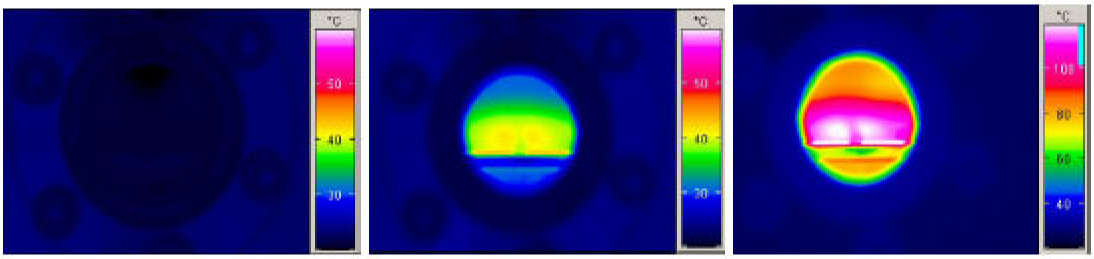
2. Chopper driver (subtask 4.1.3): Preliminary measurements on a prototype of the chopper amplifier ordered from FID Technology in Russia are very promising also if more work is needed to meet the full specifications of the chopper driver. The first of four modules should be available by the end of the year. The specs are summarized in Fig JRA3.4.3

3. Dump (subtask 4.2.1): The dump is fully assembled and ready to be integrated in the beam line. A picture of the assembly ready to be integrated in the line is shown in Fig JRA3.4.4

4. The chopper will be modified as to be used as a pure high impedance DC voltage device in the very first measurement phase. This is a very simple modification and should ease the measurement of the effective voltage on the beam.

5. A tuning of structure for the characteristic impedance and phase velocity could be done by making a groove on the chopper plate's dielectric substrate. This idea will be tested experimentally.

6. Beam dynamics studies have been refined with a high number of particles and they have been mostly dedicated to simulating te experiments on the 3 MeV test stand with the Bunch Shape and Halo Monitor. Results are shown in Figures JRA3.4.5 and JRA3.4.6



(a) $t = 0$ min, $\Delta T = 0$ K. (b) $t = 35$ min, $\Delta T = 20$ K. (c) $t = 500$ min, $\Delta T = 120$ K.

Figure JRA3.4.1: Observation of the plate's temperature profile with an infrared camera during the heat transfer test. Note the change in scale in the rightmost picture.

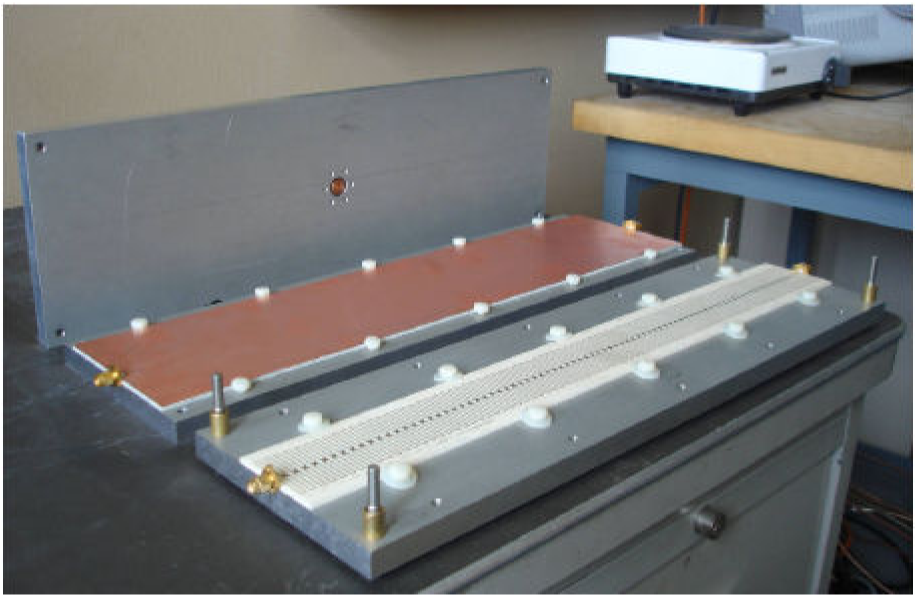
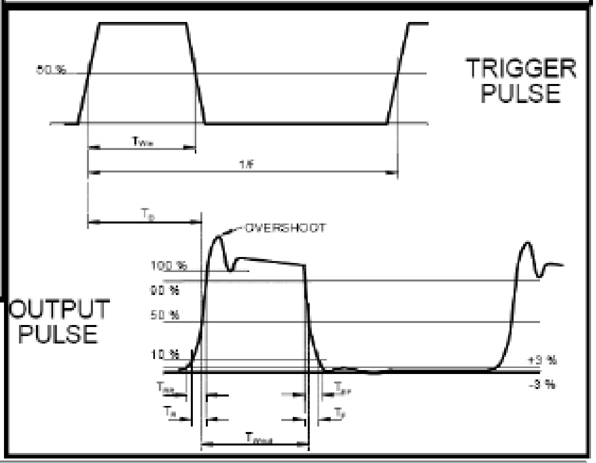


Figure JRA3.4.2: Set-up for the coverage factor measurement. The field on the beam axis is measured using a probe (top plate) for a reference line (centre) and the meander line (bottom).

OUTPUT PULSE

Parameter	Reference	Value	Remarks
Output voltage	V_{out}	> 700 V	Positive and negative outputs required
Output load impedance	Z_L	50 Ω	Load VSWR 1:1.05 up to 200 MHz
Min/Max pulse length	T_{Wout}	8ns -100 µs	Wider range if possible
Propagation delay time	T_D *	<500 ns	Constant and independent from T_{Wout} and repetition frequency
Pulse distortion	$\lvert T_{Win}-T_{Wout} \rvert$ *	<5 ns	Constant and independent from T_{Wout} and repetition frequency
Max repetition frequency	f_{max}	45 MHz	
Min repetition frequency	f_{min}	Single pulse	
Maximum burst length	T_B	1 ms	
Maximum burst repetition frequency	f_{Bmax}	50 Hz	
Rise time (10 % - 90 %)	T_R *	<2.0 ns	
Rise time (3 % - 90 %)	T_{RR} *	<2.5 ns	
Fall time (90 % - 10 %)	T_F *	<2.0 ns	
Fall time (90 % - 3 %)	T_{FF} *	<2.5 ns	
Maximum voltage between two pulses		+/-3 %	
Output voltage overshoot		<50 %	



TRIGGER PULSE

Parameter	Value
Level	TTL
Risetime (10% - 90 %)	2 ns
Falltime (90% - 10 %)	2 ns

* Note: For these parameters the gaussian error distribution shall exhibit a stardard deviation σ < 50 ps.

Figure JRA3.4.3: specifications for the chopper driver to be made at FID technology

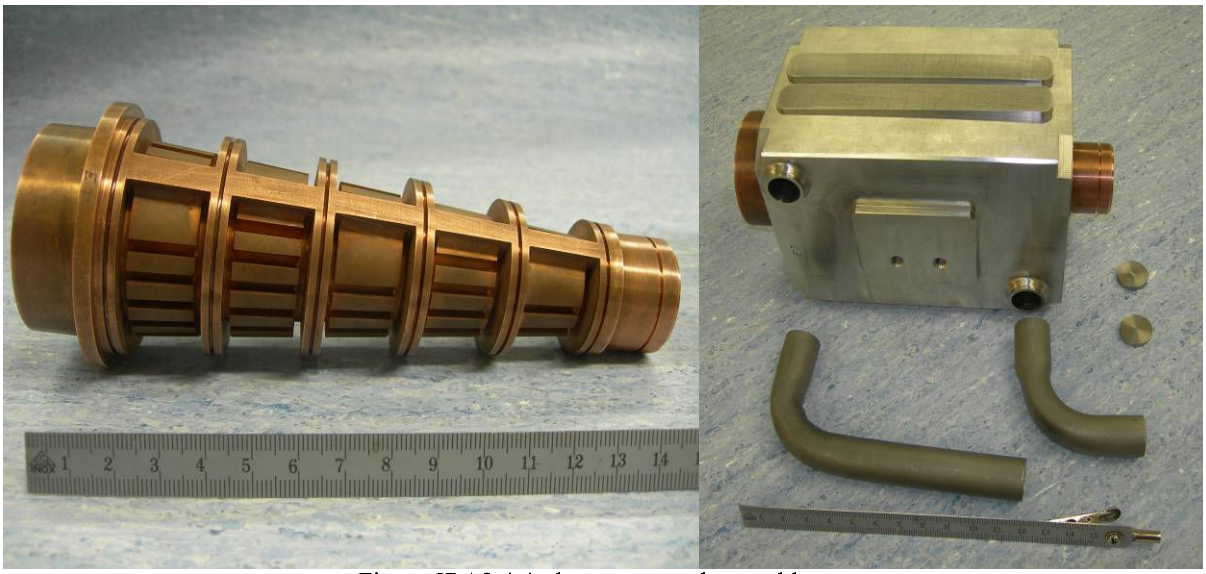


Figure JRA3.4.4: dump core and assembly

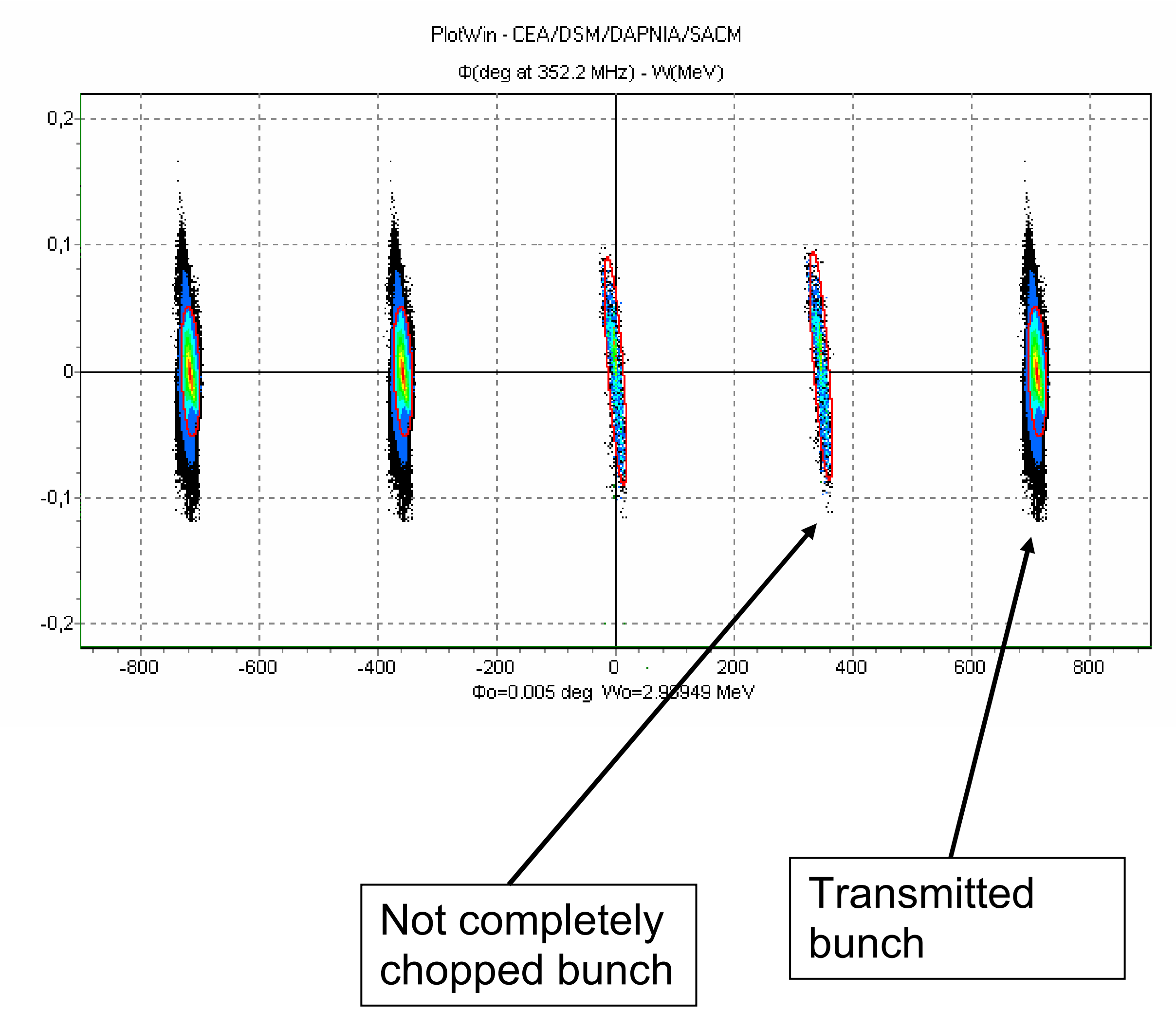


Figure JRA3.4.5: Measure of residual H^- particles in (not completely) chopped bunches with a sensitivity of ~ 10^4 ions, in the vicinity of full bunches with ~ 10^9 ions.

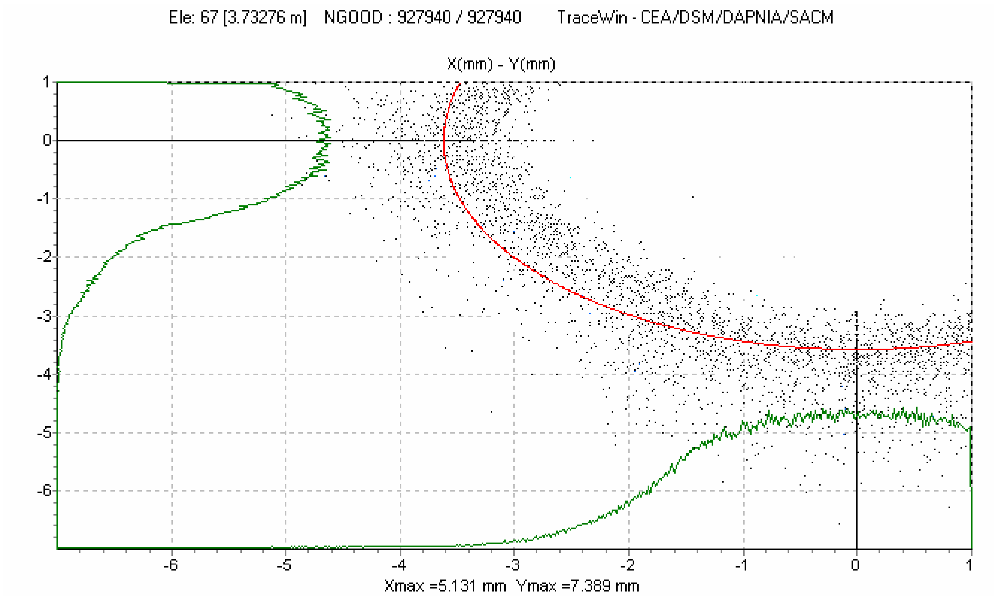


Figure JRA3.4.6: Transverse halo density profile as it should appear at the BSHM. Results of a run with 1 Million particles.

JRA3.4.2 CCLRC-RAL Activities

Important aspects of the RAL HIPPI activity for this year are as follows:

1. RAL MEBT Optical designs: A high priority has been placed on the identification and development of three candidate optical schemes for a MEBT chopper line that will be a key part of a proposed 'Front-End Test Stand' (FETS) project, to be sited at RAL. Schemes A and B address three weaknesses in the original ESS MEBT optical design (now similar to scheme C), these being, the high chopper field requirement, the absence of a dedicated chopper beam dump, and an overly compact component layout. The schemes have been refined in the GPT code, where a filtered version of the IPHI RFQ output distribution, was used as an input distribution to the RAL MEBT. The CERN MEBT design was used as a bench-mark, to verify the accuracy of the GPT code, and the results obtained were found to be in good agreement with those obtained from the 'PATH' code. Schemes A and B make use of the 'optical amplification' of beam deflection in a downstream quadrupole (a key feature of the proposed Linac 4 MEBT design at CERN), to significantly lower the chopper field requirement, and to enable an increase in beam aperture.

2. Simulation of CERN meander structure coverage factor : RAL simulations of E-field 'coverage factor' for the CERN meander structure have been refined in the CST EM studio code. This work was prompted by discussions at the WP4 meeting at CERN, and by subsequent e-mail contact. The results are now in good agreement with measurement, in that they predict an on axis value of ~78.4%,falling to ~74.3% at the beam edge. The geometry implemented is shown in Figure JRA3.4.8

3. RAL meander structure: work on the RAL meander structure has been delayed, as a higher priority has been given to the development of new optical schemes for the FETS MEBT line. Suitable replacements for two RAL HIPPI personnel previously working on the MEBT optical designs have not yet been found, and effort that would have been available for the meander design has been re-directed to the optical design task. However, good progress has now been made with the optical work, and so it is likely that effort can be directed back to the meander design task. Discussions have started on the possibility of testing the RAL choppers in the CERN MEBT using a modified optical set-up, with a 'plug-in' modular configuration.

4. Plans for the RAL fast pulse generator (FPG): The RAL FPG is now available for testing meander structures (Z0=50 Ohm). The range of available pulse amplitudes, and durations are +/- 200 to +/- 1400 V, and 8 to 15 ns, respectively. RAL has offered to conduct a series of low and high voltage tests on the new CERN meander structures, when they become available. In addition, RAL is considering the possibility of shipping the RAL FPG to Saclay for preliminary tests of the CERN chopper system, and will try to make sure that space is pre-allocated at Saclay for the RAL FPG.

5. Progress with the RAL slow pulse generator (SPG): Work on the RAL SPG has been delayed, as a higher priority has been given to the development of new optical schemes for the FETS MEBT line. Suitable replacements for two RAL HIPPI personnel previously working on the MEBT optical designs have not yet been found, and effort that would have

been available for the SPG task has been re-directed to the optical design task. However, good progress has now been made with the optical work, and so it is likely that effort can be directed back to the SPG design task. In addition, preliminary testing of the 'off the shelf' 8kV SPG MOSFET switch has shown that pulse transition times increase, and durations decrease, during the first 20 us of the burst. However, the new RAL MEBT optical designs (schemes A & B) appear to halve the ESS SPG voltage requirement, and so the direction for the new SPG development will be revised towards a lower voltage (< 4 kV), custom designed switch, that should significantly reduce the above- mentioned initial shift in observed pulse transition time and duration.

6. Re-buncher cavity and hybrid quadrupole design: work on a FETS MEBT re-buncher cavity design and on novel hybrid quadrupole configurations for compact structures is continuing. Construction and field mapping of prototype PM / EM hybrid quad designs are planned. Aster Enterprises Inc. (USA) has offered to provide a ‘surplus to requirements' SNS linac type PM quad for this work, at reduced cost. Simulations of the magnetic field for the hybrid quadrupole for two possible configurations are shown in Fig. JRA3.4.9

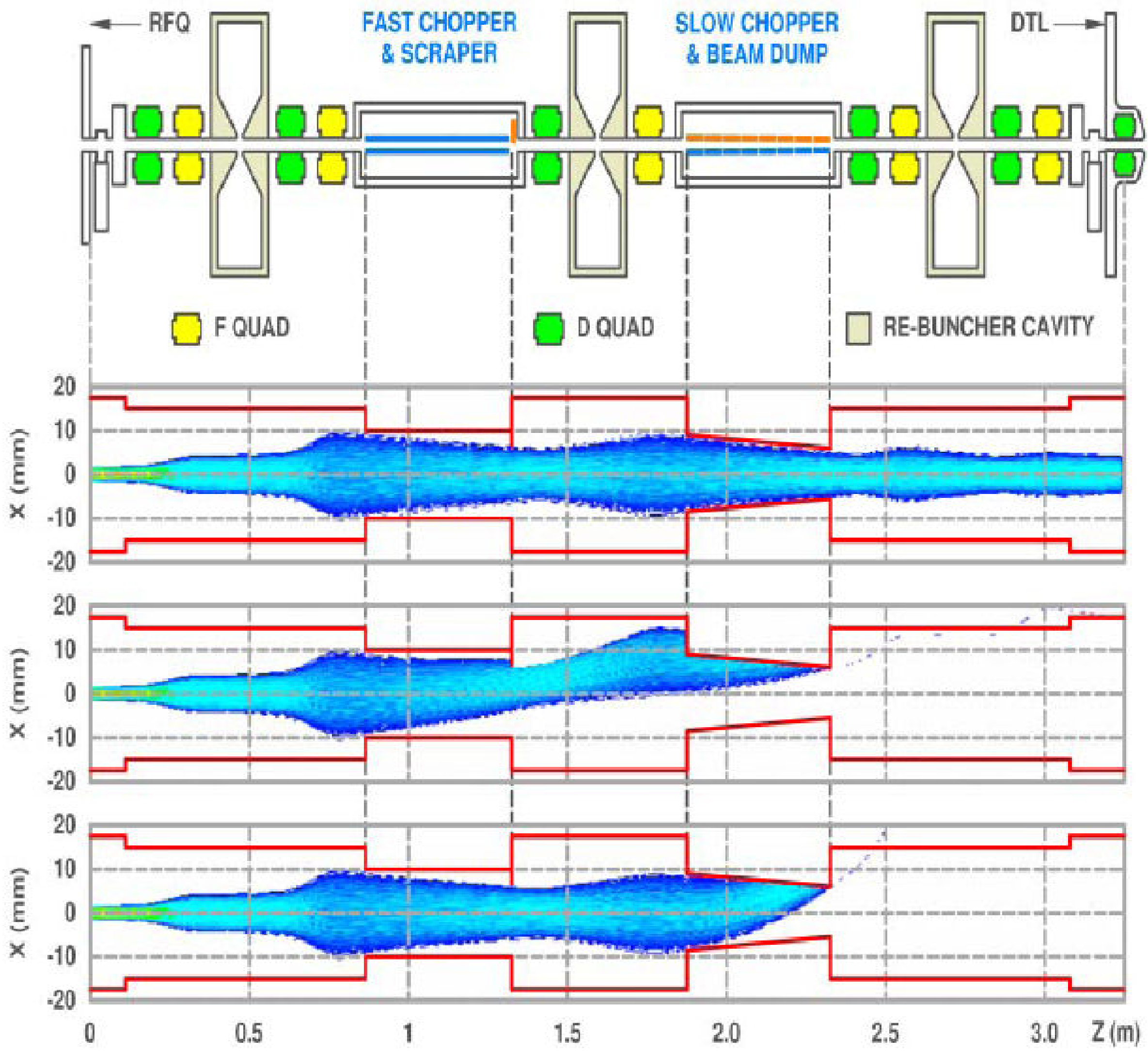


Figure JRA3.4.7: FETS Scheme C1 / Beam-line layout and GPT trajectory plots

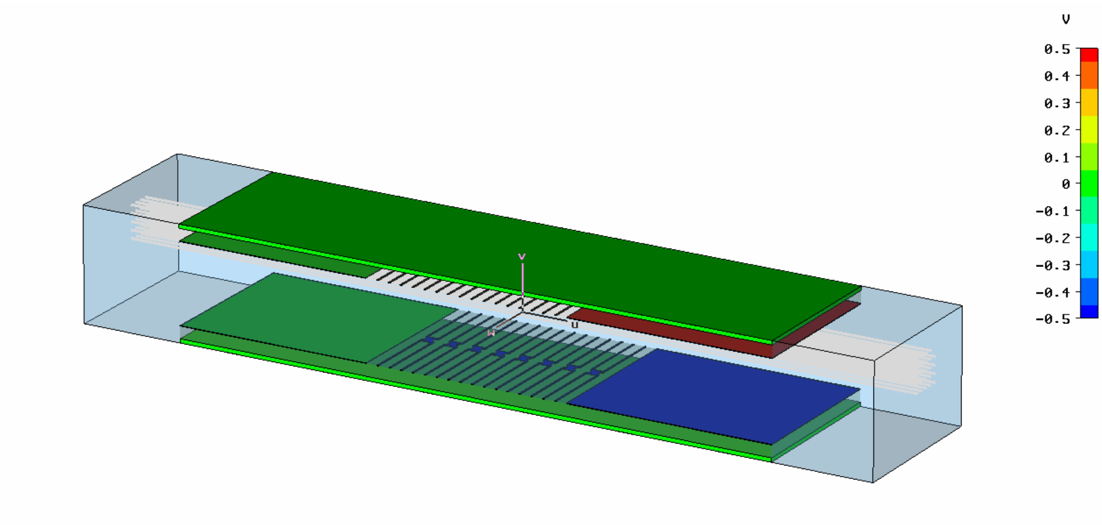


Figure JRA3.4.8: CERN meander line geometry implemented in EM Studio

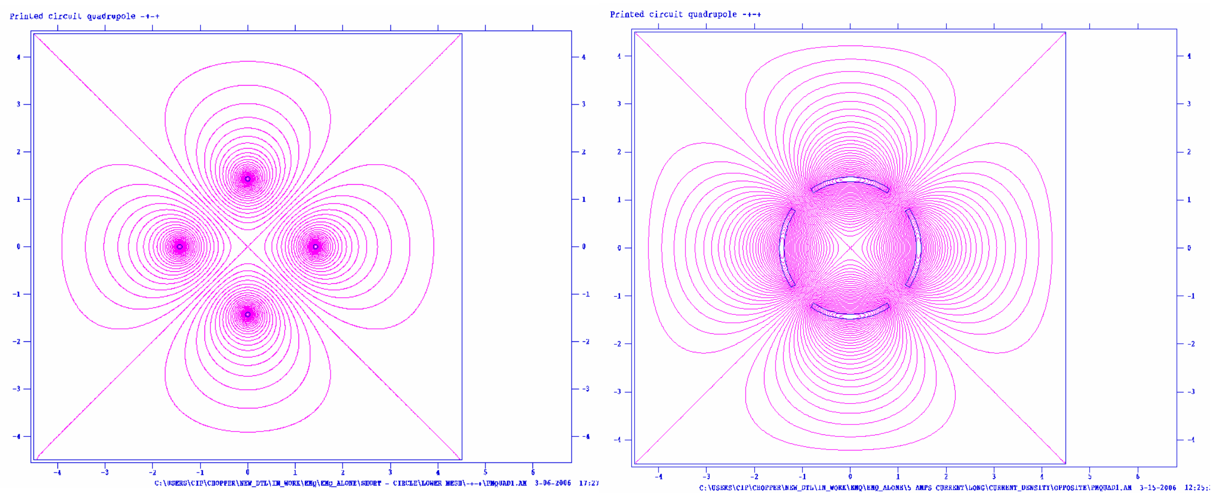


Figure JRA3.4.9: The Printed Circuit Quadrupole model: Model A: 4 wires (left) and Model B: 4 plates (right).

JRA3.4.3 Overall Progress of Work Package 4

WBS #	Title	Original begin date (Annex 1)	Original end date (annex1)	Estimated Status	Revised end date
4.1	Chopper structure A (CERN)				
4.1.1	Pre-prototype construction	January 2004	June 2004	Finished	June2005
4.1.2	Pre-prototype testing	July 2004	November 2004	Combined with task 4.1.5	December 2005
4.1.3	Driver construction & testing	January 2004	December 2005	Finished	
4.1.4	Full scale prototype design	January 2005	June 2005	Finished	
4.1.5	Full scale prototype construction	January 2005	December 2005	Finished	
4.1.6	Prototype testing w/o beam	January 2006		50%	
4.2	Chopper line (CERN)				
4.2.1	Dump design	January 2004	June 2004	Finished	
4.2.2	Dump construction	January 2005	June 2005	Finished	June06
4.3	Chopper structure B (RAL)				
4.3.1	Pre-prototype design and test	January 2004	June 2005	Finished	
4.3.2	Prototype design	January 2005	December 2005	Finished	

Status with respect to the interim reports and deliverables due in 2006 according to the MS project breakdown

WBS #	Title	Due date in Annex 1	Status	Revised delivery date
4.1.1	Chopper A design report	June 2005	delivered	December 2005
4.1.2	Intermediate test report	March 2005	Delivered	August 2006
4.2.2	Dump design report	June 2005	Delivered	April 06
4.3.1	Chopper B design report	June 2006		December 2006
4.1.2	**Chopper A prototype ready**	August 2006	finished	

JRA3.5 Work Package 5: Beam Dynamics

Exchange between WP5 and WP3:

Following the proposal of the ESAC committee a joint WP5 and WP3 meeting was held in April 27/28 in FZJ. It was very useful in helping to bridge the gap between superconducting structure design and beam dynamics considerations. It was planned to have a similar meeting also in 2007.

JRA3.5.2 CEA Activities

1. **Design optimization** from a beam dynamics point of view has been studied and presented at the joint WP5 and WP3 meeting in April. The advantage of "smooth" designs is found, where frequency jumps and too many matching sections are avoided. On this level the design of the cavity (spoke or elliptical) is found to have little impact on beam dynamics.
2. **To implement the collisions processes** into the code for ECR sources and neutralized LEBTs, several Monte Carlo method have been developed and checked. First hard sphere approximation have been used for modeling elastic and inelastic collisions (charged-neutral particle collisions), second, a partial differential cross section approach have been studied to more accurately simulate charged particles collisions. The routines have been checked with a simulation of a DC glow discharge.
3. **The benchmarks for acquiring a cluster** have started and several manufacturers are contacted. New collision routines were introduced and tested on the cluster.

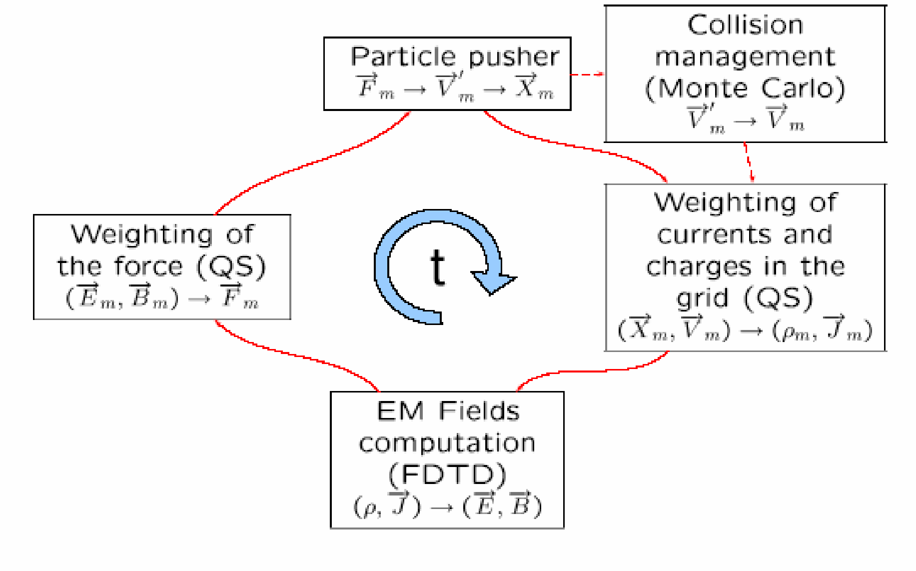


Figure JRA3.5.1: Code architecture for ECRIS and neutralization

JRA3.5.3 CERN Activities

1. **Simulation codes:** beam dynamics studies for the high energy part of LINAC4 have been carried out on the basis of the sc spokes cavity. Simulations with TraceWin (50'000 particles) have shown emittance growth between 3-5%, depending on the cavity voltage for designs where the longitudinal-transverse emittance coupling is avoided. The reference SCL is found equivalent, from a beam dynamics point of view, with the spokes cavity structure as option.
2. **The PATH code** was extended to include possibility of doing statistical error studies. A comparison with TRACEWIN on LINAC4 DTL was successful
3. **End-to-end simulation** starting with an input beam distribution from the source was performed. Re-matching for the new conditions all along the linac4 is still in progress.
4. **Halo formation** in the linac is a considerable source of emittance growth and uncontrolled beam losses in the structures. Beam scrapers can reduce the halo and the emittances and consequently the max beam size in the machine reducing the risk of uncontrolled losses on structures. More calculations and optimizations of the source and LEBT is required to reduce the emittances.

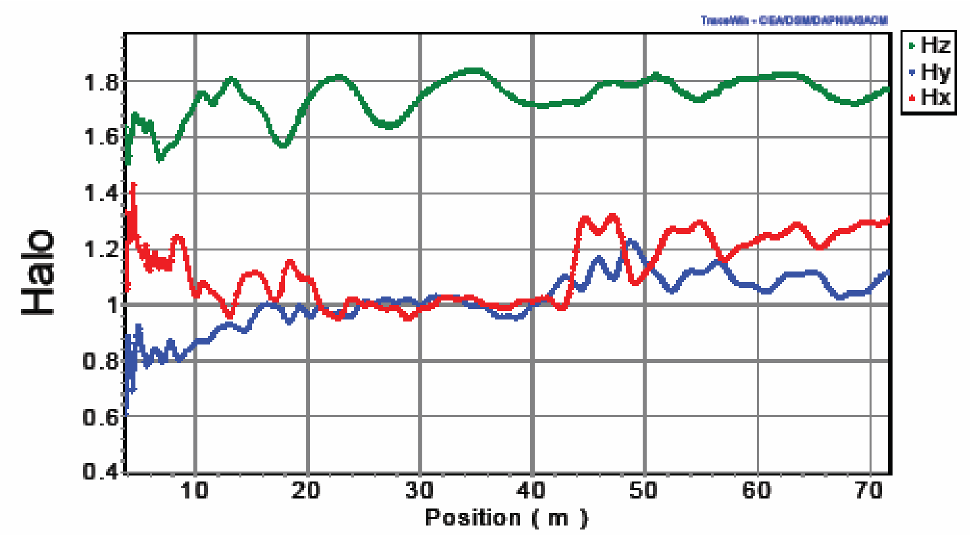


Figure JRA3.5.2: Reduced halo development for Linac4 with a scraper between chopper and DTL

JRA3.5.4 FZJ Activities

1. **Beam dynamics studies on sc linacs with slot structure cavities:** beam dynamics studies have shown that in the energy range of 3-21 MeV the slot-finger structure is preferable, with a real estate gradient of 1.7 MV/m. Efforts have been made to lower the ratio peak to accelerating field. In the range 90-180 MeV the different structures have been found to show no differences from a beam dynamics point of view.
2. **Beam Diagnostics:** According to our schedule the beam profile monitor based on fluorescence is upgraded now to read each of the 32 PMT channels individually, leading to a higher resolution. This change also results in a new data analysis, the development of which has started. System enhancements for tailoring this beam profile monitor for use in circular accelerators cover three issues: (i) Measurements showed that the photocathode of the PMT must have optimum sensitivity for hydrogen photons. (ii) Measurements showed that the vacuum chamber of the beam profile

monitor has to be covered with a black surface. (iii) For low intensity applications (e.g. time resolved measurements) a local enhancement of residual gas pressure will be considered.

3. **Full beam dynamics calculation:** The calculation of beam dynamics with space charge has been completed for the energy range from 3 to 180 MeV using slot-finger resonators and slot resonators. Stable particle motion could be verified for peak currents of up to 40 mA due to combination of accelerating field and focussing fields in the resonators of the low energy part.

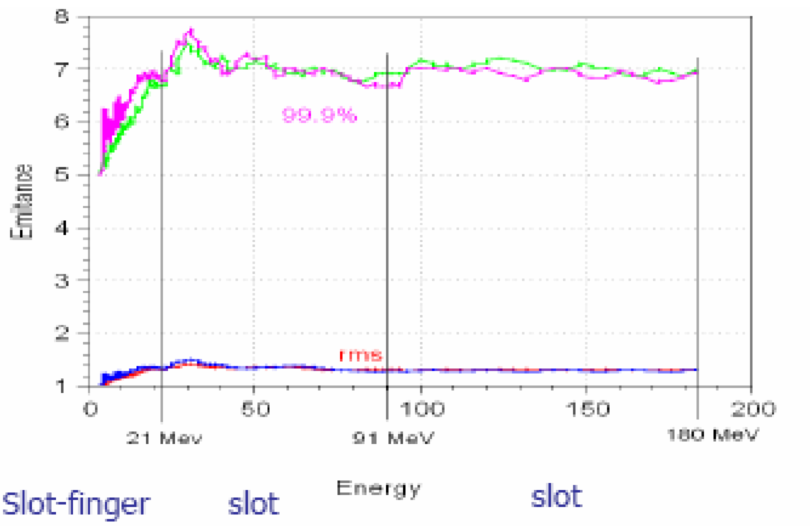


Figure JRA3.5.3: Complete high intensity (40 mA) beam dynamics for slot-finger and slot structures

JRA3.5.5 GSI Activities

1. **Diagnostics:** Further tests of rest gas fluorescence yield have been carried out to optimize the non-destructive diagnostics by the “beam induced fluorescence method”, also in the high energy beam line at 750 MeV/u. Longitudinal bunch profile measurements have been tested for resolution optimization. The online transmission control is in the testing phase.
2. **Beam Dynamics Experiment preparation:** In preparation of the UNILAC experiments in May 2006 the required diagnostics has been tested and optimized. For low current the emittance was found nearly conserved, whereas for high current operation about doubling of emittances is found in tank 1, which is relatively well confirmed by the Dynamion simulations.
3. **Code Benchmarking:** Further progress is achieved in tracking in the UNILAC Alvarez by extending to elongate rather than the idealized spherical bunches. After eliminating some misinterpretations the transverse emittances are now in better agreement. The longitudinal emittances are also in good agreement, except for Dynamion, up to tank 3, where a significant mismatch makes the emittances diverge. The role of a suitable buncher to cure the mismatch between tanks 1 and 2 has been studied. (Results see:

   http://www-linux.gsi.de/~franchi/HIPPI/code_benchmarking_tracking.html)
4. **UNILAC Experiments**: The first bloc of the UNILAC beam dynamics experiment planned for HIPPI was successfully conducted end of May using 1 emA of Ar^{10+} beam (low-current). During the experiments it was verified that for a low intensity beam

energy parasites lead to significant transmission losses and emittance growth. By optimizing RF parameters especially of the HSI RFQ and the second HSI IH structure, the phase correlation between HSI and Alvarez DTL, the settings of the gas stripper, and the matching of the beam to the first Alvarez tank a transmission of 99% and a minimum transverse emittance growth of about 1.2 was achieved. Further multi-particle simulations are needed to understand the results of these experiments in more detail.

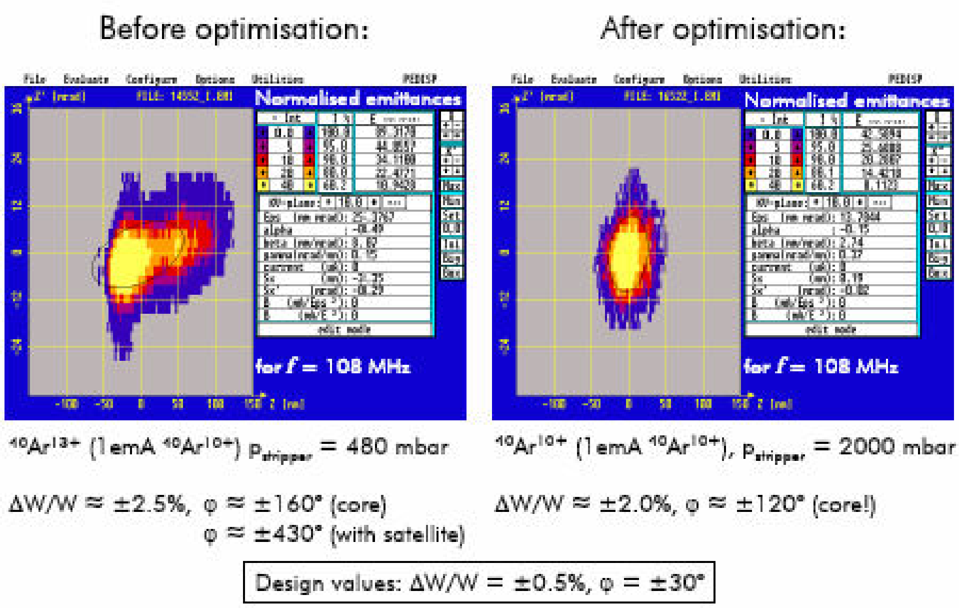


Figure JRA3.5.4: Optimization of longitudinal phase space in first campaign of HIPPI benchmarking experiment

5. **High-Current UNILAC experiment:** a campaign was carried out in November/ December. Evaluation is still pending.
6. **Simulation:** The experimental data are in the process of being compared with different simulation codes (Parmila, Dynamion and Path))

JRA3.5.6 IAP-FU Activities

1. A new version of the LORASR space charge routine based on a 3D FFT is now routinely used for simulations up to 10^6 simulation particles for verification, and 10^5 simulation particles for design. In order to make use of this new capability a breeding technique was developed and successfully tested that allows enhancing the small seed of particles (few 10^3) of the RFQ output distribution to seeds of 10^5 or 10^7 particles while maintaining the important phase space information.
2. The LORASR code was included to the UNILAC Alvarez section tracking benchmark. The results are well fitting to those achieved by the other participating codes. Further information can be gathered from the HIPPI Code Comparison Web page, as well as from the Note CARE-Note-2006-011-HIPPI.
3. The LORASR routines for error study and loss profile calculations have been further improved. Error studies on the GSI Proton Linac beam dynamics design will be started next.

JRA3.5.7 CNRS-LPSC Activities

1. **A statistical error study** has been conducted for Linac4 including: Space charge, longitudinal and transverse errors and tolerances. For each error type a set of sensitivity simulations with one single error applied and varying the amplitude of the error was carried out. Error amplitudes were determined for minimizing beam degradation while keeping realistic conditions.
2. **The individual sensitivities** were found to add up for KV-distributions with 30 to 50% less emittance growth than for Gaussian. A small effect of multi-polar components (K. Hanke) was determined. Results by TraceWin were in good agreement with studies using IMPACT (F. Gerigk) and Path Manager (T. Muetze). The DTL tolerances were set and accepted by the manufacturer.

JRA3.5.8 Overall Progress of Work Package 5

WBS #	Title	Original begin date (Annex 1)	Original end date (annex1)	Estimated Status	Revised end date
5.1	Code development				
5.1.1	Preparation, Dev. of 3D space charge routines, Testing	January 2004	June 2006	70 %	December 2007
5.1.2	LORASR development	January 2004	December 2005	Completed	
5.1.3	Neutralization and ECR source modeling	January 2004	June 2008	50%	On time
5.1.4	Improvement, modeling high current	January 2004	June 2006	90%	December 2006
5.1.5	Codes preparation for 3 MeV test stand	January 2004	December 2006	80 %	June 2006
5.1.6	Codes preparation for SC linacs	January 2004	June 2007	80 %	On time
5.1.7	Code comparison and benchmarking	January 2004	December 2006	90 %	June 2006
5.2	Experiment at UNILAC: preparation & simulations	January 2004	June 2006	Completed	
5.3	Diagnostics and collimation				
5.3.1	Profile measurement prototype design and construction (GSI)	July 2004	February 2005	Completed	
5.3.2	Profile measurement testing (GSI)	March 2005	June 2006	Completed	
5.3.3	Non-interceptive bunch measurement design (GSI)	October 2004	December 2006	Completed	
5.3.4	Non-interceptive measurement construction, testing	January 2005	December 2006	75%	June 2007
5.3.5	Halo measurement device design & construction (CERN)	January 2004	June 2005	100 %	On time
5.3.9	Halo measurement improvement	June 2005	March 2007	75 %	On time
5.3.6	On-line transm. control	October 2005	June 2007	20 %	On time
5.3.7	Beam profile monitor design (FZJ)	January 2005	June 2007	60%	
5.3.8	Collimators design (CERN)	January 2005	December 2005	Completed	

Status with respect to the interim reports and deliverables due in 2006 according to the MS project breakdown

WBS #	Title	Due date in Annex 1	Status	Revised delivery date
5.1.5	Code preparation for 3 MeV test stand: Intermediate Report	June 2006	Delivered	
5.3	**Simulations and experiment at UNILAC Final Report**	December 2006	Delayed	July 2007
5.5.1	**Profile measurement by fluorescence Final Report**	July 2006	Delayed	February 2007
5.5.2	**Non-interceptive e bunch measurement Final report**	December 2006	Delayed	
5.5.6	**Collimators design Final report**	December 2006	Completed	

JRA3.6 Significant Achievements

JRA3.7 List of all milestones and deliverables (D) during the reporting period

Milestone/Deliverable in blue: achieved (with link)

Milestone/Deliverable in yellow: delayed

Updated to December 15th, 2006

	Milestones	Deliverables	Comments
WP2: NORMAL CONDUCTING STRUCTURES			
1.1Drift Tube Linac			
1.1.1 DTL design	Jun-07: Intermediate report		
1.1.2 Development of critical DTL components	Jan-07: Intermediate report	Jan-07: Prototype ready	
1.1.3 DTL beam dynamics design	Jun-08: Intermediate report		
1.1.4 Optimised DTL design		Dec-08: Final report	
1.2 H-mode Drift Tube Linac			
1.2.1 CH model cav ity construction, tests	Dec-05: Intermediate report		Delayed December 06
1.2.2 Prototype design, construction, tests		Dec-06: Prototype ready	Delayed Spring08
1.2.3 H-DTL beam dynamics	Jun-05: Design report		
1.2.4 H-DTL design finished		Dec-08: Final report	
1.3 Side Coupled Linac			
1.3.1 RF cold model prototy pe design, test		Dec-07: Final report	
1.4 Cell Coupled Dri ft Tube Linac			
1.4.1 Pre-prototype testing	Jun-05: Intermediate report (CARE-NOTE-2006-021)		
1.4.2 Prototype design, construction, test	Jun-06: Prototype ready	Dec-06: Design report	Delayed June06
1.4.3 CCDTL design finished		Jun-08: Final report	
1.5 Comparative assessment of NC structures		Dec-08: Final repor	
WP3: SUPERCONDUCTING STRUCTURES			
2.1 Elliptical cavities			
2.1.1 Cavity A vertical tests	Dec-04: Intermediate report		
2.1.2 Tuner design construction & test	Dec-05: Intermediate report		
2.1.3 Cavity A assembly			
2.1.4 Cavity A ready in CRYOLAB	Mar-07: Cavity A ready		Delayed Nov 07
2.1.5 RF Coupler design and test			
2.1.6 Design, construction assembly cavity B			
2.1.7 Cavity B ready		Jun-06: Cavity B ready	Delayed Dec06

2.1.8 700 MHz test stand preparation			
2.1.9 Test stand ready		Mar-07: Test stand ready	
2.1.10 High power pulsed tests cavity A and B		Dec-08: Final report	
2.2Spoke cavities			
2.2.1 Evaluation of 700 MHz prototype	Mar-05: Intermediate report		
2.2.2 Evaluation of 352 MHz 2-gap prototype	Oct-05: Intermediate report		
2.2.3 Design and test of coupler prototype			
2.2.4 Design of 352 MHz multi-gap prototype	May -05: Design report		
2.2.5 Construction of multi-gap prototype			
2.2.6 Prototype ready f or testing		Oct-07: Prototype ready	Jan08
2.2.7 Testing of prototype		Dec-08: Final report	
2.3 CH resonator			
2.3.1 Study of tuning system	Jun-05: Intermediate report		Delayed sept06
2.3.2 Tuning design and fabrication			
2.3.3 Measurements		Dec-08: Final report	
Comparative assessment of SC structures		Dec-08: Final Report	
WP4: CHOPPING			
3.1 Chopper Structure A			
3.1.1 Pre-prototype design and test	Mar-05: Intermediate report		
3.1.2 Prototype design and construction	Jun-05: Design report (CARE-note-2006-017)		Delayed 15oct06
3.1.3 Prototype ready		Aug-06: Prototype ready	completed
3.1.4 Prototype testing (w/o and with beam)		Aug-07: Final report	
3.2 Chopper Line			
3.2.1 Dump design and construction	Jun-05: Intermediate Report		
3.2.3 Beam line assembling and measurements	Mar-07: Measurement start	Dec-07: Final report	Delayed 08
3.3 Chopper Structure B			
3.3.1Pre-prototype design and test	Jun-05: Intermediate Report		
3.3.2 Prototype design and construction	Jun-06: Design report		Delayed Dec-06
3.3.3 Prototype ready	Jun-07: Prototype ready		
3.3.4 Prototype testing		Jun-08: Final report	
Comp. assessment of chopper designs		Oct-08: Final Report	
WP5: BEAM DYNAMICS			
4.1Code development			
4.1.1 3D code development	Dec-07: Intermediate report		Delayed
4.1.2 LORASR development	Dec-05: Intermediate report		

4.1.3 Transport in 3D map, space charge comp.			
4.1.4 Improvement, modelling high current			
4.1.5 Code preparation for 3 MeV test stand	Jun-06: Intermediate report		
4.1.6 Codes preparation f or SC linacs			
4.2 Code benchmarking		Oct-08: Final report	
4.3 Simulations and experiment at UNILAC		Dec-06: Final report	Delayed July2007
4.4 Simulations and experiment at CERN		Dec-08: Final report	
4.5 Diagnostics and collimation			
4.5.1Profile measurement by fluorescence	Mar-05: Prototype ready	Jul-06: Final report	Delayed Feb07
4.5.2 Non-interceptive e bunch measurement:	Jun-05 Components ready	Dec-06: Final report	
4.5.3 Online transmission control		Oct-07: Final report	
4.5.4 Halo meas. dev ice design, construction	Jun-05: Prototype ready	Jun-05: Final report	
4.5.5 Beam profile monitor f or high intensity		Jun-07: Final report	
4.5.6 Collimators design	Dec-06: Prototype ready	Dec-06: Final report	Task merged with 3.2.1
Comp. assessment of dynamics and meas.		Dec-08: Final report	

JRA3.8 List of major meetings organized under HIPPI during the reporting period

The list of events concerning HIPPI during the year 2006 is shown in the following table (web-site or address of the minutes).

Date	Title/subject	Location	Main organizer	Number of participants	Comments and Web site
Jun 15-16	IPHI-SPL collaboration meeting	CEA Saclay (F)	CEA	15	https://edms.cern.ch/document/749108/1
March 27-30	ISTC project # 2875	BINP, Novossibirsk (RU)	BINP	6	https://edms.cern.ch/document/808903/1
April 5-7	ISTC project # 2888 and 2889	CERN (CH)	CERN	12	https://edms.cern.ch/document/723728/1
May 4 - 5	Workshop of HIPPI WP4	CERN (CH)	HIPPI WP4	10	
April 27 - 28	Workshop of HIPPI WP3	FZJ Jülich (DE)	HIPPI WP3	(20)	http://www.fz-juelich.de/ikp/hippi/spring2006/
April 27 - 28	Workshop of HIPPI WP5	FZJ Jülich (DE)	HIPPI WP5	(20)	http://www.fz-juelich.de/ikp/hippi/spring2006/
May 18 - 19	Workshop of HIPPI WP2	LPSC Grenoble (FR)	HIPPI WP2	8	http://lombarda.home.cern.ch/lombarda/WP4/WP4-Chopper/cern06/WP4%20on%204-5%20May%202006.htm
Sept. 27 - 29	HIPPI annual meeting	Jülich (DE)	HIPPI JRA	37	http://www.fz-juelich.de/ikp/hippi/autumn2006/
Nov. 15 - 17	CARE annual meeting	CERN (CH)	CARE	~ 100	http://www.lnf.infn.it/conference/care06/index.htm

The third annual meeting of the HIPPI JRA has been organized in Jülich (Germany) by the Institute of Nuclear Physics (IKP) of the Forschungszentrum Jülich (FZJ), from September 26 to 29, 2006. The structure of the meeting has been slightly modified with respect to previous years, with the goals of improving the exchanges between work packages and of easing the work of the ESAC. In addition to half-day sessions dedicated to the Work-Packages the programme included general presentations on the status of the linac projects covered by HIPPI and presentations on subjects at the boundary between Work Packages. The ESAC members had two sessions for a total of 5 hours to prepare their preliminary assessment. The three ESAC members were present to the Meeting.

The ten laboratories participating into HIPPI were properly represented: a total of 37 people attended the Meeting, coming from 14 Laboratories (the 10 HIPPI Laboratories, the 3 Laboratories of the ESAC members and one attendant from a non-HIPPI Laboratory). The programme included 28 presentations.

A summary of the HIPPI Annual meeting is given in Annex 1, and the transparencies of all talks are available on the HIPPI06 web-site: http://www.fz-juelich.de/ikp/hippi/autumn2006/

1.4.4 JRA4: Next European Dipole (NED)

The list of participants and of their implication in the NED Work Packages (**C**: Coordination, X: Participation) is given in the table bellow. The overall management is done by CEA and TEU.

Number	Participant	WP1 M&C	WP2 TSQP	WP3 CD	WP4 IDI	WG MDO[a)]	Person-months
1	**CEA**	**C**	X	X	X	X	30.33
10	**INFN**	X	**C**	X			17 (6)
	INFN-Ge	X		X			
	INFN-Mi	X	**C**	X			
11	**TEU**	X		X			
15	**WUT**	X	X				
16	**CSIC**	X				**C**	
	CIEMAT	X				X	
17	**CERN**	X		**C**		X	6
20	**CCLRC**	X	X		**C**	X	17.26
	CCLRC-RAL	X	X		**C**	X	17.26

a) The Working Group on Magnet Design and Optimisation (WGMDO) is an extension of scope with respect to CARE Annex 1.

JRA4.1 Work Package 1: Management and Communication (M&C)

2005 Summary

The NED Steering Committee (SC) has met four times: 20 January and 14 April at CERN, 7 July at WUT and 24 November at CERN.

A total of 9 papers (6 contributed and 1 invited) have been presented at international conferences pertinent to NED. Six of them will be published in a peer-review journal.

Three status reports have been produced

- 1st quarter of 2005: EDMS 588774V2
- 2rd quarter of 2005: EDMS 673326V2
- Yearly report for 2005: EDMS 689720V3

2006 Summary

The NED Steering Committee (SC) has met three times: 23 February at CERN, June 1st at CIEMAT and 12th September at CERN.

A total of 10 papers (6 orals and 3 posters) have been presented at International Conference. Six of them will be published in a peer-reviewed journal. There was also an article in the CERN Bulletin on NED condcutor development (Nos. 43 & 44 October 2006).

Two status reports have been produced

- 1st quarter of 2006: EDMS 721734V3
- Yearly report: EDMS 803565

JRA4.1.1 Overall Coordination

The NED JRA is coordinated by A. Devred (CEA&CERN), helped by A. den Ouden (TEU).

The following actions have been carried out and/or are foreseen

- ✓ 19–21 November 2003: participation of A. Devred (CEA&CERN) and A. den Ouden (TEU) to CARE Kick Off meeting at CERN
- ✓ 13 January 2004: visit of A. Devred (CEA&CERN) to INFN-Ge
- ✓ 16 January 2004: visit of P. Védrine (CEA) and A. Devred (CEA&CERN) to CIEMAT
- ✓ 27 January 2004: visit of A. Devred (CEA&CERN) to TEU
- ✓ 13 February 2004: A. Devred (CEA&CERN), P. Lebrun and L. Rossi (CERN) to INFN-Mi
- ✓ 23–24 February 2004: participation of A. Devred (CEA&CERN) to CARE Steering Committee and Dissemination Board meetings in Paris, France
- ✓ 19 March 2004: visit of F. Rondeaux and P. Védrine (CEA), A. Devred (CEA&CERN) to CCLRC
- ✓ 22–24 March 2004: participation to Workshop on Accelerator Magnets Superconductor (WAMS) organized within the framework of AMT Work Package of HHH Network Activity
- ✓ 13 April 2004: visit of A. Devred (CEA&CERN) and M. Pojer (CERN) to INFN-Ge
- ✓ 2–3 June 2004: visit of B. Baudouy and F. Michel (CEA), A. Devred (CEA&CERN), R. Van Weelderen (CERN) to WUT
- ✓ 24–25 June 2004: participation of A. Devred (CEA&CERN) and A.den Ouden (TEU) to CARE Steering Committee and Dissemination Board meetings in Warsaw, Poland
- ✓ 24 August 2004: visit of M. Chorowski (WUT) to CEA/Saclay
- ✓ 2–5 November 2004: participation of A. Devred (CEA&CERN) to CARE general meeting at DESY
- ✓ 11-12 November 2004: participation of a number of NED collaborators to the HHH/AMT annual meeting at CERN.
- ✓ 3-4 March 2005: participation of a number of NED collaborators to the HHH meeting on Beam-Generated Heat Deposition and Quench Levels in LHC Magnets organised at CERN.
- ✓ 22-23 March 2005: participation of a number of NED collaborators to the HHH/AMT meeting on Insulation & Impregnation Technique organised at CERN
- ✓ 5-6 September 2005: participation of A. Devred /CEA&CERN) to CARE Steering Committee and Dissemination Board meetings in Paris
- ✓ 22-25 November 2005: participation of a number of NED collaborators to CARE general meeting at CERN
- ✓ 23 November 2005: participation of a number of NED collaborators to the HHH/AMT annual meeting at CERN
- ✓ 24 November 2005: participation of A. Devred to CARE Governing Board and Dissemination meetings at CERN
- ✓ 26 January 2006: visit of A. Devred to INFN-Mi

- ✓ 3-6 April 2006: large participation of NED collaborators to WAMDO organized by HHH/AMT at CERN
- ✓ 11 April 2006: participation of A. Devred to CARE Steering Committee meeting at LPNHE (Paris)
- ✓ 27 April 2006: visit of A. Devred to INFN-Ge
- ✓ 31 May–1 June 2006: visit of A. Devred to CIEMAT
- ✓ 13-14 September: participation of A. Devred to CARE Steering Committee and ESGARD meetings at CERN
- ✓ 15-17 November: participation of S. Canfer, G. Elwood (CCLRC), A. Devred (CEA&CERN), L. Oberli (CERN), P. Fabbricatore, S. Farinon (INFN-Ge), F. Broggi (INFN-Mi) and A. den Ouden (TEU) to CARE general meeting at Frascati.

JRA4.1.2 Meetings

JRA4.1.2.1 Steering Committee Meetings

The oversight of the NED JRA is ensured by a Steering Committee (SC) made up of

- E. Baynham (CCLRC)
- A. Devred (CEA&CERN), Chairman
- L. Oberli (CERN)*
- J.M. Rifflet (CEA)
- G. Volpini (INFN-Mi)
- A. den Ouden (TEU), Secretary

* L. Oberli has taken over D. Leroy's responsibility since 30 June 2005.

SC meetings are held every three months. Available copies of the presentations and minutes of the meetings have been loaded into EDMS and are posted on the NED website.

The following actions have been carried out and/or are foreseen

- ✓ 8 January 2004: meeting at CERN
  participants: E. Baynham (CCLRC), A. Devred (CEA&CERN), D. Leroy, L. Oberli and O. Vincent-Viry (CERN), P. Fabbricatore (INFN-Ge), G. Volpini (INFN-Mi), A. den Ouden (TEU)
  special guests: L. Rossi (CERN), H. ten Kate (CERN&TEU)
  agenda+talks: EDMS 548032; also available on NED website
- ✓ 25 March 2004: meeting at CERN
  participants: B. Baudouy and J.M. Rifflet (CEA), A. Devred (CEA&CERN), D. Leroy and R. van Weldeeren (CERN), F. Toral (CIEMAT), G. Volpini (INFN-Mi), E. Baynham and S. Canfer (CCLRC), A. den Ouden (TEU)
  special guests: A. Yamamoto (KEK), S. Gourlay (LBNL)
  agenda+talks: EDMS 548033; also available on NED website
- ✓ 8 July 2004: meeting at CERN
  participants: E. Baynham and S. Canfer (CCLRC), A. Devred (CEA&CERN), F. Rondeaux and P. Védrine (CEA), T. Boutboul, D. Leroy, L. Oberli, V. Previtali, O. Vincent-Viry, R. van Weldeeren (CERN), P. Fabbricatore and S. Farinon (INFN-Ge), M. Sorbi (INFN-Mi), A. den Ouden (TEU)
  special guests: –
  agenda+talks: EDMS 548034; also available on NED website

- ✓ 29 October 2004: meeting at CEA/Saclay
  participants: S. Canfer (CCLRC), A. Devred (CEA&CERN), H. Felice, L. Quettier, J.M. Rifflet, F. Rondeaux, P. Védrine (CEA), T. Boutboul, D. Leroy, L. Oberli, V. Previtali, R. van Weldeeren (CERN), M. Greco (INFN-Ge), D. Pedrini, M. Sorbi, G. Volpini (INFN-Mi), A. den Ouden (TEU), M. Chorowski, J. Polinski (WUT)
  special guests: R. Aleksan (CPPM), P. Debu, M. Durante (CEA), B. Adamowicz (Kryosystem)
  agenda+talks: 548035; also available on NED website
- ✓ 20 January 2005: meeting at CERN
  participants: S. Canfer, E. Baynham (CCLRC), A. Devred (CEA&CERN), F. Michel, J.M. Rifflet (CEA), T. Boutboul, P. Fessia, D. Leroy, L Oberli, D. Richter, W. Scandale, C. Scheuerlein, N. Schwerg, S Sgobba (CERN), P. Fabbricatore, S. Farinon, M. Greco (INFN-Ge), F. Broggi, V. Granata, M. Sorbi, G. Volpini (INFN-Mi), A. den Ouden (TEU)
  agenda+talks: 548036; also available on NED website
- ✓ 14 April 2005: meeting at CERN
  participants: S. Canfer, E. Baynham (CCLRC), A. Devred (CEA&CERN), T. Boutboul, L Oberli, C. Scheuerlein, R. Schmidt, S Sgobba, R. Van Weldeeren (CERN), F. Toral (CIEMAT), S. Farinon, M. Greco (INFN-Ge), V. Granata, M. Sorbi, G. Volpini (INFN-Mi), A. den Ouden (TEU), S. Petrowicz, M. Chorowski (WUT)
  agenda+talks: 575731
- ✓ 7 July 2005: meeting at WUT
  participants: S. Canfer (CCLRC), A. Devred (CEA&CERN), F. Michel, J.M. Rifflet (CEA), T. Boutboul, D. Leroy, L Oberli, S Sgobba, R. Van Weldeeren (CERN), M. Greco (INFN-Ge), M. Sorbi, G. Volpini (INFN-Mi), A. den Ouden (TEU), S. Petrowicz, M. Chorowski (WUT)
  agenda+talks: 604114
- ✓ 24 November 2005: meeting at CERN
  participants: E. Baynham, S. Canfer, G. Ellwood (CCLRC), A. Devred (CEA&CERN), B. Baudouy, P. Védrine (CEA), T. Boutboul, A. Desirelli, P. Fessia, D. Leroy, L Oberli, M. Pojer, F. Regis, D. Richter, V. Previtali, C. Scheuerlein, S Sgobba, R. Van Weldeeren (CERN), M. Greco, P. Fabbricatore, S. Farinon (INFN-Ge), F. Broggi, M. Sorbi, G. Volpini (INFN-Mi), A. den Ouden (TEU), M. Chorowski (WUT)
  agenda+talks: 680728
- ✓ 23 February 2006: meeting at CERN
  participants: E. Baynham, S. Canfer, G. Ellwood (CCLRC), A. Devred (CEA&CERN), J.M. Rifflet (CEA), T. Boutboul, S. Illie, J.P. Koutchouk, D. Leroy, L Oberli, D. Richter, V. Previtali, C. Scheuerlein, S Sgobba (CERN), M. Greco, S. Farinon (INFN-Ge), F. Broggi, M. Sorbi, G. Volpini (INFN-Mi), J. Fydrych. Chorowski (WUT)
  agenda+talks: 700477
- ✓ 1st June 2006: meeting at CIEMAT
  participants: S. Canfer, G. Ellwood (CCLRC), A. Devred (CEA&CERN), M. Aguilar, L. Garcia Tabares, F. Toral (CIEMAT), T. Boutboul, L.-Oberli, (CERN), M. Greco (INFN-Ge), G. Volpini (INFN-Mi), A. den Ouden (TEU)
  agenda+talks: 740115
- ✓ 12 September 2006: meeting at CERN

participants: E. Baynham, S. Canfer (CCLRC), A. Devred (CEA&CERN), B. Bellesia, T. Boutboul, C. Hoa, D. Leroy, L. Oberli, C. Scheuerlein, S Sgobba, R. van Weelderen (CERN), A. den Ouden (TEU), S. Petrowicz, M. Chorowski (WUT)
agenda+talks: 771787

⇒ next meeting: 25 January 2007 at CERN

JRA4.1.2 External Scientific Advisory Committee Meetings

JRA4.1.4 Overall Progress of the Activity

The NED JRA Coordinator is assisted by an External Scientific Advisory Committee (ESAC). The charges and composition of the committee are defined in EDMS 548039. The committee is made up of

- J.L. Duchateau (CEA)
- P. Lebrun (CERN)
- L. Rossi (CERN)
- R.M. Scanlan (formerly LBNL, retired)
- J.B. Strait (FNAL), Chairman
- H.H.J. ten Kate (CERN&TEU)

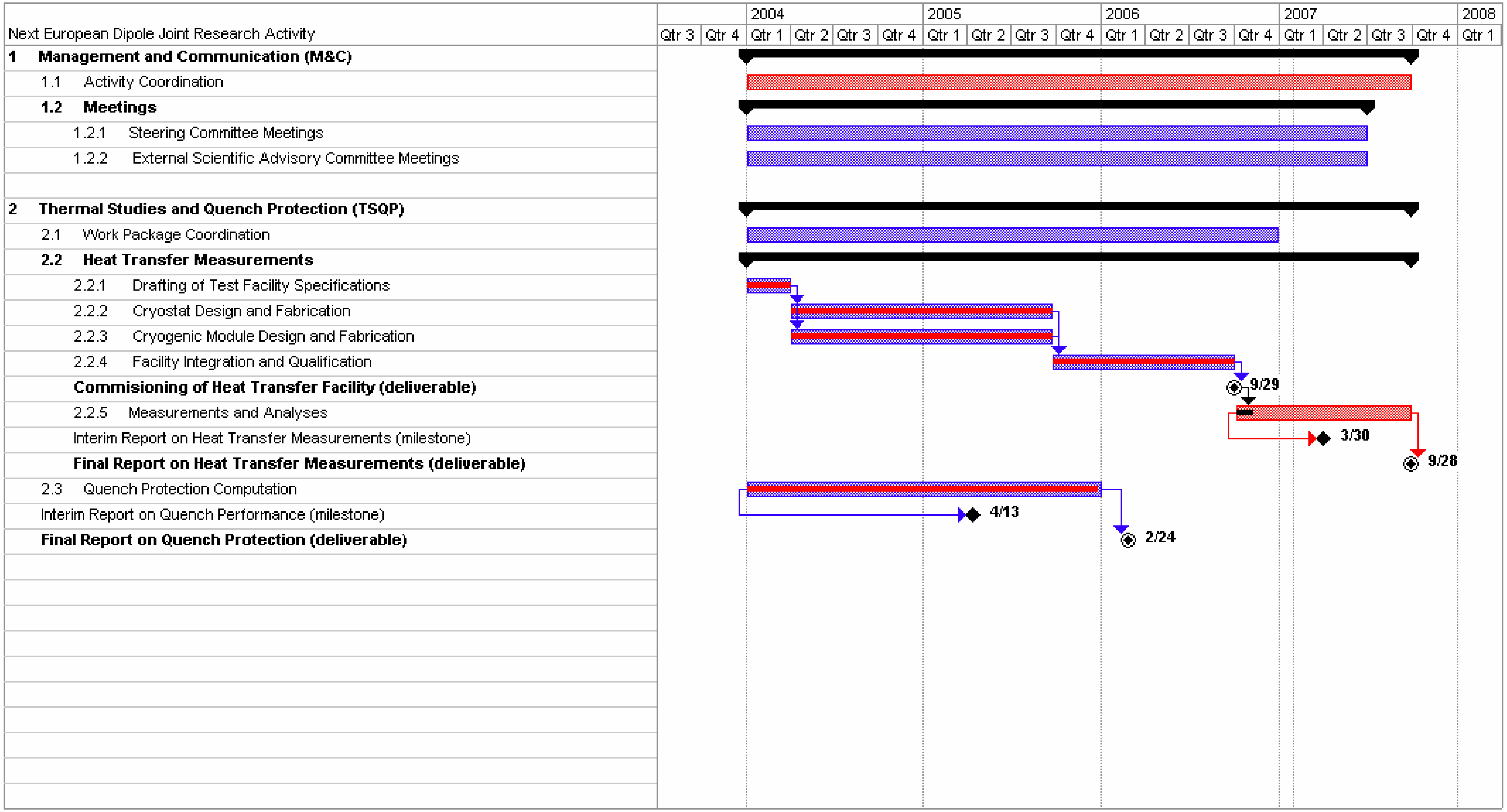
The following actions have been carried out and/or are foreseen

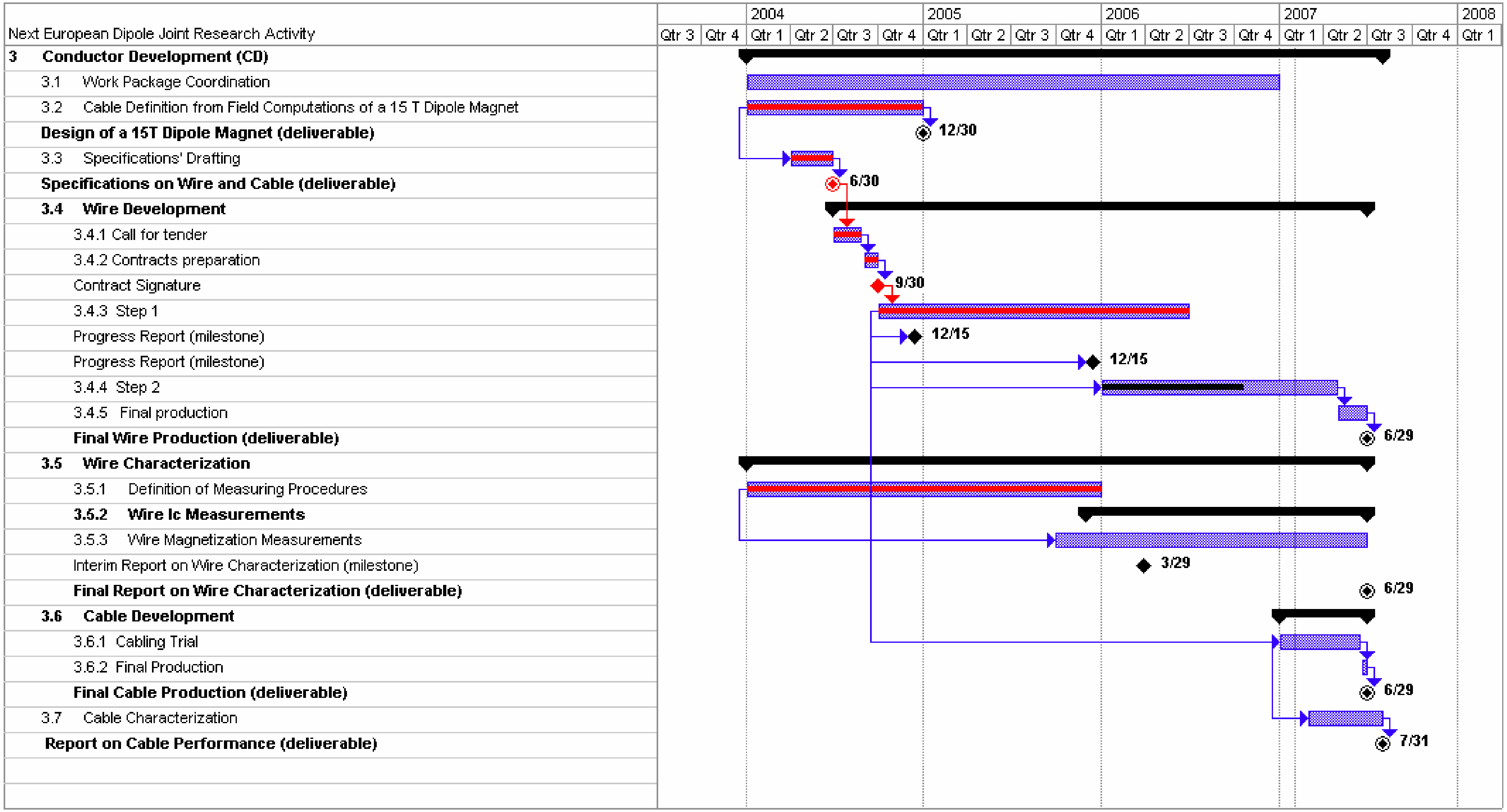
✓ 24 March 2004: first meeting at CERN
agenda: EDMS 548039; presentations available on NED website

✓ 29 March 2004: first ESAC report (EDMS 548041)
agenda+talks: 548035; also available on NED website

⇒ next meeting: Spring of 2007

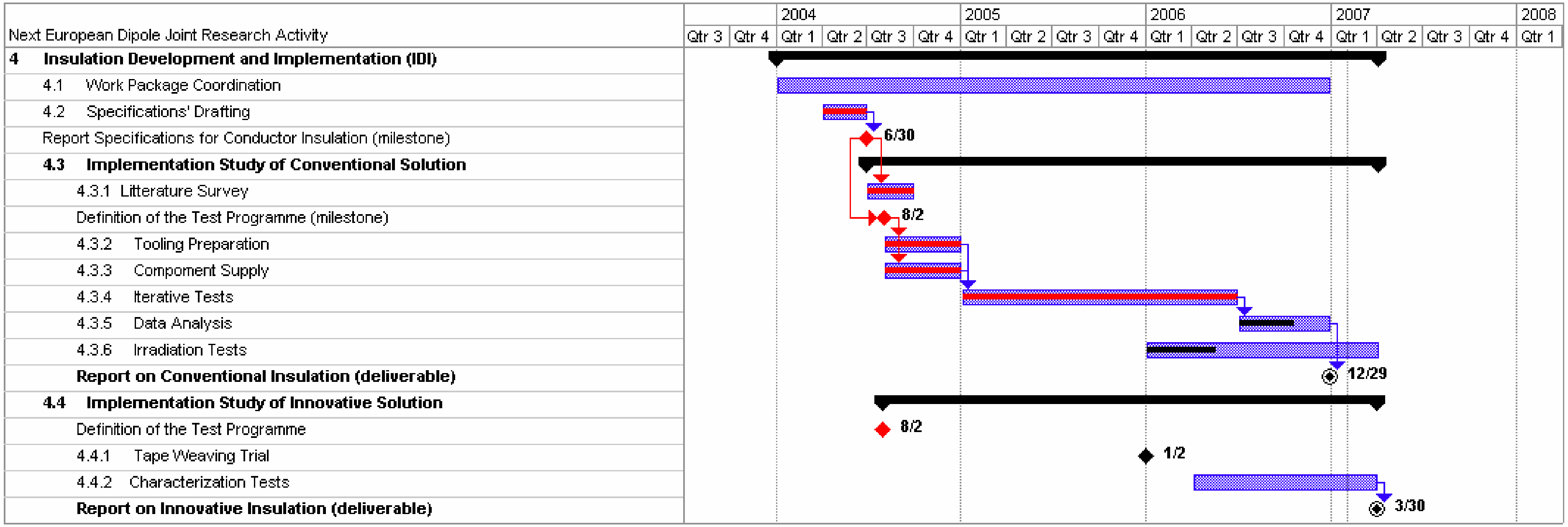
Updated implementation plan (Gantt chart) for the NED/JRA as described in the Technical Annex of CARE Contract





NB:

- The CARE Annex I milestone entitled “First Results on Wire Development” that was due on 30 June 2005 has been split into two “Status Reports” due on 15 December 2004 and 15 December 2005.
- Reports on wire I_C and magnetization measurements are produced on a regular basis (one per sample batch).



NB:

- Task 4.3.6 is an extension of scope with respect to CARE Annex I.
- Task 4.4.1 has been dropped.
- The scope of Task 4.4.2 has been modified with respect to CARE Annex I.

JRA4.2 Work Package 2: Thermal Studies and Quench Protection (TSQP)

Work Package 2 includes two main Tasks:

- development and operation of a test facility to study and characterize heat transfer to helium through Nb_3Sn conductor insulation

(involving CEA and WUT, under the supervision of B. Baudouy, CEA)

- quench protection computation

(carried out by INFN-Mi, Task Leader: G. Volpini)

2005 Summary

Some delays have been encountered in the manufacturing of the cryostat and of the enclosed heat exchanger. Preliminary reception tests were held at WUT during the 3rd week of April, which revealed some problems. The problems were fixed in May-June 2005 and another round of tests was carried out at WUT on 6-8 July 2005. These tests included thermal and leak tests in liquid helium environment at 4.2 K and were deemed successful. The cryostat was then transported by road to CEA/Saclay, where it arrived on 20 September 2005. It is now being prepared for tests in He II and commissioning. The first measurements are expected to take place in early 2006.

In parallel, CERN is carrying out a detailed analysis of existing cold test data from LHC magnet models and prototypes so as to verify whether or not the high heat-transfer coefficients measured at CEA on coil mock-ups are also observed in actual magnets. The analysis is based on a review of quench data and of AC-loss measurement as a function of ramp rate and will be compared to similar work carried out at FNAL on LHC Insertion Region quadrupole magnet model. It is expected to be completed by December 2005.

CERN has also undertaken a review of cooling modes and has come to the preliminary conclusion that the most efficient one remains pressurized superfluid helium as chosen for the LHC. The heat removal capabilities of pressurized superfluid helium are very well suited to the magnet designs under consideration. The benefit from enhanced Nb_3Sn critical current is as well an argument. As a result, it is likely that NED-like magnets will have to be operated at 1.9 K. The effort on magnet cooling optimization will be pursued within the framework of an existing collaboration between CERN and Wroclaw University of Technology.

Quench computations have been carried out by INFN-Mi for a 10-m-long magnet relying on the reference 88-mm-aperture, $\cos\theta$, layer design. They confirm the results already obtained for smaller lengths: the hot spot temperature always remains below 300 K and the maximum voltage can be limited to 800 V by an adequate choice of dump resistor. This implies that that such type of magnet is safe to operate, thanks mainly to the choice of strand and cable parameters made early on. In addition, the two softwares that have been used (QLASA and QUABER) appear to yield similar results. To wrap up this Task, computations have been run on a more challenging 160-mm-aperture, $\cos\theta$ slot design for a length of 5 m. The magnet protection, albeit feasible, appears more difficult than for the conventional $\cos\theta$ layer design and requires efficient quench protection heaters in every slot. The final report on the protection of the $\cos\theta$ layer designs was completed on 8 November 2005 (EDMS 683013) and is presently under peer review. The additional work on the $\cos\theta$ slot design will be written as an Appendix. A summary paper on this Task was presented at the Magnet Technology Conference (MT'19) in Genova.

2006 Summary

The first cool down of the cryostat manufactured under WUT supervision was carried out at CEA in February. A temperature of 4.2 K has been reached in 7 hours as it was expected. No problem in instrumentation nor vacuum has been encountered. One can mention that the time to reach the temperature of liquid helium is a proof of the excellent thermal insulation.
The pumping system and the feeding tube have been tested. A temperature of 1.5 K in the He-II pressurized bath (HeIIp) has been reached (TT4) by pumping in the He-II saturated bath (HE-IIs). Only one problem occurred: the liquid level meter in the saturated bath was not functioning properly and prevented to test the liquid level regulation system in the saturated cryostat and, therefore, the temperature regulation system in the pressurized bath. Nevertheless, a pseudo regulation at 2 K within 10 mK in the He-IIp bath with 1.9 K in the He-IIs bath (TT2) has been achieved.
Consequently to the liquid level malfunctioning, both meters (the 4 K and 2 K) have been tested several times to identify the problem. The problem has been identified and solved but a new level meter has been ordered as a back up. The new liquid level is under test and will be placed shortly in the cryostat
This test offered the opportunity to test the acquisition system (hardware and software) of the cryostat monitoring and control system. No problem was encountered. The hardware of the acquisition system for the measurements system has been also tested with no problem.
Finally, the software for the measurements system has been completed and tested at room temperature. No problem either.
In September 2006, the cryostat has been retested to complete its commissioning. During this test, all the parts of the cryostat have been checked. To summarize, the cryostat reached the desired temperatures between 1.5 K to 2.1 K with the desired temperature regulation and stability (1 mK around an hour). Since the automation system is validated and the temperature stability and the performance obtained are within specifications, the NED cryostat has been accepted. A report concerning the commissioning tests had been edited CARE-Report-06-031-NED EDMS 794381.
In November 2006, the first series of measurements have been performed on a stack sample prepared and tested 10 years ago at CEA in order to verify the measuring chain. The test was successful and the results are identical to the results obtained at CERN on the same sample (sse below).
In December 2006, the cryostat has been prepared to run another test on the same stack sample to study the effect of mechanical constraint on heat transfer characteristics. The test will be performed in January 2007.
A paper describing the optimization of the NED cryostat thermal shielding was presented at the CryoPrague conference (EDMS 801875).

In parallel to the CEA activities, two complementary efforts have been launched at CERN: (1) analysis of available LHC magnet test data at high ramp rate to determine how well the heat-transfer measurements at CEA correlate with actual magnet data, and (2) heat transfer measurements performed in situ on magnet coil sections cut out from production coils.
Regarding the first task, ramp rate data from 34 1-m-long dipole magnet models manufactured at CERN between 1995 and 1999 have been thoroughly re-analyzed so as identify a meaningful subset enabling the determination of an effective heat transfer coefficient from the conductor to the helium superfluid bath. In final, 5 model magnets were retained because they offer a complete and coherent set of AC loss measurements and of high ramp rate quenches

originating in the inner coil blocks next to the coil midplane. The AC loss measurements are used to determine an average cable crossover resistance value from which one can evaluate the power dissipated during ramping in the coil turn where the quenches eventually originate, while the quench currents are used to estimate the cable temperature at the time of quench and, thereby, the temperature increase with respect to the initial superfluid helium bath temperature. Then, the plot of temperature increase versus dissipated power can be compared to the measurements on insulated cable stacks carried out at CEA 10 years for samples relying on a similar insulation system. There appears to be a factor 2 between the two, which can be explained by the fact that, for this kind of temperature increase (a few Kelvins), the heat transfer takes place on two sides of the sample in the CEA set up, while it is limited to one side in an actual magnet coil (the side of the inner coil directly in contact with the annular helium channel around the beam tube).
Regarding the second task, a series of preliminary tests were carried out at CERN by adapting a cryostat previously used for critical current measurement. At first, an old CEA sample was re-measured to validate the cryogenic set up and the measurement procedure (the same sample was eventually re-measured at CEA –see above– yielding very similar results). Second, *in situ* heat transfer measurements were carried out on a coil section cut out from an actual LHC dipole coil. The coil section was heated up by supplying currents to pairs of cable strands, thereby forcing a transfer and a Joule heating through contact resistances, while the temperature was measured by means of thermocouples mounted directly on the strands. This second experiment also yielded reasonable but some improvements must be implemented to limit heat leaks.
The results of these two experiments were summarized in a paper presented at the 2006 Applied Superconductivity Conference (poster: EDMS 803652; paper: EDMS 803778).

INFN-Mi has completed its quench computation work on the 160-mm-aperture, cosθ slot design by summarizing its results in a paper presented at the 2006 Applied Superconductivity Conference (oral: EDMS 803403; paper: EDMS 803346).

JRA4.2.1 TSQP Work Package coordination

As already mentioned, the TSQP Work Package is articulated around two main tasks: Heat Transfer Measurements (2.2) and Quench Computation (2.3). Task 2.2 is coordinated by B. Baudouy (CEA), while Taks 2.3 is coordinated by G. Volpini (INFN-Mi). The Task Leaders report to the NED Steering Committee and, ultimately, to the NED/JRA Coordinator.

JRA4.2.2 Heat Transfer Measurements

The following actions have been carried out and/or are foreseen

JRA4.2.2.1 Drafting of Test Facility Specifications

- ✓ 28 January 2004: preparatory meeting at CEA/Saclay participants: B. Baudouy, P. Chesny, B. Hervieu, F. Michel and J.M. Rifflet (CEA), A. Devred (CEA&CERN)
- ✓ 27 February 2004: programme proposal issued by B. Baudouy (CEA; EDMS 548123)
- ✓ March 2004: review of programme proposal by P. Lebrun and D. Leroy (CERN) and approbation by SC meeting

- ✓ 4 May 2004: cryostat specification issued by B. Baudouy, B. Hervieu and F. Michel (CEA; EDMS 548129V1)
- ✓ May 2004: specification submitted for review to P. Lebrun and R. Van Weelderen (CERN) and M. Chorowski (WUT)
- ✓ 8 June 2004: final cryostat specification issued by B. Baudouy, B. Hervieu and F. Michel (CEA; EDMS 548129V2)

Sub-Task completed

JRA4.2.2.2 Cryostat Design and Fabrication

- ✓ 3 June 2004: preparatory visit to Kryosystem (Poland)

participants: B. Baudouy, F. Michel (CEA), A. Devred (CEA&CERN) R. van Weelderen

(CERN), M. Chorowski, J. Fydrych and J. Polinski (WUT), B. Adamowicz, G. Michalski

and G. Strychalski (Kryosystem)

- ✓ July 2004: start of technical design at WUT
- ✓ July 2004: start of tendering procedure
- ✓ 10 August 2004: redefinition of WUT budget allocation
- ✓ August 2004: contract attribution to Kryosystem
- ✓ 29 Ooctober 2004: Production Readiness Review at CEA Saclay

participants: B. Baudouy, F. Michel (CEA), R. van Weelderen (CERN), M. Chorowski, J.

Polinski (WUT), B. Adamowicz (Kryosystem)

report: EDMS 548154)

- ✓ 17 November 2004: hiring of Grzegorz Michalski and Maciej Matkowski at WUT (additional staff; till 30 June 2005)
- ✓ Early April 2005: completion of manufacturing
- ✓ 20-22 April 2005: preliminary reception tests at WUT, in participants: B. Baudouy and F. Michel (CEA) and of M. Chorowski and J. Polinski (WUT)
  Test report: EDMS 587176
- ✓ 2 May 2005: set of recommendations issued by B. Baudouy, F. Michel (CEA) and A. Devred (CEA&CERN) – EDMS 587176
- ✓ 6 May 2005: report on mechanical design study issued by M. Chorowski and J. Polinksi (WUT) – EDMS 592247
- ✓ 12 May 2005: first status report on repairs issued by M. Chorowski and J. Polinksi (WUT) – EDMS 592246
- ✓ 19 May 2005: Comments on status report issued by B. Baudouy and F.Michel (CEA) – EDMS 593633
- ✓ 3 June 2005: second status report on repairs issued by M. Chorowski and J. Polinksi (WUT) – EDMS 598854
- ✓ 3 June 2005: second version of report on mechanical design study issued by M. Chorowski and J. Polinksi (WUT) – EDMS 592247V2
- ✓ 6-8 July 2005: second round of reception tests at WUT

participants: B. Baudouy and F. Michel (CEA) and of M. Chorowski and J. Polinski (WUT)
Test report: EDMS 609237
- ✓ 20 September 2005: reception of cryostat at CEA

Sub-Task completed

JRA4.2.2.3 Cryogenic Module Design and Fabrication

- ✓ 22 June 2004: design specifications issued by B. Baudouy and F. Michel (CEA; EDMS 548139, based on design study reviewed in EDMS 548137)
- ✓ 1st July 2004: call for tender issued by F. Michel (CEA)
- ✓ 15 July 2004: reception of answers to call for tender
- ✓ 17 September 2004: purchase requisition to be issued by F. Michel (CEA)
- ✓ 10 October 2004: contract awarded to Kryosystem.
- ✓ Early April 2005: completion of manufacturing

Sub-Task completed

JRA4.2.2.4 Facility Integration and Qualification

- ✓ September 2005 vacuum and pressure test
- ✓ September 2005: leak test
- ✓ October-November 2005: instrumentation, wiring and insulation
- ✓ December 2005: external cabling
- ✓ February 2006: first successful cool down test down to 1.5 K, revealing problem with liquid level meter
- ✓ February 2006: first successful cool down test down to 1.5 K, revealing problem with liquid level meter
- ✓ 4 September 2006: hiring of J. Polinski by CEA (additional staff for 1 year)
- ✓ September 2006: retest in He II for the commissioning
- ✓ 6 November 2006: report on NED cryostat commissioning issued by B. Baudouy, J. Polinski and L. Vieillard (CEA; EU deliverable, EDMS 794381)

Sub-Task completed

JRA4.2.2.5 Measurements and Analyses

- ✓ June-July 2006: re-test at CERN of old cable stack sample measured 10 years ago at CEA
- ✓ July 2006: Paper on optimization of the NED cryostat thermal shielding was presented at the CryoPrague conference (EDMS 801875))
- ✓ July-August 2006: preliminary measurement at CERN on a coil section cut out from an LHC dipole coil
- ✓ September 2006: paper on preliminary CERN analyses and measurements presented at the 2006 Applied Superconductivity Conference (poster: EDMS 803652; paper: EDMS 803778)

- ✓ 10 October/15 November 2006: seminars at CERN and CEA/Saclay on "Evaluation of the transfer of heat from the LHC dipole coil to LHe", presented by D. Ricther (CERN; EDMS 803 673)
- ✓ November 2006: first successful test of a stack sample at CEA in new cryostat (sample is the same as the one measured at CERN in June-July and results are in good agreement)

JRA4.2.3 Quench Protection Computation

The following actions have been carried out and/or are foreseen

- ✓ 5 March 2004: draft computation programme issued by M. Sorbi and G. Volpini (INFN-Mi; EDMS 555747)
- ✓ March 2004 SC meeting: discussion of computation programme
- ✓ April–June 2004: compilation of material properties (EDMS 555753)
- ✓ June-October 2004: first computations on Reference Design V1 (88-mm-aperture, cosθ, layer design)
- ✓ November-December 2004: extended computations on Reference Design V1
- ✓ 25 November 2004: hiring of Valeria Granata by INFN-Mi (additional staff for 6 months)
- ✓ 3 February 2005: first version of interim report (EDMS 555756; EU milestone)
  authors: V. Granata, M. Sorbi, G. Volpini, D. Zamborlin (INFN-Mi)
- ✓ 13 April 2005: second version of interim report (EDMS 555756V2)
  authors: V. Granata, M. Sorbi, G. Volpini, D. Zamborlin (INFN-Mi)
- ✓ 24 May 2005: termination of Valeria Granata
- ✓ 29 September 2005: first version of MT19 paper
- ✓ 8 November 2005: first version of final report (INFN-Mi); EDMS 683013, EU deliverable
- ✓ 6 December 2005: final version of MT19 paper issued by M. Sorbi (EDMS 688572)
- ✓ 13 February 2006: second version of final report (INFN-Mi); EDMS 683013 V2, EU deliverable
- ✓ 24 February 2006: third version of final report (INFN-Mi); EDMS 683013 V3, EU deliverable
- ✓ September 2006: paper on quench computation on cosθ slot design presented at the 2006 Applied Superconductivity Conference (oral: EDMS 803403; paper: EDMS 803346).

Sub-Task completed

JRA4.2.4 Overall Progress of Work Package 2

Status of the lowest Sub-Tasks level in the TSQP WP (as of 30 April 2006).

WBS #	Title	Original begin date (Annex 1)	Original end date (Annex 1)	Estimated Status	Revised end date
2.1	TSQP WP Coordination				
2.2	Heat Transfer Measurements				
2.2.1	Drafting of Test Facility Specifications	1 January 2004	31 March 2004	Completed	8 June 2004
2.2.2	Cryostat Design and Fabrication	1 April 2004	31 Dec. 2004	Completed	8 July 2005
2.2.3	Cryogenic Module Design and Fabrication	1 April 2004	31 Dec. 2004	Completed	8 July 2005
2.2.4	Facility Integration and Qualification	1 January 2005	31 March 2005	Completed	September 2006
2.2.5	Measurements and Analyses	1 April 2005	31 Dec. 2006	5%	31 August 2007
2.3	Quench Protection Computation	1 April 2004	30 June 2005	Copmleted	February 2006

JRA4.3 Work Package 3: Conductor Development (CD)

Work Package 3 includes three main Tasks:

- conductor development
  (under CERN supervision, Task Leader: L. Oberli)
- conductor characterization
  (involving CEA, CERN, INFN-Mi, INFN-Ge and TEU, under the supervision of A. den Ouden, TEU)
- FE wire model to simulate cabling effects
  (involving CERN and INFN-Ge and TEU, under the supervision of S. Farinon, INFN-Ge)

The CD Work Package is the core of the program and will absorb about 70% of the EU funding.

2005 Summary

Both industrial sub-contractors have received their raw materials and have started assembling and transforming STEP1 billets.

During STEP1, SMI has tried to increase the non-copper critical current density of the 192 filament Powder In Tube strand to a value above 2500 A/mm^2 at 12 T. SMI has produced 2 billets using a tantalum barrier around the niobium tube of each filament and 2 billets (called B201 and B205) with a modified powder composition without using a tantalum barrier. The drawing to a diameter of 1 mm of the 2 billets using a Ta barrier was not successful due to a large number of breakages attributed to a poor quality of the Ta barrier. The 2 other billets B201 and B205 were drawn without breakage to a diameter of 1 mm and two unit lengths of 327 m and 320 m were delivered to CERN. A critical current density around 2350 A/mm^2 at 12 T was measured on the billet B201, much lower than expected due to Sn leakage occurring at the melting point of Sn. A piece length of 20 m of another billet called B179 was delivered to CERN. On a sample of the billet B179, a critical current density of 2584 A/mm^2 at 12 T was obtained by SMI.

CERN has carried out an extensive program to characterize the strands. A RRR value of 220 was measured on a sample of the billet B179 above the specified NED value. RRR measurements performed on samples of the billet B201 have confirmed the Sn leakage in the copper matrix. The Sn leakage is a consequence of the rupture of the Nb tube. Metallographic strand cross-sections of the reacted strand have permitted to observe a burst Nb tube by optical microscopy, which explains the low critical current density. Same test will be performed on the billet B205 as Sn leakage was also reported by SMI, even if the free Sn content in the powder was decreased compared to the Sn content used in the powder of the billet B201. CERN has also investigated the strand behaviour under heavy deformation to evaluate if the strands are indeed capable to sustain the cabling. Samples of the 2 billets B179 and B201 were rolled down at CERN to flatten the strand from 1 mm to 0.85, 0.75 and 0.65 mm. The filament layout was observed by optical metallography of the cross-section of the samples. Whereas the filament layout of the billet B179 rolled to 0.75 mm was severely deformed showing shear fracture planes crossing the filaments, the filament layout of the billet B201 was able to sustain the high unidirectional deformation. More extensive investigations will be launched on samples from billets B179 and B205 to understand how the internal filament layout sustains the deformation by rolling. For the next period, the effort will be focused on the qualification of the final design by using filaments identical to the billet B179 with equal powder composition and with more copper around the filaments as for the billet B201.

For STEP1, Alstom/MSA has launched 5 types of strand in fabrication following an internal tin process. The different layouts were discussed with CERN with the aim to determine the optimum design to get a good workability and a high critical current. Alstom/MSA has encountered few problems in the preparation of the Sn rods used in billet assembly and in the extrusion of the monofilament billets. Solutions have been found and CERN has contributed by performing quality assurance tests on the Sn rods to verify the suitability of the process and acid cleaning of the Nb bars. All intermediate billets have been assembled and drawn. Only one type of intermediate billets with a central Sn core was successfully drawn without breakages to restacked dimension. Alstom/MSA has investigated the possible reasons and has decided in agreement with CERN to produce two additional intermediate billets with a modified process. A revised plan for STEP2 is in discussion with CERN to improve the manufacturing process followed for STEP1 and to develop alternative manufacturing process for intermediate billets. The first results of STEP1 are expected in January 2006, while those of STEP2 are expected in the Summer of 2006.

The cross-calibration program launched by the Working Group on Conductor Characterization has proven more difficult than anticipated. Three rounds of "virgin" test wires have been circulated among the various laboratories and have pointed out a number of problems and discrepancies in sample preparation and instrumentation as well as in measurement procedures. The first round included a reference, LHC-type, NbTi wire, and two Nb_3Sn wires: one 1.26-mm-diameter ECN PIT wire provided by TEU and one 0.83-mm-diameter EM Internal Tin wire provided by INFN-Mi (the EM wire samples were either "virgin" or extracted from a Rutherford-type cable). The second round relied again the 1.26-mm-diameter ECN PIT wire, while the third round included a 1-mm-diameter, SMI, ternary $Nb(Ta)_3Sn$, PIT wire, also provided by TEU. INFN-Mi and TEU have now achieved a good convergence on I_C measurements (results for the SMIT PIT wire samples agree within 2%) while CEA is still in the process of upgrading its test facility. The third round also included "virgin" and "deformed" samples of the 1.26-mm-diameter ECN PIT wire to evaluate cabling degradation (the wire was rolled down at CERN with diameter reductions of 0.30, 0.35, 0.40 and 0.45 mm, but only the samples with a 0.35-mm diameter reduction were tested). The INFN-Mi and TEU measurements of these samples show a larger dispersion (5 to 7%) than for the SMI PIT wire measurements (which may be due to heterogeneity in the wire itself); the I_C degradation between deformed and virgin samples is estimated around 40%. A status report on the cross-calibration program was presented at the Magnet Technology Conference (MT'19) in Genova (EDMS 690009).

INFN-Ge has carried out detailed investigations of the 1.26-mm-diameter ECN PIT wire mentioned above to develop his characterization techniques. Magnetization measurements performed as a function of temperature (in a 1-mT parallel field) with a SQUID magnetometer clearly show two transitions: one for a temperature of ~17.4 K, corresponding to Nb_3Sn, and one around 9.2 K, corresponding to pure Nb. The origin of these two transitions can be readily understood when considering the wire structure: it is drawn down from a billet made up from thick-walled niobium tubes, arranged in a pure copper matrix and stuffed with a mixture of $NbSn_2$, Cu and Sn powders. During heat treatment, the powder mixture reacts with the Nb tubes and precipitate Nb_3Sn layers, which grow from the inner to the outer radii of the tubes. The heat treatment is usually optimized so as to react about 2/3rd of the tube walls, thereby leaving a sheath of un-reacted niobium at the tube periphery. As a result, when cooling down the ECN PIT wire to cryogenic temperatures in a small background magnetic field, a first transition occurs when the Nb_3Sn layers on the inner part of the tubes become superconducting, and a second transition follows when the un-reacted Nb sheaths on the outer part of the tubes, in turn, become superconducting. Furthermore, the amplitudes of the magnetizations measured in these two stages enable one to determine the magnetically-shielded volumes which are associated and, thereby, the outer diameters of the reacted Nb_3Sn layers and of the un-reacted Nb tubes. In our example, we get: 44 μm for the Nb_3Sn layers and 65 μm for the Nb tubes. These values are in good agreement with the physical values that can be estimated from a backscatter electron micrograph of a reacted tube. A summary of these measurements was presented at the Magnet Technology Conference (MT'19) in Genova (EDMS 688570). This paper also exhibits experimental evidences that part of the large flux jumps observed on this wire may originate in the un-reacted Nb phase.

Data from the nano- and micro-hardness measurements have been analyzed and cross-checked with available literature data, yielding a summary table of relevant material properties (Young's modulus, yield strength, maximum elongation and ultimate tensile strength) in the cold work state of the wire at the end of drawing (EDMS 567375V1). In parallel, tensile tests have been carried out at CERN (EDMS 592009) and at the BundesAnstalt für Materialforschung (BAM), in Berlin, on samples of the old ITER-type wire while complementary nano-hardness measurements on longitudinal cuts of this wire have been sub-contracted to EIAJ. Analyses of this second round of measurements led to an iteration on the table of material properties (EDMS 567375V2). This latter table presents provides a fairly consistent set of data that will be used in the FE model to study the behavior of two types of internal tin wires developed by Alstom/MSA: the old, ITER-type design and the new NED design (EDMS 575661).

2006 Summary

SMI contract

After further investigation and characterization, the best results achieved by SMI during STEP1 where those measured on a wire sample of 1 mm in diameter drawn down from billet B179, which exhibited a critical current density of 2410 A/mm^2 at 12 T. For STEP2, it was decided to continue the development with a strand design for NED of diameter 1.25 mm that includes 288 $(NbTa)_3Sn$ filaments so as to get 50 μm filament diameter, by keeping the same NbTa tube and the same powder composition as for billet B179 and by adjusting the filament layout to have more copper around the filaments. For STEP 2, SMI produced two new billets with the final strand design. CERN has carried out an extensive program to characterize the strands. Virgin strand samples of the first 3 kg billet B207 were sent by CERN to INFN-Mi for critical current measurements. A high critical current value of 1313 A was measured at 12 T and 4.2 K on the samples which corresponds to a non-copper critical current density of 2069 A/mm^2. This lower than anticipated critical current density is attributed to a problem in the powder preparation which underwent by mistake an additional heat treatment. A RRR value of 250 was measured at CERN on a virgin sample of billet B207, well above the specified NED value. To evaluate if the strands are capable to sustain cabling, the strands were deformed at CERN by rolling to investigate the filaments layout behaviour under different levels of deformation. The filament layout of the 3 kg billet was able to sustain the high unidirectional deformation as observed by optical metallography of the cross-section of samples, confirming the importance to have enough copper around the filaments. A RRR value of 80 was measured at CERN on a sample deformed at a level of 28%. The critical current degradation due to flat deformation at a level of 28% was around 15%, which is still acceptable as we believe that the deformation due to flat rolling should be more drastic than cabling. A second 10 kg billet B215 was launched in fabrication by SMI, keeping the filament layout of the billet B207. A strand piece length of 900 m was obtained without any breakage. A high critical current of 1397 A was measured by Twente University at 12 T and 4.2 K thus only 15% below the 1636 A target value of the NED specification. This value corresponds to a non-copper critical current density of 2500 A/mm^2 and it is worthwhile to point out that this value was achieved in a strand with 50 μm filament diameter. Finally, rolling tests were carried out at CERN to study the wire sensitivity to deformation. The strand samples deformed with a 0.35 mm diameter reduction (deformation level of 28%) sustained well the deformation according to the cross-section of the samples observed at CERN by optical metallography. Critical current measurements performed at Twente University on samples flattened at the same level of deformation yield a degradation of 37% at 12 T and 4.2 K, although the deformed samples of the billet B215 sustained the unidirectional deformation as well as the billet B207. The origin of this high degradation is under investigation. Cabling tests are foreseen to be done in January 2007 at Berkeley National Laboratory. A 20 m long cable will be fabricated with the available 900 m strand piece length. The cabling tests have to prove the suitability of the SMI-NED strand for cabling.

Alstom contract

For Alstom/MSA, which develops the internal tin diffusion technology, STEP1 was devoted to study the influence of relevant parameters on workability and performances. For STEP1, Alstom/MSA has launched five different types of strands in fabrication with the aim to determine the optimum design in term of workability and critical current. All the sub-element billets have suffered from a too large number of breakages due to a lack of cohesion between the different components. The manufacturing process of the sub-element billet has been improved by Alstom/MSA, which has produced a sub-element billet with a modified filament layout. A final billet making use of this new sub-element has been assembled with 78 sub-elements and has been drawn to 1.25 mm and 0.8 mm showing a very good workability. At a diameter of 0.8 mm, the sub-elements of the strand had a diameter of 50 μm, as requested for the NED strand. Strand samples were sent by CERN to LASA-Milan for critical current measurements. A critical current value of 740 A was measured at 12 T and 4.2 K on the samples which corresponds to a non-copper critical current density of 1500 A/mm2. The non-copper critical current density achieved on the strand corresponds to the expected value as calculated by Alstom/MSA for this sub-element, which has a large local Cu to Nb ratio. A sound sub-element design has been achieved by Alstom/MSA. This design is being used for STEP2 keeping a very similar filament layout but increasing the amount of Nb and decreasing the amount of Cu in order to reach a non-copper critical current density of at least 2500 A/mm^2 at 12 T and 4.2 K. The development plan for STEP2 was discussed in detail between CERN and Alstom/MSA. The decision was taken to launch in fabrication a few billets with two different sub-element designs following a cold drawing process. In parallel, Alstom/MSA will also launch in fabrication a sub-element billet following a hot extrusion process. Alstom/MSA is focusing the development on the manufacturing process of the final billet to switch from 78 to 246 sub-elements in order to get 50 μm sub-element diameter as required by the NED program. The first results of step 2 are expected at the beginning of 2007. The completion of STEP2 is foreseen in June 2007.

Finite Element wire model to simulate cabling effects
INFN-Ge has pursued the development of it a Finite Element mechanical model of Nb_3Sn strands, with the aim of simulating the mechanical behavior of a strand subjected to a severe plastic deformation. A plane strain 2D model was chosen as the strain value as measured at CERN along the longitudinal direction is 0.5 % for a 28 % reduction in diameter. The PIT-SMI strand deformed at few different reductions in diameter has been well simulated by the FE analysis. The calculations give a suitable description of the overall behavior of the real strand. Different PIT strand designs were investigated with the aim to find an optimum design minimizing cabling damages. The FE analysis has confirmed the beneficial effect of increasing the local Cu to non-Cu area ratio. A strand layout with a large copper core obtained by removing 12 filaments around the core and by placing them on the external part of the filamentary region was simulated. A 30 % reduction of the Von Mises strain in the most deformed filaments was obtained. A model of the Alstom/MSA strand has also been built and is being investigated so as to improve the billet design. A summary of the material properties used in the model was presented at the Cryoprague conference (talk: EDMS 796708, paper: EDMS 797692) while a detailed description of the model was presented at the 2006 Applied Superconductivity Conference (talk: EDMS 803531, paper: EDMS 803705). This topic was also selected for a highlight talk at the CARE general meeting in Frascati (EDMS 803680).

Nb_3Sn Heat Treatment Studies
CERN, HMI and ESRF have joined forces to submit a proposal (MA187; EDMS 815460) to ESRF for an innovative experiment combining fast micro-tomography and diffraction measurements during in-situ Nb_3Sn strand heating cycles so as to study phase precipitation and void formation. The proposal was accepted by the ESRF review panel and 15 shifts of beam time at the ESRF ID15A high energy beam line were allocated in September 2006.
A quantitative description of the void growth and the coinciding phase transformations in an Internal Tin (IT) Nb_3Sn strand has been obtained for the first time. This enabled the identification of three void growth mechanisms in IT Nb_3Sn superconductors: initially, void growth is driven by a reduction of void surface area. The main void volume increase is caused by density changes upon formation of Cu_3Sn in the strand. Only the formation of Kirkendall voids may be influenced by the heating ramp rate. Long lasting temperature ramps and isothermal holding steps cannot reduce the void volume and neither improve the chemical strand homogeneity prior to the superconducting A15 phase nucleation and growth.
As for the finite element model, these heat treatment studies are an extension of scope with respect to CARE Annex I.

JRA4.3.1 CD WP coordination of a 15 T Dipole Magnet

As already mentioned, the CD Work Package is articulated around three main poles: conductor development (encompassing Tasks 3.2, 3.3, 3.4 and 3.6), conductor characterization (encompassing Tasks 3.5 and 3.7), and mechanical studies (extension of scope with respect to CARE Annex I, initiated by INFN-Ge and partially supported by CERN).

The conductor development pole was launched by D. Leroy (CERN) and is presently coordinated by L. Oberli (CERN). A working Group on Conductor Characterization (WGCC), chaired by A. den Ouden (TEU) has been set up to coordinate the conductor characterization efforts, while S. Farinon (INFN-Ge) is the principal investigator on the mechanical model. The Pole Coordinators report to the NED Steering Committee and, ultimately, to the NED/JRA Coordinator.

JRA4.3.2 Design of a 15 T Dipole Magnet

The following actions have been carried out

- ✓ September 2003–July 2004: preliminary design computations carried out by O. Vincent-Viry (CERN) under D. Leroy supervision (CERN)
- ✓ November 2003: report on 2D magnetic induction analytical calculation issued by O. Vincent-Viry (CERN; EDMS 431540)
- ✓ January 2004 SC meeting: first presentation of preliminary design computations by O. Vincent-Viry (CERN)
- ✓ 4 May 2004: meeting at CEA to review magnetic configurations and choice of 88-mm-aperture, cosθ layer as Reference Design V1 (EDMS 555825)
  participants: H. Félice, L. Quettier, J.M. Riflet, P. Védrine (CEA), A. Devred (CEA&CERN), D. Leroy and O. Vincent-Viry (CERN)
- ✓ 2 August 2004: seminar at CERN by O. Vincent-Viry (CERN) on preliminary magnet designs
- ✓ 16 February 2005: first version of preliminary design report issued by D. Leroy and O. Vincent Viry (CERN; EDMS 555826)
- ✓ 26 July 2005: final version of preliminary design report issued by D. Leroy and O. Vincent Viry (CERN; EDMS 555826V2); EU deliverable

Sub-Task completed

JRA4.3.3 Specifications on Wire and Cable

The following actions have been carried out

- ✓ 11 May 2004: first draft specification issued by D. Leroy (CERN) and communicated to A. Devred (CEA&CERN)
- ✓ 14 May 2004: first draft reviewed by A. Devred (CEA&CERN)
- ✓ 18 May 2004: second draft specification issued by D. Leroy and communicated to A. Devred (CEA&CERN) and A. den Ouden (TEU)
- ✓ 1 June 2004: third draft specification issued by D. Leroy and communicated to NED SC
- ✓ 4 June 2004: Specification Committee Meeting at CERN
  participants: T. Boutboul, P. Bryant (Chairman), P. Lebrun, D. Leroy, L. Oberli, L. Rossi (CERN), H.H.J. ten Kate (CERN&TEU)]
- ✓ 18 June 2004: final specification and technical questionnaire issued by D. Leroy (CERN; EDMS 475443); EU deliverable

Sub-Task completed

JRA4.3.4 Wire Development

The following actions have been carried out and/or are foreseen

- ✓ 12 December 2003: preparatory visit to Alstom/MSA, France

participants: A. Devred (CEA&CERN), D. Leroy, T. Boutboul and L. Oberli (CERN)]

Trip report: EDMS 739047

- ✓ 15 December 2003: preparatory visit to European Advanced Superconductors (EAS, Germany)
  participants: A. Devred (CEA&CERN), D. Leroy and L. Oberli (CERN) + SMI representative
- ✓ 27 January 2004: preparatory visit to ShapeMetal Innovation (SMI, The Netherlands)

participants: A. Devred (CEA&CERN), D. Leroy, T. Boutboul, and A. Unervick (CERN) +

EAS representatives

Trip report: EDMS 739050

- ✓ 21 June 2004: call for tender issued to Alstom/MSA, EAS, Outokumpu Copper (OK Cu, Finland), Outokumpu SI (OKSI, Italy) and SMI
- ✓ 20 August 2004: meeting at CERN with SMI and EAS to prepare answer to call for tender
- ✓ 23 August 2004: meeting at CERN with OK to prepare answer to call for tender
- ✓ 24 August 2004: meeting at CERN with Alstom/MSA to prepare answer to call for tender
- ✓ 6 September 2004: tenders' opening at CERN; selection of Alstom/MSA and SMI
- ✓ 16 September 2004: visit of T. Boutboul, D. Leroy, L. Oberli (CERN) to Alstom/MSA
  Trip report: EDMS 739048
- ✓ 24 September 2004: sending of orders to CERN Finance Division
- ✓ 15 November 2004: contracts' signature by Alstom/MSA and SMI
- ✓ 15 December 2004: first progress reports issued by Alstom/MSA and SMI (restricted access)
- ✓ 17 May 2005: visit of T. Boutboul, D. Leroy, L. Oberli (CERN) to Alstom/MSA
- ✓ 28 June 2005: visit of T. Boutboul, D. Leroy, L. Oberli (CERN) to SMI
- ✓ 14 September 2005: visit of T. Boutboul, L. Oberli (CERN) to Alstom/MSA
- ✓ 21 October 2005: meeting at Archamps to discuss progress of Alstom/MSA

participants: T. Boutboul, L. Oberli (CERN) and C. Verwaerde (Alstom/MSA)

- ✓ 29 November 2005: visit of T. Boutboul, D. Leroy, L. Oberli (CERN) to Alstom/MSA
- ✓ 10-11 January 2006: meeting at CERN to discuss progress of Alstom/MSA
  Participants: T. Boutboul, D. Leroy, L. Oberli (CERN), C. Verwaerde and L. Villars (Alstom/MSA)
- ✓ 14 March 2006: meeting at CERN to discuss progress of SMI
  Participants: T. Boutboul, D. Leroy, L. Oberli (CERN),
  J. Lindenhovius (SMI)
  Trip report : EDMS 739051
- ✓ 15 March 2006: meeting at CERN to discuss progress of Alstom/MSA
  Participants: T. Boutboul, D. Leroy, L. Oberli (CERN), G. Grumblatt and C. Verwaerde (Alstom/MSA)
- ✓ 10-11 April 2006: visit of T. Boutboul, D. Leroy, L. Oberli (CERN) to Alstom/MSA
  Trip report: EDMS 739049
- ✓ 28 June 2006: visit of T. Boutboul and L. Oberli (CERN) to Alstom/MSA
- ✓ 12 October 2006: visit of T. Boutboul and L. Oberli (CERN) to Alstom/MSA
  Trip report: EDMS 794482
- ✓ 21 November 2006: Highlight talk given by L. Oberli at CARE general meeting in Frascati (EDMS 803677)
- ✓ 21 November 2006: MCS seminar given at CERN on “Nb_3Sn strand development and characterization for NED project” by T. Boutboul (CERN; EDMS 803686)
- ✓ 12 December 2006: meeting at CERN to discuss progress of Alstom/MSA
  Participants: T. Boutboul, D. Leroy, L. Oberli, C. Scheuerlein (CERN), C. Verwaerde and L. Villars (Alstom/MSA)
- ⇒ June 2007: final wire and cable production: EU deliverable

JRA4.3.5 Wire Characterization

The following actions have been carried out and/or are foreseen

JRA4.3.5.1 Definition of Measurement Procedures

- ✓ March 2004: setting up of Working Group on Conductor Characterization (WGCC), chaired by A. den Ouden (TEU)
  WGCC charges and composition: EDMS 548084
- ✓ 19 May 2004: first Working Group meeting at CERN
  participants: L. Quettier (CEA), V. Previtali (CERN), P. Fabbricatore and M. Greco (INFN-Ge), D. Pedrini, G. Volpini (INFN-Mi), A. den Ouden (TEU)
  Talks: EDMS 567255
- ✓ June 2004-October 2004: first round of test wires for cross-calibration purposes

- ✓ 28 October 2004: second Working Group meeting at CEA
  participants: L. Quettier (CEA), V. Previtali, T. Boutboul (CERN), M. Greco (INFN-Ge), D. Pedrini, G. Volpini (INFN-Mi), A. den Ouden (TEU)
- ✓ November 2004-January 2005: second round of test wires for cross-calibration purposes
- ✓ 22 February 2005: third Working Group meeting at INFN-Mi
  participants: L. Quettier (CEA), A. Devred (CEA&CERN), T. Boutboul and V. Previtali (CERN), M. Greco and P. Fabbricatore (INFN-Ge), D. Pedrini, G. Volpini (INFN-Mi)
  Talks and Minutes: EDMS 576267
- ✓ 3 May 2005: fourth Working Group Meeting at CERN
  participants: L. Quettier (CEA), T. Boutboul, D. Leroy, L. Oberli (CERN), M. Greco (INFN-GE), D. Pedrini, G. Volpini (INFN-Mi), A. den Ouden (TEU)
  Talks: EDMS 593632
- ✓ May-July 2005: third round of test wires for cross-calibration purposes (includes deformed wires by rolling)
- ✓ 22 November 2005: fifth Working Group Meeting at CERN
  participants: L. Quettier (CEA), A. Devred (CEA&CERN), T. Boutboul, L. Oberli V. Previtali (CERN), D. Pedrini (INFN-Mi), A. den Ouden (TEU)
  Talks: EDMS 682996
- ✓ 13 December 2005: final version of MT19 paper issued by A. den Ouden (TEU; EDMS 690009)
- ✓ December 2005-February 2006: final iteration on third round of cross calibration
- ⇒ 30 June 2007: final report on wire characterization; EU deliverable

JRA4.3.5.2 Wire IC Measurements at CEA

- ✓ 11 October 2004: Report No 1 issued by L. Quettier (CEA; EDMS 722289)
- ✓ 14 February 2005: Report No 2 issued by L. Quettier (CEA; EDMS 722295)
- ✓ 25 April 2005: Report No 3 issued by L. Quettier (CEA; EDMS 722301)
- ✓ 27 July 2005: Report No 4 issued by L. Quettier (CEA; EDMS 722306)
- ✓ 4 October 2005: Report No 5 issued by L. Quettier (CEA; EDMS 722313)
- ✓ 17 November 2005: Report No 6 issued by L. Quettier (CEA; EDMS 722317)
- ✓ 9 February 2006: Report No 7 issued by L. Quettier (CEA; EDMS 722320)
- ✓ 27 March 2006: Report No 8 issued by L. Quettier (CEA; EDMS 789484)

JRA4.3.5.3 Wire IC Measurements at INFN-Mi

- ✓ 29 September 2004: Report No 1 issued by G. Volpini (INFN-Mi; EDMS 722401)
- ✓ 2 February 2005: Report No 2 issued by G. Volpini (INFN-Mi; EDMS 722410)
- ✓ April 2005: Report No 3 issued by G. Volpini (INFN-Mi; EDMS 722411)
- ✓ July 2005: Report No 4 issued by G. Volpini (INFN-Mi; EDMS 722414)
- ✓ January 2006: Report No 5 issued by G. Volpini (INFN-Mi; EDMS 722416)
- ✓ 2 February 2006: Report No 6 issued by G. Volpini (INFN-Mi; EDMS 722422
- ✓ 26 October 2006: Report No 7 issued by G. Volpini (INFN-Mi; EDMS 789488
- ✓ 16 November 2006: Report No 8 issued by G. Volpini (INFN-Mi; EDMS 797865

JRA4.3.5.4 Wire IC Measurements at TEU

- ✓ September 2004: Report No 1 issued by A. den Ouden (TEU; EDMS 722424)
- ✓ February 2005: Report No 2 issued by A. den Ouden (TEU; EDMS 722428)
- ✓ April 2005: Report No 3 issued by A. den Ouden (TEU; EDMS 722430)
- ✓ July 2005: Report No 4 issued by A. den Ouden (TEU; EDMS 722431)
- ✓ September 2006: Report No 5 issued by A. den Ouden (TEU; EDMS 789485)
- ✓ October 2006: Report No 6 issued by A. den Ouden (TEU; EDMS 789487)

JRA4.3.5.5 Wire Magnetization Measurements at INFN-Ge

- ✓ 21 January 2004: preparatory meeting at CERN
  participants: A. Devred (CEA&CERN), D. Leroy (CERN) and P. Fabbricatore (INFN-Ge]
- ✓ 23 March 2004: first report on preliminary measurements issued by P. Fabbricatore and M. Greco (INFN-Ge)
- ✓ 23 March 2004–13 April 2004: review of preliminary measurements by A. Devred (CEA&CERN) and D. Leroy (CERN)
- ✓ June 2004-July 2005 2005: participation to cross-calibration program defined by WGCC
- ✓ 23 November 2005: highlight talk given by M. Greco (INFN-Mi) at the CARE general meeting at CERN
- ✓ 5 December 2005: final version of MT19 paper issued by M. Greco (INFN-Mi; EDMS 688570)
- ✓ 5 April 2006: meeting at CERN for discussing measurements on SMI PIT wire B207
  Participants: A. Devred (CEA&CERN), D. Leroy, L. Oberli (CERN) M. Greco (INFN-Ge)

- ✓ September 2006: paper on magnetization measurements presented at 2006 Applied Superconductivity Conference (talk: EDMS 803531, paper: EDMS 803656)
- ✓ November 2006: Measurement Report on PIT ECN wire issued by M. Greco (INFN-Ge; EDMS 797846)
- ✓ November 2006: Measurement Report on IT Alstom/CEA wire issued by M. Greco (INFN-Ge; EDMS 797849)
- ✓ November 2006: Measurement Report on PIT SMI B1083 wire issued by M. Greco (INFN-Ge; EDMS 797853)
- ✓ November 2006: Measurement Report on PIT SMI B179 wire issued by M. Greco (INFN-Ge; EDMS 797856)
- ✓ November 2006: Measurement Report on PIT SMI B207 wire issued by M. Greco (INFN-Ge; EDMS 797859)
- ✓ 8 January 2007: Measurement Report on Alstom 51B76 wire issued by P. Fabbricatore (INFN-Ge; EDMS 811256)
- ✓ 8 January 2007: Measurement Report on Alstom 51S00215A01UX.031 wire issued by P. Fabbricatore (INFN-Ge; EDMS 811260)

JRA4.3.6 Cable development and manufacturing

Not started

JRA4.3.7 Cable Characterization

Not started

JRA4.3.8 Mechanical Studies

These studies are an extension of scope with respect to CARE Annex I and are supported by additional resources provided by INFN-Ge and CERN.

The following actions have been carried out and/or are foreseen

- ✓ 28 January 2004: parameters of mechanical model for 19-subelement, internal tin wire issued by A. Devred (CEA&CERN; EDMS 548087)
- ✓ 30 January 2004: mesh proposal issued by S. Farinon (INFN-Ge)
- ✓ Early February 2004: review of mesh proposal by A. Devred (CEA&CERN), D. Leroy (CERN) and C. Verwaerde (Alstom/MSA)
- ✓ 25 March 2004: informal discussion of preliminary computation results
  participants: A. Devred (CEA), D. Leroy (CERN), S. Farinon (INFN-Ge), C. Verwaerde and P. Mocaer (Alstom/MSA)]
- ✓ 9 June 2004: meeting at CERN to review material properties and discuss computation results
  participants: A. Devred (CEA&CERN), T. Boutboul, P. Fessia, D. Leroy and S. Sgobba (CERN), S. Farinon and R. Musenich (INFN-Ge), P. Loverage (CCLRC)
- ✓ 7 July 2004: meeting at CERN to review material properties and discuss computation results
  participants: A. Devred (CEA&CERN), T. Boutboul, P. Fessia, L. Oberli M. Pojer and S. Sgobba (CERN), P. Fabbricatore and S. Farinon (INFN-Ge)

- ✓ September 2004: first contract issued to EIAJ to perform nano-indentation measurements on an un-reacted, internal-tin wire cross-section
- ✓ 14 October 2004: visit to EIAJ, Le Locle (CH)

participants: T. Boutboul, C. Scheuerlein, S. Sgobba (CERN)

trip report: EDMS 520095

- ✓ 29 October 2004: first report issued by EIAJ on nano-indentation measurements (EDMS 548100)
- ✓ 11 November 2004: meeting at CERN to review nano-indentation measurements performed at EIAJ

participants: A. Devred (CEA&CERN), T. Boutboul, P. Fessia, D. Leroy, L. Oberli, V. Previtali, D. Richter and S. Sgobba (CERN), P. Fabbricatore and S. Farinon (INFN-Ge)

- ✓ 11 November 2004: first report issued by C. Scheuerlein (CERN) on micro-hardness measurements at CERN (EDMS 548116)
- ✓ 22 November 2004: meeting at CERN to review micro-hardness measurements

participants: A. Devred (CEA&CERN), T. Boutboul, C. Scheuerlein, S. Sgobba and W. Scandale (CERN)

- ✓ 15 February 2005: second report issued by C. Scheuerlein (CERN) on micro-hardness measurements at CERN (EDMS 567297)
- ✓ 15 February 2005: meeting at CERN to update table of material properties to be used in FE model
  participants: A. Devred (CEA&CERN), T. Boutboul, D. Leroy, C. Scheuerlein, S. Sgobba (CERN)
- ✓ 17 February 2005: report issued by T. Boutboul (CERN) on RRR measurements at CERN (EDMS 567365)
- ✓ 22 February 2005: table of material properties issued by S. Sgobba and C. Scheuerlein (CERN; EDMS 567375)
- ✓ 23 March 2005: note issued by T. Boutboul and L. Oberli (CERN) defining new parameters of internal tin wire (EDMS 575661)
- ✓ April 2005: second contract issued to EIAJ to perform nano-indentation measurements on a longitudinal cross-section of an un-reacted, internal-tin wire
- ✓ 9 May 2005: first version of report on UTS measurements at CERN issued by C. Scheuerlein (CERN; EDMS 567375)
- ✓ 6 June 2005: second version of report on UTS measurements at CERN issued by C. Scheuerlein (CERN; EDMS 567375V2)
- ✓ 6 October 2005: meeting at CERN to discuss results of tensile tests performed at BAM
  participants: A. Devred (CEA&CERN), T.Boutboul, L. Oberli, C. Scheuerlein (CERN)

- ✓ 10 November 2005: visit of C. Scheuerlein to BAM (CERN; EDMS 681910)
- ✓ 11 November 2005: meeting at CERN to update Table of material properties (CERN; EDMS 567375V2)
  participants: L. Oberli, C. Scheuerlein, S. Sgobba (CERN)
- ✓ 24 November 2005: meeting at CERN to discuss problems with FE modelling in the plastic range
  participants: A. Desirelli and S. Sgobba (CERN), S. Farinon (INFN-Mi)
- ✓ 9 December 2005: report on "room temperature tensile properties of the powder-in-tube (PIT) Nb_3Sn strand SMI B201 for NED" issued by C. Scheuerlein (CERN; EDMS 688862)
- ✓ 6 April 2006: meeting at CERN for discussing FE mechanical model for PIT wires
  Participants: T. Boutboul, D. Leroy, L. Oberli (CERN) and S. Farinon (INFN-Ge)
- ✓ 9 May 2006: meeting at CERN for discussing progress on FE mechanical model for PIT wires
  Participants: T. Boutboul, D. Leroy, L. Oberli, C. Scheuerlein (CERN) and S. Farinon (INFN-Ge)
- ✓ 21 June 2006: meeting at CERN for discussing progress on FE mechanical model for PIT wires
  Participants: T. Boutboul, D. Leroy, L. Oberli (CERN), A. Devred (CEA&CERN) and S. Farinon (INFN-Ge)
- ✓ July 2006: summary paper on material properties presented at CryoPrague 06 (talk: EDMS 796708, paper: EDMS 797692)
- ✓ 2 August 2006: meeting at CERN for discussing progress on FE mechanical model for PIT wires
  Participants: T. Boutboul, D. Leroy, L. Oberli (CERN), A. Devred (CEA&CERN) and S. Farinon (INFN-Ge)
- ✓ September 2006: paper on FE model presented at 2006 Applied Superconductivity Conference (talk: EDMS 803531, paper: EDMS 803705)
- ✓ 25 October 2006: meeting at CERN for discussing progress on FE mechanical model for PIT wires
  Participants: T. Boutboul, D. Leroy, L. Oberli (CERN), A. Devred (CEA&CERN) and S. Farinon (INFN-Ge)
- ✓ 21 November 2006: Highlight talk given by S. Farinon (INFN-Ge) at CARE general meeting in Frascati (EDMS 803680)
- ✓ 11 December 2006: meeting at CERN for discussing progress on FE mechanical model for Alstom/MSA wires
  Participants: T. Boutboul, D. Leroy, L. Oberli (CERN), A. Devred (CEA&CERN), S. Farinon (INFN-Ge), C. Verwaerde and L. Villars (Alstom/MSA)

JRA4.3.9 Heat treatment studies

These studies are an extension of scope with respect to CARE Annex I and benefit from a proposal submitted to ESFR which has been accepted (proposal MA186).

The following actions have been carried out and/or are foreseen

- ✓ 1st March 2006: proposal submission to ESRF (EDMS: 815460)
- ✓ 19 June 2006: acceptance of proposal by ESFR Review Board
- ✓ 5 July 2006: trip of C. Scheuerlein (CERN) to ESRF to prepare experiment (trip report: EDMS 757510)
- ✓ 5-11 October 2006: combined micro-tomography/XRD measurements at ESRF carried by C. Scheuerlein
- ✓ 19 December 2006: MCS seminar at CERN on "Combined synchrotron tomography and powder diffraction study for the heat treatment optimization of Internal Tin and Powder In Tube Nb3Sn strands" presented by C. Scheuerlein (CERN; EDMS 815067)

JRA4.3.10 Overall Progress of Work Package 3

Status of the lowest Sub-Tasks level in the CD WP (as of 30 April 2006).

WBS #	Title	Original begin date (Annex 1)	Original end date (Annex 1)	Estimated Status	Revised end date
3.1	CD WP Coordination				
3.2	Design of a 15 T Dipole Magnet	1 January 2004	31 Dec. 2004	Completed	July 2005
3.3	Specifications on Wire and Cable	1 April 2004	30 June 2004	Completed	On time
3.4	Wire Development	1 July 2004	30 June 2006	Started	30 June 2007
3.5	Wire Characterization				
3.5.1	Definition of Measuring Procedures	1 January 2004	30 June 2005	Completed	Fall 2005
3.5.2	Ic measurements at CEA	1 July 2005	30 June 2006	Started	30 June 2007
3.5.3	Ic measurements at INFN-Mi	1 July 2005	30 June 2006	Started	30 June 2007
3.5.4	Ic measurements at TEU	1 July 2005	30 June 2006	Started	30 June 2007
3.5.5	Wire Magnetization Measurements	1 July 2005	30 June 2006	Started	30 June 2007
3.6	Cable Development	1 July 2005	31 Dec. 2006	Just Started	30 June 2007
3.7	Cable Characterization	1 October 2005	31 Dec. 2006	Not started	-
3.8	Mechanical Studies[a)]	1 January 2004	31 Dec. 2005	50%	30 June 2007

[a)] Extension of scope with respect to CARE Annex I.

JRA4.4 Work Package 4: Insulation Development & Implementation (IDI)

Work Package 4 includes two main Tasks:

- o conventional insulation development
  (carried out by CCLRC/RAL, Task Leader: S. Canfer)
- o innovative insulation development
  (carried out by CEA, Taks Leader: F. Rondeaux)

2005 Summary

Screening testing of candidate materials for Conventional Insulation has progressed well. CCLRC has developed a standardised laminate production system and relies on three tests for screening: (1) inter-laminar fracture test, (2) short-beam shear test and (3) electrical breakdown test. The standard laminates leave sufficient material for radiation testing.

To gain experience and validate the inter-laminar fracture tests, three know systems of epoxy resins have been investigated: (1) a brittle system made up of DGEBA resin with an acid anhydride hardener (HY918, Ciba), (2) a tough system, made up of DGEBA resin with an aliphatic amine hardener (Jeffamine D-400), and (3) an intermediary system, made up of DGEBF resin, a PPGDGE flexibiliser and an aromatic amine hardener (HY5200, Ciba). All samples were prepared using as received E-glass tapes with commercial sizing, and the tests were performed at room temperature and at 77 K. As expected, the brittle system yields the lowest work of fracture (~0.45 kJ/m^2 at room temperature), while the toughest system yields the highest one (~1 kJ/m^2 at room temperature), and the intermediary system is in between (~0.8 kJ/m^2 at room temperature). The results are in the same order, but 20 to 40% higher at 77 K.

Furthermore, CCLRC has investigated the issue of fibre glass sizing. The sizing that coats the filaments of commercial fibre tapes is a mixture of organic materials that is not intended for high temperature use, and, if left in place, can result in undesirable carbon residues at the end of the Nb_3Sn reaction cycle. In practice, the sizing is removed from the tapes (by carbonization in air at temperatures in the 350-450 ºC range) prior to conductor wrapping and winding. However, removing the sizing renders the tape fragile and easy to tear off by friction, which complicates the manufacturing process. In addition, sizing removal has proved to have a bearing on the mechanical and electrical performances of the final insulation system. CCLRC has identified an improved sizing material, which is a commercial polyimide produced by Hydrosize, NC, USA that may sustain the Nb_3Sn reaction cycle without deleterious degradation. This sizing has been applied to glass and quartz fibre fabric by JPS Glass, SC, USA.

To assess the suitability of the polyimide sizing, CCLRC has undertaken a comparative test on standard laminates made up of conventional S-glass tapes (as received, de-sized and heat treated for 60 hours at 660 ºC in a vacuum after de-sizing) and of polyimide-sized, S-glass and quartz fabrics provided by JPS (as received and heat-treated for 60 hours at 660 ºC in a vacuum without de-sizing). The laminates were vacuum-impregnated with a system made up of DGBEF resin (DER354P, Dow) and a DETDA hardener (HY5200, Vantico). (This system was chosen because it is both relatively radiation stable and has a low viscosity, and, thereby, seems the best suited to NED application). The work of fracture measured on the conventional, as-received, S-glass sample is 0.49 kJ/m^2 at room temperature, which puts the resin system into the brittle category (not unexpected given the nature of the hardener that was chosen). No meaningful work of fracture could be measured on the conventional, de-sized, heat-treated, S-glass sample. Indeed, the sample failed through the glass layer and not in an inter-laminar fashion, thereby indicating that the glass was adversely affected by heat treatment. The results on the polyimide-sized, S-glass samples are very promising: the work of fracture on the sample made up of as-received fabric is 0.7 kJ/m^2 at room temperature and stays at 0.67 kJ/m^2 on the sample made up of heat-treated fabric. The short-beam shear strengths measured at 77 K are above ~90 MPa for all samples, save for the conventional, de-sized, heat-treated, S-glass sample where it falls to 69 MPa. Finally, electrical breakdown tests were carried out on conventional, heat-treated, de-sized and not de-sized S-glass samples and on heat-treated, polyimide-sized S-glass samples. The voltage measured on the conventional, de-sized sample and on the polyimide-sized sample are both in excess of 30 kV/mm, while the one measured on the sample made up of conventional S glass, heat-treated without de-sizing, is degraded to 2.5 kV/mm. Preliminary results on this sub-task were reported in a paper presented at ICMC2005 in Keystone, CO (EDM 685456)

The work on the Innovative Insulation is still on hold pending the hiring of a technician in the chemistry lab at CEA, which has been further delayed until the end of 2005. To compensate this delay, it has been decided to re-allocate part of the EU funding to hire a postdoc at CEA.

2006 Summary

CCLRC/RAL has carried out characterization of conventional insulation systems in the areas described below. The work carried out for the last 3 years on conventional insulation is summarized in a detailed report that is part of the EU deliverable (EDMS 815074)

Effect of compaction pressure on glass fibre

During magnet assembly and before impregnation with a polymer, the glass fibre will experience compaction pressures of up to 5 MPa. The sensitivity of the glass fibre to varying compaction pressure was studied and a paper was presented orally at ICMC 2006 in Prague (talk: EDMS 801102, paper: EDMS: 801123).

An experiment was performed where compaction pressure could be closely controlled using a mechanical testing machine. Glass fibre was impregnated with epoxy while under compaction pressure. Impregnation was performed using a vacuum bag technique. The epoxy was cured, still while maintaining compaction pressure, by heating.

The resulting epoxy-glass laminates were mechanically tested in short-beam shear at a temperature of 77 K. Samples were polished for microscopy. Further samples were taken for density, void content and glass/epoxy resin ratio determination by burning off the polymer.

Applied mechanical stress up to approximately 2 MPa has a beneficial effect on short beam shear strength and glass content of epoxy-glass fibre laminates produced by vacuum infusion. Above an applied stress of 2MPa, the glass content does not increase significantly and shear strength is reduced. At a stress of 10 MPa the laminate is of poor quality and shear strength is reduced to one third of a high quality laminate. All results suggest that visual inspection is a good guide to laminate strength. These results provide useful data for magnet insulation systems, but further investigations must be carried out on insulated cable stacks that are more representative of actual coil configurations.

Screening testing

An additional epoxy material has been tested in interlaminar fracture. The tetra-functional epoxy, which should be a good epoxy for radiation resistance, suffers from low work of fracture. The work of fracture is the same as an anhydride-cured epoxy, considered a brittle material, 0.49kJ/m2.

Irradiation

Opportunistic irradiation of a range of epoxy-glass laminates has been carried out in a neutron flux. The dose is estimated to be in the same order of magnitude that an LHC IR upgrade dipole might experience. The resulting samples are too active to handle and so mechanical testing is not feasible at present. This demonstrates that testing of such irradiated materials requires special consideration and some considerable investment.

Cyanate Ester materials

Samples of cyanate ester materials have been obtained which could offer improved radiation hardness compared to epoxy resins. Their high cost needs to be justified. Mechanical and electrical screening tests are planned in November.

Characterisation of polyimide sizing on glass using TGA

A thermogravimetric analyzer, TGA, has been used to characterise the thermal decomposition behaviour of polyimide sizing on glass fibre. To date it has not been possible to obtain reproducible results using this technique. It is thought that this is due to the very small weight changes involved. Approximately 1% by weight of the sample is polyimide so weight changes are very small.

Cable stack testing

Tooling has been manufactured to enable a cable stack to be heat treated and mechanically tested. This represents the next step on from testing pure epoxy-glass laminates in that the cable is included. It will enable a more realistic testing configuration.

The work on innovative insulation was restarted at CEA on 3 April 2006, thanks to the arrival of a NED-funded additional staff. The test program was redefined in order to focus on the characterization and the improvement of the mechanical properties of insulated cable stacks representative of magnet coils and the task about testing the influence of tape weaving pattern was dropped out. Since April, two issues have been investigated: (1) foaming of ceramic samples during heat treatment, which has been eliminated by modification of the preparation method of the ceramic powder and (2) degradation of the rheological behaviour of ceramic suspensions, attributed to variations in the clay properties, likely due to a granulometric classification in the clay bag; clay was restocked and a study of a sampling procedure to avoid rheological behaviour drift was carried out. In the meantime, 3 heat treatment moulds to produce insulated cable stacks have been designed and manufactured. The moulds were used to prepare various insulated cable stacks relying on different pre-compressions during heat treatment so as to study the effect of this pre-compression on mechanical properties. The next step will be to test these stacks under transverse loading, but the measurements have been delayed to a failure of the press which is under repair.

JRA4.4.1 Work Package Coordination

The IDI Work Package is coordinated by E. Baynham (CCLRC). The conventional Insulation Task (4.3) is headed by S. Canfer (CCLRC) while the Innovative Insulation Task (4.4) is headed by F. Rondeaux (CEA). The Work package and Task Leaders report to the NED Steering Committee and, ultimately, to the NED/JRA Coordinator.

JRA4.4.2 Specification Drafting
The following actions have been carried out

- ✓ 6 May 2004: draft specifications issued by S. Canfer (CCLRC)
- ✓ 11 May 2004: conference call on insulation specifications
- ✓ participants: S. Canfer and J. Greenhalgh (CCLRC), F. Rondeaux (CEA), A. Devred (CEA&CERN), A. den Ouden (TEU)
- ✓ 11 May 2004: Version 2 of specifications issued by S. Canfer (CCLRC; EDMS 548037V1)
- ✓ 25 May 2004: Version 2.2 of specifications issued by S. Canfer (CCLRC; EDMS 548037V2)
- ✓ 1 June 2004: Version 2.3 of specifications issued by S. Canfer (CCLRC; EDMS 548037V3)
- ✓ 23 June 2004: Version 2.3b of specifications issued by S. Canfer (CCLRC; EDMS 548037V4)
- ✓ 16 July 2004: final specifications (EDMS 548037V5); EU milestone

Sub-Task completed

JRA4.4.3 Conventional Insulation
The following actions have been carried out and/or are foreseen

- ✓ 27 July 2004: first draft of conventional insulation Test Programme (EDMS 548038V1)
- ✓ 12 August 2004: second draft of conventional insulation Test Programme
- ✓ 27 October 2004: final insulation Test Programme (including Test Programme for innovative insulation; EDMS 548038V2); EU milestone
- ✓ 30 September 2004: completion of Literature Survey (Sub-Task 4.3.1)
- ✓ 30 November 2004: completion of Tooling Preparation (Sub-Task 4.3.2)
- ✓ 31 December 2004): completion of Component Supply (Sub-Task 4.3.3)
- ✓ 1 January 2005 – 31 May 2006: Iterative Tests (Sub-Task 4.3.4)
- ✓ 1 October 2005 – 30 June 2006: Data Analysis (Sub-Task 4.3.5)
- ✓ 1 July 2005 – 30 June 2006: Irradiation Tests (extension of scope with respect to CARE Annex I); first neutron irradiation to be completed in May 2006
- ✓ 22 February 2006: visit of S. Canfer and G. Ellwood (CCLRC) to CERN polymer laboratory (with S. Ilie)
- ✓ 30 June 2006: conventional insulation test program extended until 31 December 2006
- ✓ July 2006: Oral Paper on compaction of glass fibre presented to ICMC/CryoPrague Conference (paper: EDMS 801123, talk: EDMS 801102)

- ✓ September 2006: supply of thin, polyimide-sized S-glass tape delivered to RAL
- ✓ November 2006: A test method has been developed to allow TGA characterisation of small (2mg) quantities of glass fibre to be analysed; this will form a useful quality assurance test method for glass fibre tape
- ✓ November 2006: Stack test tooling delivered and trialled
- ✓ December 2006: Identified that the thin S-glass tape does not show the same behaviour as the previous glass fibre with "high temperature sizing", because the original low-temperature sizing was still in place
- ✓ December 2006: Neutron-irradiated test pieces are still too active to enable mechanical testing with existing equipment
- ✓ 22 January 2007: First version of final report on conventional insulation issued by S. Canfer (CCLRC; EDMS 815074)
- ⇒ 31 January 2007: final report on conventional insulation; EU deliverable

JRA4.4.4 Innovative Insulation

The following actions have been carried out and/or are foreseen

- ✓ 6 May 2004: preparatory meeting at CEA
- ✓ participants: J.M. Rifflet, F. Rondeaux and P. Védrine (CEA), A. Devred (CEA&CERN); conclusions of this meeting are reported above
- ✓ 30 August 2004: first draft of innovative insulation Test Programme
- ✓ September 2004: final innovative insulation Test Programme (added to EU milestone on conventional insulation Test Programme)
- ✓ 3 April 2006: hiring of Patrick Fourcade by CEA (additional staff for 1 year)
- ✓ April-June 2006: redefinition of test plan with elimination of Sub-Task 4.4.1 and change of scope of Sub Task 4.4.2 with respect to CARE ANNEX 1 to concentrate on characterization and improvement of mechanical properties of insulated cable stacks.
- ✓ April-December 2006:
  Investigation of foaming of ceramics samples during heat treatment
  Manufacture of 3 heat treatment moulds to produce cables stackings with ceramic insulation.
  Investigation of the degradation of the Rheological behaviour of ceramic suspensions
  Manufacture of insulated cable stacks with ceramic with different levels of compression during heat treatment
  Installation of specific instrumentation on press to realize mechanical tests in compression
  (program is now on hold pending a reparation of the press)
- ⇒ 31 March 2007: final report on innovative insulation; EU deliverable

JRA4.4.5 Overall Progress of Work Package 4

Status of the lowest Sub-Tasks level in the IDI WP (as of 31 December 2006).

WBS #	Title	Original begin date (Annex 1)	Original end date (Annex 1)	Estimated Status	Revised end date
4.1	IDI WP Coordination				
4.2	Specifications' Drafting	1 April 2004	30 June 2004	Completed	22 July 2004
4.3	Conventional Insulation				
4.3.1	Literature Survey	1 July 2004	30 Sept. 2004	Completed	On time
4.3.2	Tooling Preparation	1 October 2004	30 October 2004	Completed	31 Dec. 2005
4.3.3	Component Supply	1 October 2004	31 Dec. 2004	Completed	On time
4.3.4	Iterative Tests	1 January 2005	30 Sept. 2005	90%	31 May 2006
4.3.5	Data Analysis	1 October 2005	31 Dec. 2005	80%	30 June 2006
4.3.6	Irradiation tests[a)]	1 July 2005	30 June 2006	In progress	TBD[b)]
4.4	Innovative Insulation				
4.4.1	*Tape Weaving Trial*	*1 July 2004*	*31 Dec. 2004*	*Eliminated*[c)]	*31 December 2006*
4.4.2	Characterization Tests[d)]	1 July 2004	30 June 2005	Ongoing	31 March 2007

[a)] Extension of scope with respect to CARE Annex I.
[b)] When irradiated samples will be cold enough.
[c)] Eliminated from test program to focus on Task 4.4.2.
[d)] Modification of scope with respect to CARE Annex I.

JRA4.5 Working Group Magnet Design and Optimisation

2005 Summary

CCLRC/RAL has chosen to investigate the Reference Design V1, cosθ, layer design and to assess the feasibility of a double-helix magnetic configuration. The cosθ optimization was carried out using software supplied by the commercial company Vector Fields, which has close links with the RAL magnet group. At first, the software was used to construct a 2D parameterized FE model, which includes the option of modeling the nonlinear effects of iron and a non-uniform current density in the conductor winding (as generated by the slightly-keystoned, NED Rutherford-type cable). A number of test cases were run to check the optimizer provided by Vector Fields and to look at the effects of changing the objective functions. The output from the full model has now been compared with ROXIE and it gives the same results for the same geometry and field. Investigations are being carried out to determine whether the optimizer routines from both packages yield the same solutions, given the same starting point. The work on the helical dipole configuration has just begun and a basic model capable of being used with the VF optimizer has been built and is ready to run.

In parallel, CCLRC/RAL has started the development of a 2D mechanical model of NED Reference Design V1 based on ANSYS®. The model is in two steps. The first step includes the coil assembly, the ground plane insulation, pairs of austenitic steel collars and keys. It is used to simulate the collaring process during which the collars are implemented around the insulated coil assembly and are clamped by means of the keys to pre-compress the coil azimuthally. The second step includes the aforementioned collared-coil assembly completed by a two-piece, horizontally-split, iron yoke and a welded outer shell that holds the coldmass together. The two yoke halves are assembled around the collared-coil assembly in such way that there remains a gap at their midplane. The room-temperature coil pre-compression after collaring and the yoke midplane gap after shell welding must be optimized to ensure that, when the magnet is cold and energized, the coil remains under compression and the yoke midplane gap is closed, thereby providing a very stiff support against the Lorentz force. The first step of the model is now fully operational, while the details of the second step are being worked out.

CEA has been working on an original design referred to as *ellipse-type*, and has carried out 2D electromagnetic analyses of 88-mm-, 130-mm- and 160-mm-aperture models using ROXIE. It has been shown that, in each case, accelerator-field quality can be reached by optimizing the conductor distribution and that the peak-to-central-field ratio is very advantageous. Nevertheless, the Lorentz forces involved are huge a lot of attention has to be paid to the mechanical design. CEA is presently developing a mechanical model of the 130-mm-aperture design based on CASTEM.

In parallel, and at the margin of the WGMDO efforts, CEA has been subcontracted by EFDA to study a 130-mm-aperture, 12.5-central-field, dipole magnet relying on a conventional cosθ, layer design. The preliminary mechanical analysis carried out as part of this study concludes that the Lorentz stresses originating in the coils are excessive and that there is no easy way to control and limit them. This may indicate that such a field level in such an aperture is out of reach for the conventional cosθ, layer design and that one needs to rely on a different magnetic configuration.

CERN has pursued the 2D electromagnetic optimization of Reference Design V1 with ROXIE. The optimization was carried out with respect to

- conductor geometry (to minimize all multipole coefficients and improve radial positioning of conductor blocks in 2D cross-section),
- shape of iron yoke inner boundary (to minimize saturation effects),
- size and implementation of ferromagnetic shims (to compensate superconductor magnetization effects).

The re-optimization is now completed and has led to the definition of a new reference design, referred to as Reference Design V2 (EDMS 692145), with a good field quality (all multipole coefficients are below 1 unit at a reference radius of 29 mm, save for the normal 18-pole, b_9, which is equal to 1.7 unit and the normal 22-pole, b_{11}, which is equal to 2.7 unit), efficient peak-to-central field ratio (~1.03 to 1), 15.0 T conductor peak field for a quench current of 29.4 kA and a more radial conductor distribution.
Regarding iron saturation, computations were carried out for the conductor distribution of Reference Design V2 and two different yoke configurations: one with a circular inner boundary (with an inner radius of 125.4 mm) and one with an optimized, elliptical inner boundary (with a vertical, half major axis of 136.6 mm and an horizontal, half minor axis of 125.4 mm). Relying on an elliptical inner boundary enables one to reduce the b_3 peak-to-peak variations by a factor ~3.
Regarding superconductor magnetization, computations were carried out either computed when taking into account the full effect (no corrective shims) and or when introducing two ferromagnetic shims at suitable locations inside the coils: one 1.5-mm-thick shim attached right below the upper wedge of the outer layer and one 0.7-mm-thick shim attached right below the middle wedge of the inner layer. The effects of persistent magnetization currents were estimated using a ROXIE feature which combines a vector hysteresis model for hard superconductors with the BEM-FEM method and which relies on a given $J_C(B)$ fit function for the superconducting filaments. The $J_C(B)$ function used in the simulation was extracted from magnetization measurements performed by Twente University on an existing 0.9-mm-diameter, 504-filament PIT wire, produced by SMI in 2000, appropriately rescaled to NED specifications (in particular, with respect to the non-copper critical current density of 3000 A/mm^2 at 4.2 K and 12 T and to the effective filament outer diameter of 50 μm; EDMS 638344). The introduction of the two ferromagnetic shims enables one to reduce the b_3 variations during the up-ramp (lower part of the hysteresis curves) by a factor in excess of 3.
These encouraging results show that the selected correction schemes can be quite effective (at least on the normal sextupole coefficient, b_3), and that we do have some means of compensating the effects of both iron saturation and superconductor magnetization.

CIEMAT has worked on the 2D electromagnetic analysis of the 88-mm- and 130-mm-aperture motor-type design and of the 88-mm-aperture common-coil design using ROXIE. Starting from the set of design parameters agreed upon by the Working Group, the field quality has been optimized in the cross-section while keeping an eye on the feasibility of the mechanical design and on the Lorentz forces to be handled. For both configurations, the number of design variables is enough to get an optimum field quality, as well as a good peak-to-central field ratio. However, the motor-type design appears to yield a high fringe field while calling for a large superconductor volume.

2006 Summary
CCLRC/RAL have continued to develop a mechanical design based around the coil cross-section of Reference Design V1. The key objectives were to understand how best to achieve a uniform stress distribution in the coil, and to limit the peak compressive azimuthal-stress to

within the affordable limits of modern Nb_3 Sn cable.
A new structure geometry is proposed, which in principal gives a very uniform distribution of azimuthal-stress on the mid-plane conductor, while eliminating applied bending and shear stresses from the coil. These improvements are achieved by introducing additional wedges in the coil winding to create radial poles, and by establishing an angular azimuthal interference fit between collar and coil. Having radial coil poles ensures that the contact pressure arising from the collar interference acts purely in the azimuthal direction, eliminating any radial (shear) force component. If the magnetic design were to be optimised to include radial conductors at the coil pole then the need for additional wedges would be eliminated. A situation close to this is proposed in coil cross-section Reference Design V2. The collar geometry and interference fit is defined such that the deformed (compressed) coil retains its circular outer-boundary and radial poles and there is no applied bending during preload. The role of the stiff iron yoke and outer cylinder is to achieve a well-supported, circular collar geometry prior to powering.
A 2D ANSYS finite element model with an "infinitely stiff collar" assumption was used to predict the stress distribution in the magnet coil after powering. Results show that the azimuthal stress at the coil mid-plane varies from 110 MPa at the inner edge to 150 MPa at the outer edge, while contact between collar and coil at the pole is only maintained at the outer edge of each layer. Results from the ANSYS model agree well with a series of verification hand-calculations. Work is ongoing to reintroduce a realistic yoke/cylinder structure into the model.

CCLRC/RAL has also been looking at the feasibility of using NED conductor to create helical dipoles. Different ways to create a helical dipole have been modelled in 3D using Vector Fields software and examined, these include

- Winding a continuous elliptical spiral on a circular bore
- Winding a continuous circular winding on an elliptical bore
- Using tilted circular solenoids to create a dipole with an elliptical bore
- Using tilted elliptical solenoids to create a dipole with an circular bore

The initial work has shown that a continuous winding is not practical. The most advantageous route is to use tilted solenoid type windings grouped together, a practical winding scenario for this method has been identified. The work has shown that a real winding like this will need at least 3 double layers of winding to minimise the ratio of the peak field/central field, and a tilt of 30° to maximise the efficiency of the winding. It is also evident that the aspect ratio of standard NED cable 26:2175 is not suitable for creating these dipoles. It leads to a very inefficient winding, an aspect of 6.5:2.175 is much more favourable. Salient parameters for each of the different windings is being tabulated and compared with a similar $\cos\theta$ layer design.

CEA has been working on a mechanical model of the 130-mm-aperture elliptic design based on CASTEM. An internal support has been introduced to prevent the coils from bending due to the vertical component of the Lorentz forces. The drawback is the decrease of the free aperture. The iron yoke and the collars are vertically split to allow the prestress of the coils by means of an outer stainless steel shell. Frictionless contact surfaces are modelled between the collars and the yoke, and also between the yoke and the shell. The assembly, cooldown and Lorentz forces are considered for a correct modelling. Preliminary results show that the peak stresses on the coils can be kept below 150 MPa. This work has become a chapter of the Ph.D. dissertation of Hélène Félice who defended it on 12 October 2006 (dissertation: EDMS 815073, defense: EDMS 815072).

CERN has summarized the results of 2D magnetic optimization of the $\cos\theta$ layer carried out in 2005 in a paper presented at the 2006 Applied Superconductivity Conference (poster: EDMS 803651; paper: EDMS 803730)
CERN has performed a parametric analysis of forces and stresses in sector winding superconducting quadrupole coils, which could be easily extended also to dipoles. This study aims at the minimization of the peak stress on the coils for a given gradient, as a function of the aperture and the coil thickness. The quadrupole modelling is simplified: an infinitely stiff radial support is assumed, while neither iron yoke nor pre-stress are included. The magnetic field in the aperture, the stored magnetic energy, the Lorentz forces and the stress distribution in the coils (due only to the electromagnetic forces, the cooldown is not modelled) are computed with both analytical and numerical methods. Two different approaches are used for analytical calculations: a $\cos\theta$ current distribution or a sector winding with uniform current density. The numerical analysis is done by means of the finite element method (Ansys). Two superconducting materials are considered, NbTi and Nb_3Sn, and their critical current properties are parametrized for the optimization.
Analytical methods provide a good estimate of the field in the aperture, but not so good at the coils. However, analytical approaches yield a good estimate of the forces and stresses if an adequate value of the peak field is used. Anisotropic coil material properties does not affect significantly the stress distribution. Therefore, despite analytical models can only include isotropic materials, their results are quite accurate. The peak stress along the mid-plane coil increases almost linearly with the aperture for a given coil thickness. The peak stress along the mid-plane shows a very non-linear behaviour for a set aperture while varying the coil width. For a given aperture, there is coil width (gradient) for which this stress is minimized.The stress on the outer edge provides a good hint to evaluate the behaviour of the peak stress.

CIEMAT has studied a way to decrease the high stray field of the motor-type design. An additional coil block is included close to the outer coil blocks with opposite polarity current. Two main advantages arise: the fringe field decreases sharply with the radial distance to the magnet, as the magnetic moment of the overall outer blocks is very low; and the number of ampere-turns is about one half than in the previous model, because the field in the aperture is now mainly created by the inner coil blocks. However, one important problem is still to solve: the mechanical assembly is getting more complex, and further mechanical analysis should be done on the coil end stress distribution. Besides, the fringe field is still high close to the yoke outer radius, and it is not possible to decrease it with an iron screen, which even enhances locally the field. This coil configuration has been optimized for the three given apertures: 88, 130 and 160 mm. Self-inductance is about twice higher while the superconductor efficiency and the ratio of bore to peak field are lower than in the $\cos\theta$ reference design, but the Lorentz forces are lower, and the average compression on the midplane is around 100 MPa. Further quench protection studies are mandatory.
CIEMAT has revisited the $\cos\theta$ slot design and has evaluated it for the three given apertures. It is a very efficient design, similar to the layered $\cos\theta$ one, but the mid-plane stresses are lower, as the collar noses help to withstand the Lorentz forces of the upper blocks. The cross-section has not drawbacks, although the coil end design is still a challenging engineering problem.
CIEMAT has completed the common coil design study for the three apertures. The optimization has not been done automatically, because the necessary design variables were not available in ROXIE at the time of the computation. Therefore, the field quality is still not completely optimized. For the time being, the main conclusions are that the most effective turns are being replaced by spacers to improve the high field quality. Iron poles have been added to the iron yoke geometry to decrease the peak-to-bore field ratio. Another possible

method to improve the field quality is the addition of some auxiliary coils, but the magnet assembly becomes more complex.
CIEMAT has also studied a variant of the conventional $\cos\theta$ layer design, but where the inner and outer layer wedges have the same angular positions and both layers have the same pole angle. Therefore, the wedges can be clamped together to the collars, or even coil winding can be done directly onto the collars, as for the slotted motor-type design. The cable is rectangular, to better fit both layers, but a keystoned cable would enable a better placement of the turns in the radial direction. In any case, it seems a simple way to match the nice layered $\cos\theta$ performance with affordable stresses on mid-plane cables. It is worth studying this design from the mechanical point of view, and to analyse the winding techniques as well.
Some of the configurations studied by CIEMAT allow the use of different size or "graded" cables, as a number of the coil blocks see a lower magnetic field and, therefore, the current density can be increased in the superconductor while keeping a low working point on the load line. The 2-D magnetic studies performed at CIEMAT show that superconductor saving can reach up to 25% for a given bore field. Another possibility is to use a cable with the same size, but a lower critical current density.

Last but not least, the results of the 2D magnetic design comparisons have been summarized in an oral presentation and a paper presented at the 2006 Applied Superconductivity Conference (talk: EDMS 803653, paper: EDMS 803782).

The following actions have been carried and/or are foreseen

- 19 May 2004: brainstorming session at CEA/Saclay
- participants: H. Felice, L. Quettier and P. Védrine (CEA), A. Devred, (CEA&CERN), P. Fessia (CERN), S. Sanz and F. Toral (CIEMAT), P. Loveridge and J. Rochford (CCLRC)
- preparatory document: EDMS 547883
- minutes: EDMS 547884
- 23 November 2004: meeting at CERN to discuss CCLRC computations on NED baseline (88-mm-aperture, $\cos\theta$, layer) design
- participants: D.E. Baynham and P. Loveridge (CCLRC), A. Devred, (CEA&CERN), D. Leroy (CERN)
- 17 December 2004: WGMDO meeting at CIEMAT to review 2-D magnetic designs
- participants: P. Loveridge, J. Rochford (CCLRC), H. Felice, P. Védrine (CEA), A. Devred (CEA&CERN), S. Sanz, F. Toral (CIEMAT)
- talks and minutes: EDMS 547885
- 27 January 2005: visit of P. Loveridge (CCLRC) to CEA to discuss FE modelling
- participants: P. Loveridge (CCLRC), M. Ségréti and P. Védrine (CEA), A. Devred (CEA&CERN)
- 13 April 2005: meeting at CERN to discuss CCLRC progress on ANSYS model of NED Reference Design V1
- participants: E. Baynham, P. Loveridge (CCLRC), A. Devred (CEA&CERN), P. Fessia and M. Pojer (CERN)
- 13 April 2005: WGMDO meeting at CERN

- participants: E. Baynham, P. Loveridge, J. Rochford (CCLRC), H. Félice (CEA), A. Devred (CEA&CERN), P. Fessia, N. Schwerg (CERN), S. Sanz and F. Toral (CIEMAT)
- talks and minutes: EDMS 581911
- 14 June 2005: WGMDO meeting at CCLRC to review progress on 2-D magnetic and mechanical designs
- participants: E. Baynham, S. Canfer, C. Densham, J. Greenhalgh, P. Loveridge, J. Rochford, (CCLRC), H. Félice (CEA), A. Devred (CEA&CERN), N. Schwerg (CERN), S. Sanz and F. Toral (CIEMAT)
- talks and minutes: EDMS 600861
- 23 June 2005: meeting at CERN to discuss CCLRC progress on ANSYS model of NED Reference Design V1
- participants: E. Baynham (CCLRC/RAL), A. Devred (CEA&CERN) and D. Leroy (CERN)
- 1 September 2005: start date of Federico Regis at CERN, as unpaid associate supported by a Associazione Sviluppo Tecnologico e Scientifico Piemonte (ASP) grant, to work on NED mechanical design under the supervision of P. Fessia (CERN)
- 27 September 2005: CERN/AT/MAS seminar of N. Schwerg (CERN) on "Optimization of the coil cross section for NED"
- 6 October 2005: meeting at CERN to discuss CCLRC progress on ANSYS model of NED Reference Design V1
- Participants: E. Baynham, P.Loveridge (CCLRC/RAL), A. Devred (CEA&CERN), D. Leroy (CERN)
- 21 November 2005: Version 4 of Table of material properties issued by P. Loveridge (CCLRC/RAL; EDMS 683000V4)
- 22 November 2005: WGMDO meeting at CERN to review progress on 2-D magnetic and mechanical designs
- participants: P. Loveridge, (CCLRC), H. Félice (CEA), A. Devred (CEA&CERN), B. Auchmann, P. Fessia. D. Leroy, M. Pojer, F. Regis S. Russenschuck (CERN), S. Sanz and F. Toral (CIEMAT), A. den Ouden (TEU)
- agenda and talks: EDMS 682994
- 16 December 2005: Version 5 of Table of material properties issued by P. Loveridge (CCLRC/RAL; EDMS 683000V5)
- 15 March 2006: meeting at CERN to discuss CCLRC progress on ANSYS model of NED Reference Design V1
- Participants: E. Baynham, P.Loveridge (CCLRC/RAL), A. Devred (CEA&CERN), D. Leroy (CERN)
- 4 April 2006: meeting at CERN to discuss CCLRC progress on ANSYS model of NED Reference Design V1
- Participants: E. Baynham, P.Loveridge (CCLRC/RAL), A. Devred (CEA&CERN), D. Leroy (CERN)
- 7 April 2006: WGMDO meeting at CERN to review progress on 2-D magnetic and mechanical designs
- participants: P. Loveridge, (CCLRC), H. Félice (CEA), A. Devred (CEA&CERN), P. Fessia, F. Regis, C. Vollinger and N. Schwerg (CERN), F. Toral (CIEMAT)
- agenda and talks: EDMS 719322

- September 2006: presentation of NED Reference Design V2 (poster: EDMS 803651; paper: EDMS 803730) and of comparison of 2D magnetic designs (talk: EDMS 803653, paper: EDMS 803782) at 2006 Applied Superconductivity Conference
- 12 October 2006: PhD Defense of Hélène Félice (CEA; Dissertation: EDMS 815073, Defense: EDMS: 815072)
- 30 November 2006 : meeting at CERN to discuss CCLRC progress on ANSYS model of NED Reference Design V1
- Participants: E. Baynham, P.Loveridge (CCLRC/RAL), A. Devred (CEA&CERN), D. Leroy (CERN)
- 13 December 2006: Preliminary report on NED V1 mechanical design issued by P. Loveridge (CCLRC; EDMS 811059)

JRA4.6 Significant Achievements

- The awards of contracts for Nb_3Sn conductor development to Alstom/MSA (France) and SMI (The Netherlands)
- The first design of an 88 mm aperture, 15 T dipole magnet (NED Reference Design V1)

Table (Cont.): List of major achievements in 2005.

- Manufacturing and reception tests of double-bath, He II cryostat for heat transfer measurements
- Detailed computations of thermo-electrical behaviour of NED-like magnets during a quench
- Assembly of first round of billets for NED conductor production at Alstom/MSA and SMI
- Detailed analyses of magnetization measurements as a tool to probe wire microsture and reaction rate
- Identification of a polyimide-sized, glass fibre material as candidate for conventional conductor insulation
- Iterated design of 88 mm aperture, 15 T dipole magnet (NED Reference Design V2)

Table (Cont.): List of major achievements in 2006.

- Characterization tests of first 1.25-mm-diameter wire produced by SMI (record critical current of 1400 A at 4.2 K and 12 T, corresponding to a critical current density of 2500 A/mm^2)
- Production and characterization of first polyimide-sized, glass fibre tape
- Successful development of a Finite Element model to simulate cabling degradation
- Successful commissioning of double-bath cryostat manufactured under the supervision of Wroclaw University

JRA4.7 List of all milestones and deliverables (D) during the reporting period

Deliverable Number	Milestone Number	Name	Work Package/Task Number	Delivered by	Planned (in months)	Achieved (in months)	EDMS Number
04/14		Final Report on Wire and Cable Specifications	CD/3.3	CERN	6	6	475443
		Report on Specifications for Conductor Insulation	IDI/4.2	CCLRC	6	7	548037V 5
		Report on Definition of the Test Programme for Conductor Insulation[a)]	IDI/4.3&4.4	CCLRC&CEA	7	10	548038V 2
		Status Report on Conductor Development[b)]	CD/3.4	CERN	-	3	Restricted Access
04/15		Design Report on 15 T Dipole Magnet	CD/3.2	CERN	12	13	555826
		Interim Report on Quench Protection	TSQP/2.3	INFN-Mi	12	13	555756

[a)] Scope of report has been extended to include test programme on innovative insulation (Task 4.4).

[b)] The milestone entitled "First Results on Wire Development" that was due on 30 June 2005 has been split into two "Status Reports" due on 15 December 2004
and 15 December 2005.

Deliverable Number	Milestone Number	Name	Work Package/Task Number	Delivered by	Planned (in months)	Achieved (in months)	EDMS Number
05/27		Report on Heat Transfer Facility Commissioning[a)]	TSQP/2.2	CEA&WUT	16	34	794381
05/28		Report on Quench Computation	TSQP/2.3	INFN-Mi	18	23	683013
		Status Report on Conductor Development[b)]	CD/3.4	CERN	-	12	Restricted Access
		Interim Report on Heat Transfer Measurements [c)]	TSQP/2.2	CEA	9		
		Interim Report on Wire Characterization [d)]	TSQP/3.5	CEA, CERN, INFN,TEU			
05/29		Report on Conventional Insulation[e)]	IDI/4.3	CCLRC	24		
05/30		Report on Innovative Insulation[f)]	IDI/4.4	CEA	18		

[a)] Report has been delayed until 30 June 2006, due to delay in cryostat delivery and problem with liquid helium level sensor during first test at CEA.
[b)] As already mentioned, the milestone entitled "First Results on Wire Development" that was due on 30 June 2005 has been split into two "Status Reports" due
on 15 December 2004 and 15 December 2005.
[c)] Report has been delayed until 31 March 2007 due to delay in postdoc hiring at CEA.
[d)] Each laboratory involved issues a measurement report for each sample tested.
[e)] Report has been delayed until 31 December 2006.
[f)] Report has been delayed until 31 March 2007 due to human resources' problem at CEA.

Deliverable Number	Milestone Number	Name	Work Package/Task Number	Delivered by	Planned (in months)	Achieved (in months)	EDMS Number
06/24		Final Report on Heat Transfer Measurements[a)]	TSQP/2.2	CEA	36		
06/25		Final Wire Production[b)]	CD/3.4	CERN	30		
06/26		Final Report on Wire Characterization[b)]	CD/3.5	CEA, CERN, INFN, TEU	30		
06/27		Final Cable Production[b)]	CD/3.6	CERN	36		
06/28		Final Report on Cable Performances[b)]	CD/3.7	TEU	36		

[a)] Report has been delayed until 30 September 2007 due to delay in postdoc hiring at CEA.
[b)] Deliverables have been delayed until 30 June 2007 to enable further improvements and characterizations.

JRA4.8 List of major meetings organized under NED during the reporting period

NA/JRA Activity	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
CARE steering meeting		**23 Paris**				**24-25 Warsaw**					**5 Hamburg**	
NED steering meeting	**8 CERN**		**25 CERN**				**8 CERN**			**28-29 Saclay**		
NED ESAC meeting			**24 CERN**									
HHH network meeting			**22-24 WAMS Archamps**								**8-12 HHH CERN**	
Participation to meetings of other collaborations												
US-LARP						**17-18 LAPAC FNAL**						
Conferences & workshops with activity contrib.												
EPAC'04							**5-9 Lucerne**					
ASC'04										**3-8 Jacksonville**		

Date	Title /Subject	Location	Main Organizer	Number of Participants	Comments and Web Site
Jan 8	NED SC	CERN	CEA&CERN	10	http://lt.tnw.utwente.nl/project.php?projectid=9
Mar 22-24	WAMS	Archamps	CERN	100	http://amt.web.cern.ch/amt/events/workshops/WAMS2004/wams2004_index.htm
Mar 24	NED ESAC	CERN	CEA&CERN	15	http://lt.tnw.utwente.nl/project.php?projectid=9
Ma 25	NED SC	CERN	CEA&CERN	12	http://lt.tnw.utwente.nl/project.php?projectid=9
May 19	NED WGCC	CERN	TEU	7	http://lt.tnw.utwente.nl/project.php?projectid=9
May 19	NED WGMDO	CEA	CEA	9	http://lt.tnw.utwente.nl/project.php?projectid=9
Jul 8	NED SC	CERN	CEA&CERN	15	http://lt.tnw.utwente.nl/project.php?projectid=9
Oct 28	NED WGCC	CEA	TEU	7	http://lt.tnw.utwente.nl/project.php?projectid=9
Oct 29	NED SC	CEA	CEA	23	http://lt.tnw.utwente.nl/project.php?projectid=9
Nov 8-11	CARE-HHH	CERN	CERN	50	http://care-hhh.web.cern.ch/care-hhh/
Dec 17	NED WGMDO	CIEMAT	CIEMAT	7	http://lt.tnw.utwente.nl/project.php?projectid=9
Jan 20	NED SC	CERN	CEA&CERN	22	http://lt.tnw.utwente.nl/project.php?projectid=9
Feb 2	NED WGCC	LASA	INFN-Mi	6	http://lt.tnw.utwente.nl/project.php?projectid=9
Mar 3-4	HHH Beam Losses	CERN	CERN	50	http://care-hhh.web.cern.ch/care-hhh/
Mar 22-23	HHH/AMT Insulation	CERN	CERN	25	http://amt.web.cern.ch/amt/
Apr 13	NED WGMDO	CERN	CIEMAT	8	http://lt.tnw.utwente.nl/project.php?projectid=9
Apr 14	NED SC	CERN	CEA&CERN	18	http://lt.tnw.utwente.nl/project.php?projectid=9
May 3	NED WGCC	CERN	TEU	8	http://lt.tnw.utwente.nl/project.php?projectid=9
Jun 14	NED WGMDO	CCLRC	CIEMAT	11	http://lt.tnw.utwente.nl/project.php?projectid=9
Jul 7	NED SC	WUT	CEA&CERN	14	http://lt.tnw.utwente.nl/project.php?projectid=9
Oct 26-28	HHH/AMT	Frascati	CERN		http://amt.web.cern.ch/amt/
Nov 22	NED WGCC	CERN	TEU	7	http://lt.tnw.utwente.nl/project.php?projectid=9
Nov 22	NED WGMDO	CERN	CIEMAT	12	http://lt.tnw.utwente.nl/project.php?projectid=9
Nov 23	HHH/AMT	CERN	CERN		http://amt.web.cern.ch/amt/
Nov 24	NED SC	CERN	CEA&CERN	26	http://lt.tnw.utwente.nl/project.php?projectid=9

Date	**Title /Subject**	**Location**	**Main Organizer**	**Number of Participants**	**Comments and Web Site**
Feb 23	NED SC	CERN	CEA&CERN	17	http://lt.tnw.utwente.nl/project.php?projectid=9
April 3-6	HHH/AMT WAMDO	CERN	CERN	100	http://amt.web.cern.ch/amt/
April 7	NED WGMDO	CERN	CIEMAT	7	http://lt.tnw.utwente.nl/project.php?projectid=9
June 1	NED SC	CIEMAT	CEA&CERN		http://lt.tnw.utwente.nl/project.php?projectid=9
July 11	NED WGMDO	CERN	CIEMAT		http://lt.tnw.utwente.nl/project.php?projectid=9
Sept 12	NED SC	CERN	CEA&CERN		http://lt.tnw.utwente.nl/project.php?projectid=9
Oct 11-12	HHH/AMT LER	CERN	CERN		http://amt.web.cern.ch/amt/
Oct. 16-20	HHH/APD LHC-LUMI-06	IFIC	CERN		http://amt.web.cern.ch/amt/

2. List of deliverables

2004

Activity	Deliverable N°	Deliverable Name	Deliverable Type	Workpackage/ Task N°	Delivered by Contractor (s)	Planned (in months)	Achieved (in months)
ELAN	1	ELAN web site	Web site	All WPs	CNRS-Orsay	4	4
ELAN	2	Beam Dynamics code repository site functional	Data base	WP3	CERN	12	12
ELAN	3	Instrumentation web site	Web site	WP4	CCLRC, UMA	6	21
ELAN	4	Instrumentation data base	Data base	WP4	CCLRC, UMA	12	23
BENE	5	BENE web site	Web site	All WPs	INFN-Na	4	4
BENE	6	Annual report of the BENE network	Report	All WPs	INFN-Na	12	12
BENE	7	Proposal for FP6 Design Study of a new neutrino facility	Report	All WPs	INFN-Na	12	delayed to FP7
BENE	8	Proceedings of Multi-MW workshop	Report	All WPs	INFN-Na	12	14
BENE	9	BENE Physics web site	Web site	WP1	INFN-Pa, CERN	3	3
HHH	10	HHH web site	Web site	All WPs	CERN	12	9
HHH	11	APD web site	Web site	WP3	CERN	6	9
SRF	12	Final report on reliability issues	Report	WP2	DESY	9	30
SRF	13	EP on samples: best EP parameters	Report	WP5	CEA	12	26
NED	14	Final report on wire and cable specifications	Report	WP3	CERN	6	6
NED	15	Design report on 15 T dipole magnet	Report	WP3	CERN	12	13

2005

Activity	Deliverable N°	Deliverable Name	Deliverable Type	Workpackage/ Task N°	Delivered by Contractor (s)	Planned (in months)	Achieved (in months)
ELAN	1	Work plan and documentation data base	Data base	WP1	CERN	24	22
ELAN	2	Data base on SRF documents	Data base	WP2	DESY	24	24
BENE	3	18-month interim report	Report	All WPs	INFN-Na	23	23
BENE	4	Annual report of the BENE network	Report	All WPs	INFN-Na	24	24
BENE	5	Proceedings of NuFact'05 workshop	Report	All WPs	INFN-Na	24	30
BENE	6	Launch of scoping study of a new neutrino facility	Web site Report	All WPs	INFN-Na	18	18
HHH	7	Beam Dynamics code repository	Data base	WP3	CERN	24	18
SRF	8	EP on multi-cells: parameters fixed	Report	WP5	DESY	13	37
SRF	9	Automated EP is defined	Report	WP5	INFN-Legnaro	21	37
SRF	10	Dry ice cleaning: parameters fixed	Report	WP5	DESY	18	37
SRF	11	CEA tuner: start of integrated experiments	Prototype	WP8	CEA	15	24
SRF	12	Report on IN2P3 tuner activities	Report	WP8	CNRS-Orsay	24	39
SRF	13	Report on data management developments	Report	WP9	DESY	21	24
SRF	14	Report on RF gun control tests	Report	WP9	DESY	23	37
PHIN	15	High efficiency photocathode comparison	Report	WP2	FZR	24	24
PHIN	16	High power laser oscillator	Report	WP3	CCLRC-RAL	13	13
PHIN	17	Amplifier construction	Prototype	WP3	CCLRC-RAL	19	delayed, 36

PHIN	18	Oscillator + amplifier test	Report	WP3	CCLRC-RAL	23	30
PHIN	19	Pulse shaping system: phase mask acquisition and test	Report	WP3	INFN-Milano	16	23
PHIN	20	Pulse shaping system: Dazzler acquisition and test	Report	WP3	INFN-LNF	17	?
PHIN	21	Pulse shaping comparison	Prototype	WP3	INFN-LNF, INFN-Milano	22	?
PHIN	22	UV harmonic generator test	Prototype	WP3	CCLRC-RAL	16	delayed, 30
PHIN	23	Laser RF feedback development	Report	WP3	CERN	21	delayed, 40
PHIN	24	Two 3 GHz RF guns construction	Prototype	WP4	CNRS-Orsay	18	delayed, 32
PHIN	25	1-50 MeV spectrometer construction	Prototype	WP4	CNRS-LOA	24	36
HIPPI	26	Halo measurement device design and construction	Report	WP5	CERN	18	24
NED	27	Commissioning of heat transfer facility	Prototype	WP2	CEA, WUT	16	35
NED	28	Final report on Quench Protection	Report	WP2	INFN-Milano	18	23
NED	29	Report on conventional insulation	Report	WP4	CCLRC-RAL	24	delayed, 38
NED	30	Report on innovative insulation	Report	WP4	CEA	18	delayed, 42

2006

Activity	Deliverable N°	Deliverable Name	Deliverable Type	Workpackage/ Task N°	Delivered by Contractor (s)	Planned (in months)	Achieved (in months)
ELAN	1	Data base on diagnostics performance	Data base	WP4	CCLRC, UMA	36	36
BENE	2	Annual report of the BENE network	Report	All WPs	INFN-Na	36	38
BENE	3	Proposal for design studies and R&D	Report	All WPs	INFN-Na	36	?
BENE	4	Proceedings or summaries of workshops	Report	All WPs	INFN-Na	36	?
HHH	5	Data base on SC magnets and cables	Data base	WP1	CERN	36	in progress
SRF	6	Evaluation of spinning parameters	Report	WP3	INFN-Legnaro	29	37
SRF	7	1-cell spinning parameters defined	Report	WP3	INFN-Legnaro	36	delayed, ?
SRF	8	Report on new LLRF hardware components	Report	WP9	DESY	26	37
SRF	9	New BPM ready for installation	Prototype	WP11	CEA	25	34
SRF	10	Evaluation of HOM-BPM operation	Report	WP11	CEA	36	37
PHIN	11	Photocathode ready for 3 GHz RF guns	Prototype	WP2	CERN	25	delayed, 38
PHIN	12	UV generation and feedback: overall system assembly and tests	Prototype	WP3	CCLRC	30	?
PHIN	13	SC RF gun realisation	Prototype	WP4	FZR	26	36
PHIN	14	SC RF gun test	Report	WP4	FZR	36	part 1: 39 final : 42
PHIN	15	CTF3 3 GHz RF gun test at CERN	Report	WP4	CNRS-Orsay, CERN	33	delayed, 54
HIPPI	16	H-mode DTL prototype ready	Prototype	WP2	IAP-FU	36	delayed, 51

HIPPI	17	CCDTL prototype tested	Report	WP2	CERN	36	delayed, 42
HIPPI	18	Elliptical cavities: cavity B ready	Prototype	WP3	CEA	30	39
HIPPI	19	Chopping structure A: prototype ready	Prototype	WP4	CERN	32	36
HIPPI	20	Beams Dynamics: simulations and experiments at UNILAC	Report	WP5	GSI	36	delayed,42
HIPPI	21	Profile measurements by fluorescence	Report	WP5	GSI	31	38
HIPPI	22	Non interceptive bunch measurement	Report	WP5	GSI	36	40
HIPPI	23	Collimators design	Report	WP5	CERN	36	30
NED	24	Final Report on Heat Transfer Measurements	Report	WP2	CEA	36	delayed, 45
NED	25	Final wire production	Prototype	WP3	CERN	30	delayed, 39
NED	26	Final report on wire characterization	Report	WP3	CEA, INFN-Ge, INFN-Mi, TEU	30	delayed, 42
NED	27	Final cable production	Prototype	WP3	CERN	36	delayed, 42
NED	28	Final report on cable performances	Report	WP3	TEU	36	delayed, 43

3. Use and dissemination of knowledge

The CARE dissemination board includes the seven activity deputy coordinators and is chaired by the CARE deputy coordinator. The dissemination of knowledge activity focused on the publication of scientific articles presenting work partially funded by the CARE activity, on establishing Web sites and on promoting the CARE results at accelerator conferences.

3.1 Web Sites

The central CARE Web site http://care.lal.in2p3.fr/ , has been regularly updated. It includes:

- Links to the seven activity (NA and JRA) Web sites
- CARE official documents (Consortium agreement, Annex I, etc…)
- The table of CARE deliverables
- The CARE management network and directory
- The calendar of CARE meetings
- A link to the Publication repository
- Advertisements for vacant CARE funded temporary positions.

All seven activity Web sites are active and regularly updated by the corresponding activity management. Most of these Web sites provide access to informative Work Package Web pages.

3.2 Publications

As anticipated last year, four PhD thesis initiated by CARE have been successfully defended and their write up included in the CARE publications.

The five categories of CARE publications are defined by the following table:

Publication category	Type of publication and Responsibility	Reviewing	Storage and numbering
CARE/Activ Document-year-number	Technical documents Responsibility of the authors	No review	Stored locally in NA/JRA web sites Numbering by NA/JRA coordinators
CARE-Pub-year-number	Journal publications CARE responsibility	Internal review	Stored in CARE web site Central numbering
CARE-Report-year-number	Yearly reports, and final deliverables to EC CARE responsibility	Submitted to EU commission	Stored in CARE web site Central numbering
CARE-Conf-year-number-Activ	Conference proceedings NA/JRA responsibility	Abstract approved by NA/JRA coordinators Internal review	Stored in CARE web site Central numbering
CARE-Note-year-number-Activ	CARE workshops and reviewed papers not aimed at publication CARE responsibility	Internal review	Stored in CARE web site Central numbering
CARE-Thesis-year-number-Activ	PhD thesis partly funed by CARE CARE responsibility	Internal review	Stored in CARE web site Central numbering

Publication Web Repository

All CARE papers belonging to the last five categories are stored and are publicly available on Web-based publication repository http://www-dapnia.cea.fr/Documentation/Care/index.php. This Web repository is linked to the central CARE Web site from a new Web page http://care.lal.in2p3.fr/Publications/ which includes straightforwardly the following requested acknowledgement to the EC support:

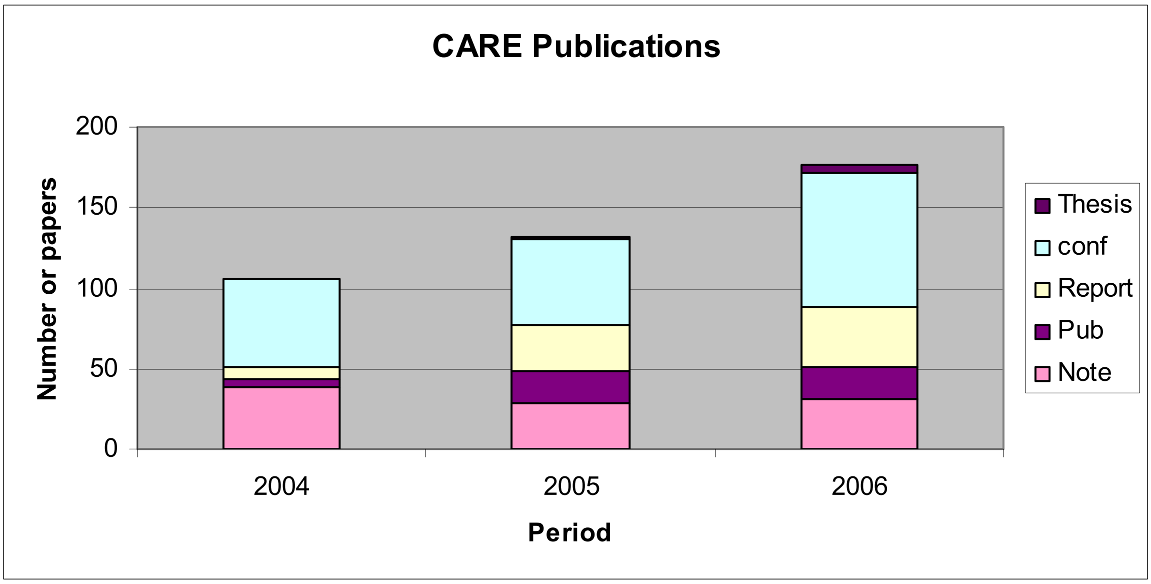
We acknowledge the support of the European Community-Research Infrastructure Activity under the FP6 "Structuring the European Research Area" programme (CARE, contract number RII3-CT-2003-506395).

The following table records the number of CARE scientific articles issued by the different activities (NA and JRA) in each category.

2006 CARE Publications

	Publications	Conférences	Notes	Reports	Thesis
ELAN		2	10	3	
BENE				4	
HHH	3	22	3	3	
SRF	10	35	4	8	3
PHIN	1	3	1	7	
HIPPI		19	13	6	
NED	6	3		5	1
ALL				1	
TOTAL	**20**	**84**	**31**	**37**	**4**

The evolution of the number of publications over the first 3 years of Care activities is shown in the histogram below :



Publication lists for 2006:

The list of CARE papers can be directly uploaded from the following Web pages:

- CARE Journal Publications:
  http://www-dapnia.cea.fr/Documentation/Care/care-pub-index-2006.php

- CARE Reports:
  http://www-dapnia.cea.fr/Documentation/Care/care-rapport-index-2006.php
- CARE Conference Proceedings:
  http://www-dapnia.cea.fr/Documentation/Care/care-conf-index-2006.php
- CARE Notes:
  - ELAN: http://www-dapnia.cea.fr/Documentation/Care/care-note-elan-index-2006.php
  - BENE: http://www-dapnia.cea.fr/Documentation/Care/care-note-bene-index-2006.php
  - HHH: http://www-dapnia.cea.fr/Documentation/Care/care-note-hhh-index-2006.php
  - SRF: http://www-dapnia.cea.fr/Documentation/Care/care-note-srf-index-2006.php
  - PHIN: http://www-dapnia.cea.fr/Documentation/Care/care-note-phin-index-2006.php
  - HIPPI: http://www-dapnia.cea.fr/Documentation/Care/care-note-hippi-index-2006.php
  - NED: http://www-dapnia.cea.fr/Documentation/Care/care-note-ned-index-2006.php

Annexes

Annex 1 – Summaries and main conclusions of the General Meeting

The CARE general meeting, CARE05, took place at INFN Frascati, (Italy) on Nov. 15-17, 2006. The meeting Web site http://www.lnf.infn.it/conference/care06 provides the information concerning the participation (125 participants), the scientific program and the presentations. An overview of the program is given on the next page.

The general meeting included one day of plenary session devoted to 12 highlight talks invited by the seven CARE activities to report on the most significant developments in their field of research. It also included one day of parallel of sessions dedicated to the CARE activity workshops and internal meetings to prepare for their annual report.

An important part of the program was the plenary session on November 17 dedicated to the summary talks of the seven CARE activity coordinators. They all reported on the continued commitment of the institutes and their scientists towards the CARE programme and the objectives of the CARE activities. They also reported on the impressive amount of scientific and technical work already accomplished. Significant results have already been obtained, outlined elsewhere in this document, and no significant delays or difficulties appeared in their respective programme. In general, the progress of the third year of the CARE project has been quite satisfactory.

The meeting was attended by CARE's Scientific Officer, Mr. Stefano Fontana who made a presentation of the goals, the instruments and the preparation of the FP7 programme. The continuation of the CARE project in FP7 Integrated Activities including accelerator R&D programs, has been discussed during the Thursday afternoon session dedicated to the reports from the three working groups set up by ESGARD.

Wednesday, 15 November

08:30 - 13:30	Registration	
	Plenary	Aula Touschek
	Introduction Session - Chair: S. Guiducci	
09:00	Welcome - Prof. M. Calvetti, LNF Director	
09:10	CARE General Status&Plans - R. Aleksan	
09:30	CARE Dissemination Activities - O. Napoly	
10:00	*Coffee Break*	
	Plenary	Aula Touschek
	Highlight Talks	
10:30	Nb3Sn conductor development in Europe for high field accelerator magnets - L. Oberli	
10:50	Study on thermal deposition in the IR magnets - F. Broggi	
11:05	A finite element analysis for simulating severe plastic deformations of Nb3Sn wires for NED - S. Farinon	
11:25	Advances in large grain and single crystal SC resonators - W. Singer	
11:45	Advances in investigations of clean Nb surfaces - G. Mueller	
12:05	Laser pulse shaping for high-brightness photoinjector - C. Vicario	
12:30	*Lunch*	
	Parallel	
	Networking/JRA	
14:00	ELAN	Aula Seminari
	BENE	Aula Div. Acc.
	HHH	Aula Puls
	SRF	Aula Touschek
	PHIN	Aula B1
	HIPPI	Aula A1
	NED	Aula Calcolo
16:00	*Coffee Break*	
	Parallel	
	Networking/JRA	
16:30 18:00	ELAN	Aula Seminari
	BENE	Aula Div. Acc.
	HHH	Aula Puls
	SRF	Aula Touschek
	PHIN	Aula B1
	HIPPI	Aula A1
	NED	Aula Calcolo

Thursday, 16 November

09:00 10:30	Steering Committee / Dissemination Board	Aula Direzione
	Parallel	
09:00	Visit to LNF	
10:30	*Coffee Break*	
	Parallel	
	Networking/JRA	
11:00	ELAN	Aula Seminari
	BENE	Aula A1
	HHH	Aula Puls
	SRF	Aula Touschek
	PHIN	Aula B1
	HIPPI	Aula Div. Acc.
	NED	Aula Calcolo
12:45	*Lunch*	
	Plenary	Aula Touschek
	Highlight Talks	
14:00	Laser plasma electron beam generation: status and perspective - V. Malka	
14:20	Results of SPS crystal-collimation experiments - W. Scandale	
14:40	A fast chopping system for high intensity linac beams - F. Caspers	
15:00	Development of a triple spoke super conducting cavity for medium-beta pulsed linear accelerators - R. Toelle	
15:20	International Scoping Study on Neutrino Factory and Superbeam - A. Blondel	
15:40	Proposal for a SCRF infrastructure at CERN - W. Weingarten	
16:00	*Coffee Break*	
	Plenary	Aula Touschek
	Reports from FP7 Groups	
16:30 19:00	Introduction, R. Aleksan	
	* Report from High-intensity High-energy Proton Beams	
	* Report from Superconducting RF Acceleration Systems	
	* Report from Novel Acceleration Systems	

Friday, 17 November

	Plenary	Aula Touschek
	JRA Activity Reports	
09:00	Report on SRF Activities - D. Proch Report on SRF Activities - T. Garvey	
09:35	Report on PHIN Activities - A. Ghigo	
10:00	Report on HIPPI Activities - M. Vretenar	
10:25	Report on NED Activities - A. Devred	
10:50	*Coffee Break*	
	Plenary	Aula Touschek
	JRA Activity Reports - Chair: R. Aleksan	
11:10	Report on ELAN Activities - F. Richard	
11:35	Report on BENE Activities - V. Palladino	
12:00	Report on HHH Activities - F. Ruggiero	
12:25	The FP7 programme - S. Fontana	
12:40	Concluding Remarks - R. Aleksan	
13:00	*Lunch*	
14:30	Governing Board	Aula Direzione

B. Management Report (financial information)

1. Justification of the resources deployed

Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	1	Participant short name	CEA

Management

Total effort in person-months (1)	21,13

Cost category	Actual direct eligible costs (€)	Justification of costs description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)
Personnel cost (2)	148 406,64	Permanent personnel for CARE management: CARE coordinator and deputy coordinator, financial assistant, secretary, accounting office.
Durable equipment		
Consumable and prototyping		
Travel	5 917,25	Participation in the: CARE Steering committee at CERN (2 persons); FP7-IA preparation meeting at CERN (2 persons); CARE Annual meeting at INFN-Frascati (2 persons); CERN Council Stategy Group meeting in Berlin (1 person).
Audit certificate	4 800,00	Cost of audit certificate for 2004-2005 period

N1-ELAN - Electron Linear Accelerator Network

Total effort in person-months (1)	

Cost category	Actual direct eligible costs (€)	Justification of costs description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)
Personnel cost (2)		
Durable equipment		
Consumable and prototyping		
Travel	2 568,37	Participation to meetings organized by ELAN : Preparation of the FP7-CNI for a European SCRF Infrastructure at Milano (1 person); TTC Meeting on Cavity Electropolishing at KEK-Tsukuba (1 person).

Cost category	Actual direct eligible costs (€)	*N2-BENE - Beam for European Neutrino Experiments* — Total effort in person-months [1]: — Justification of costs *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*
Personnel cost [2]		
Durable equipment		
Consumable and prototyping		
Travel	8 221,47	Participation to meetings organized by BENE: FFAG'05 meeting in Osaka (1 person); FFAG'06 meeting in Brookhaven (1 person); BENE week at Oxford (1 person); BENE Steering Group meeting at CERN (1 person); CARE Annual meeting at INFN-Frascati (2 persons).

Cost category	Actual direct eligible costs (€)	*N3-HHH - High Energy High Intensity Hadron Beams* — Total effort in person-months [1]: — Justification of costs *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*
Personnel cost [2]		
Durable equipment		
Consumable and prototyping		
Travel	6 369,77	Participation to meetings organized by HHH : WAMDO workshop by HHA-AMT in Geneva (8 persons), LUMI'06 workshop by HHH-APD in Valencia (1 person); 4th workshop by HHH-ABI in Lüneburg (1 person).

Cost category	Actual direct eligible costs (€)	*R1-SRF - Superconducting Radio Frequency* — Total effort in person-months [1]: 114,19 — Justification of costs *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*
Personnel cost [2]	555 013,26	Permanent and additional personnel for WP5 (Surface Preparation), Task 5.1 (EP for single cell): study of alternative EP mixture on samples, final assembly and first tests of the EP set-up. Permanent and additional personnel for WP8 (Tuners): Task 8.3 (CEA tuner): characterization of . WP10 (Tests in CRYHOLAB) project management, second and third high RF power tests of CEA piezo-tuner system with IN2P3 piezo-electric crystal. Permanent and additional personnel for WP11 (Beam Diagnostics), Task 11.1:characterization of the first beam position monitor cavity at DESY-TTF with beam; mechanics, welding and copper-coating studies for a second BPM cavity prototype; beam studies of the HOM-BPM method at DESY-TTF.
Durable equipment	12 294,96	WP8: purchasing of one RF-laboratory PC; WP11:test tubes for BPM; Amortization of 2005 purchases.
Consumable and prototyping	63 532,77	WP5: purchasing of electropolishing chemical products; WP8 : experiment sofware and drivers; WP10 : 1.3 GHz amplifier; WP11: purchasing of high resolution electronics boards, connectors and RF components, welding test of BPM tubes.
Travel	19 522,65	Participation to the CARE-SRF and CARE Annual meeting at INFN-Frascati (5 persons); WP11 (HOM-BPM) work stay at SLAC, Stanford (1 person, 1 month); BPM beam tests at DESY, Hamburg (2 persons, 4 weeks); Working meetings on WP5 (EP) and WP8 (Tuners) at DESY-Hamburg (3 persons).

		R3- HIPPI - High Intensity Pulsed Proton Injector
		Total effort in person-months [1]: 62,93
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*
Personnel cost [2]	336 828,39	Permanent personnel for WP3 (design of power coupler, realisation of modifications of HV generator, preparation of the 1 MW power test stand, follow fabrication up of klystron, cavity, high power components, mechanical tools). Permanent and additional personnel for WP5 (beam dynamics studies).
Durable equipment	19 407,42	Main components for the 1 MW - 700 MHz test stand developped in WP 3 (klystron, HV power supply, circulator, RF loads) and associated materials for control command; Amortization of 2005 purchases.
Consumable and prototyping	66 054,66	RF and HV components (connectors, cables, …) for the test stand ; field flatness tuning bench ; frame and tank for the pulsed HV power supply
Travel	9 440,59	Participation to the Joint WP3 and WP5 meeting at Jülich (3 persons); CARE-HIPPI Annual meeeting at Jülich (3 persons, 3 days); CARE Annual meeting at INFN-Frascati (3 persons); Fabrication controls in industries: cavity and mechanical tools at ACCEL, Köln (4+2 persons) and, klystron and HV power supply at CPI, Palo-Alto (2 persons).

		R4- NED - Next European Dipole
		Total effort in person-months [1]: 30,33
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*
Personnel cost [2]	147 849,89	Two additional staffs hired at CEA : one on innovative insulation (WP4), and one on Heat Transfer Measurements (WP2). Permanent personnel: NED JRA coordination (WP1), heat transfer studies (WP2), critical current measurements (WP3), innovative insulation development (WP4).
Durable equipment	1 288,20	Amortization of 2005 purchases.
Consumable and prototyping	7 900,10	WP2 (Thermal Studies and Quench Protection) : Temperature sensors and liquid He level sensor for heat transfer measurements. WP3 (Conductor Develpment) : Sample holder parts for critical current measurements.
Travel	7 715,00	Participation to 4 NED Steering Committee meetings, 3 in Geneva, 1 in Madrid, 3-to-4 people in average. Two trips to INFN/Milan to participate to critical current measurement campaigns. One trip to Oxford to discuss NED extension. One trip to INFN/Frascati to participate to CARE General Meeting. One trip to INFN/Genova to discuss Finite Element Modeling.

Total direct eligible costs	**1 423 131,38**		
Total indirect costs	**936 039,90**		
Total costs [3]	**2 359 171,28**	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	

Justify any deviations with respect to the planned budget

[1] AC contractors must include both the total estimated human effort (including permanent staff) and, in brackets, additional staff only.
[2] For TA activities excluding the effort charged under the user fees if the UF cost model is used.
[3] Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	2	Participant short name	UCLN

		Management	
		Total effort in person-months [(1)]	
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Audit certificate	300,00	audit certificate	

		N2-BENE - Beam for European Neutrino Experiments	
		Total effort in person-months [(1)]	1,0
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost [(2)]			
Durable equipment			
Consumable and prototyping	54,82	mailing costs	
Travel	776,91	meeting of MICE at RAL , October 9-13 (1 person)	

Total direct eligible costs	1 131,73		
Total indirect costs	166,35		
Adjustments to previous periods			
Total costs [(3)]	1 298,08	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	6 000,00

Justify any deviations with respect to the planned budget

[(1)] AC contractors must include both the total estimated human effort (including permanent staff) and, in brackets, additional staff only.
[(2)] For TA activities excluding the effort charged under the user fees if the UF cost model is used.
[(3)] Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	3	Participant short name	CNRS (+ UPS-travel)

		N1-ELAN - Electron Linear Accelerator Network	
		Total effort in person-months (1)	8
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Personnel cost (2)			
Durable equipment			
Consumable and prototyping			
Travel	25 893.10 (UPS) 2 597,89 (LPGP)	Meeting CARE (Geneva, 3 people), GDE meeting (Frascati, 5 people), Linear Collider Workshop (India, 4 people), Industrial Forum (Hamburg, 3 people), Polarised positron workshop (Geneva, 2 people), European ILC/GDE meeting (Hamburg, 1 person), ELAN meeting (Geneva, 1 person), TESLA meeting (Tsukuba, 1 person), SRF meeting (Milan, 1 person). LBI LPA workshop.	

		N2-BENE - Beam for European Neutrino Experiments	
		Total effort in person-months (1)	1
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)			
Durable equipment			
Consumable and prototyping			
Travel	579,60 (LPNHE)	BENE workshop (1 person, RAL-Oxford)	

		R1-SRF - Superconduting Radio Frequency	
		Total effort in person-months [(1)]	113 (LAL), 4,4 (IPN)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost [(2)]	432 508,17 (LAL) 21 775,44 (IPN)	Permanent personnel for WP7 (couplers), Task 7.1 (proto-types) - RF design calculations, mechanical and vacuum conception, engineering drawings, critical review meetings, calls for tenders. Additional (temporary) personnel for drawings of new TTF-III proto-types. Task 7.2 (TiN coating bench) - preparation of technical specification. Task 7.3 (Conditioning studies) - personnel for reception, control, clean room preparation and mounting of couplers for RF conditioning. Improvements in automated conditioning procedure, studies of bake-out and vacuum handling procedures, documentation of these procedures. Analysis of conditioning data. Operation of high power test equipment. Dissemination of information on coupler WEB page and preparation of communications to CARE meetings. Project management of WP7.	
Durable equipment	49 458,79 (LAL) 3 237,48 (IPN)	Coupler proto-types (depreciation costs only).	
Consumable and prototyping	3 592 (LAL) 2 551,64 (IPN)	WP7 - Vacuum consumables, computer components, coupler proto-types, fluids.	
Travel	7 725.90 (LAL) 2 511,62 (IPN)	Technical visit (Legnaro, 2 people), CARE meeting (Geneva, 2 people), Visit company (Cologne, 3 people), Conference attendance (Edinburgh, 1 person) . Thin Films Workshop (Legnaro, 1 person), Conference (Prague, 1 person).	

		R2-PHIN - Photo Injector	
		Total effort in person-months [(1)]	111 (LAL), 64 (LOA)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost [(2)]	507 429,26 (LAL) 243 056,25 (LOA)	Permanent personnel for; changes to design of RF gun: RF simulations, engineering drawings, conception of vacuum chamber, design of magnetic focusing elements and beam dynamics calculations. Low power tests of RF cavities. Development of the master oscillator and associated electronics. Design and test of getter coated vacuum tank. Dissemination of information. Project management. Collaboration meetings with CERN on CTF3. Design of photo-cathode preparation chamber. Liason with industry on laser acquisition. Tests of laser. Document preparation for call for tenders. Administrative work for approval for beam tests in NEPAL laboratory. Contractual personnel for engineering drawing work.	
Durable equipment	39 908,16 (LAL)	Solenoid magnets, laser, vacuum valves and pumps, RF components, computer equipm	
Consumable and prototyping	64 035,32 (LAL) 58 235,89 (LOA)	Laminar flow equipment, high purity copper, vacuum components, optical components, mechanical supports, electronics. Magnetic spectrometer equipment.	
Travel	5 344,71 (LAL) 12 625,35 (LOA)	CARE meeting (CERN, 2 people), CTF meeting (Geneva, 1 person), Technical meetings at CERN (Geneva, 6 people), Conference attendance (Edinburgh, 1 person). Meeting at CERN (3 people).	

		R3- HIPPI - High Intensity Pulsed Proton Injector	
		Total effort in person-months [(1)]	9,4 (IPN) 3 (LPSC)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost [(2)]	46 093,06 (IPN) 61 635.40 (LPSC)	Design of 1 MW input coupler. Construction of Side Coupled Linac proto-type structure. Design of DTL. Simulation of space-charge effects in Linac 4. Error/tolerance studies of longitudinal/transverse effects in Linac 4. Design and manufacture of 704 MHz power coupler. Construction of stainless steel helium vessel for spoke cavity. Design of multi-gap resonator.	
Durable equipment			
Consumable and prototyping	18 630,63 (LPSC)	Construction of proto-type cavities. Construction of coupler port.	
Travel	2600,06 (IPN) 108,00 (LPSC)	Geneva (1 person), Julich (2 people), Aachen (1 person), Aix la Chapelle (1 person).	

Total direct eligible costs	1 612 133,72		
Total indirect costs	322 426,74		
Total costs [(3)]	1 934 560,46		

Justify any deviations with respect to the planned budget

A review of the requirements of CERN for the RF gun (WP3 of PHIN) has led to a delay fabrication. Fabrication problems have meant a slight delay in production of coupler proto-types (WP7 of SRF). Difficulty in finding a suitable constructor for the TiN bench means a delay of ~1 year in its construction (WP& of SRF). The laser of WP2 of PHIN did

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Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	4	Participant short name	GSI

		N1-ELAN - Electron Linear Accelerator Network	
		Total effort in person-months (1)	2,5
Cost category	Actual direct eligible costs (€)	Justification of costs description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Personnel cost (2)	0		
Durable equipment	0		
Consumable and prototyping	0		
Travel	269,04	Franchi/Rietzlern	
		N3-HHH - High Energy High Intensity Hadron Beams	
		Total effort in person-months (1)	2,5
Cost category	Actual direct eligible costs (€)	Justification of costs *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)	0		
Durable equipment	0		
Consumable and prototyping	0		
Travel	2 887,67	Workshop "WAMDO", CERN, 3 Pers.; HHH-Workshop, Valencia, 1 Pers.	

		R3- HIPPI - High Intensity Pulsed Proton Injector
		Total effort in person-months [1] 43,5
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*
Personnel cost [2]	199 854,18	WP5: exclusively: non-distr. transv. profile meas.: 6,0 PM on-line transm. control: 1,2 PM coordination of beam diagn. works: 1,8 PM preparation/conduction of UNILAC-exp.: 21 PM simulation of UNILAC-exp: 3,0 PM high current modeling, code improvm./benchmarking: 4,1 PM WP management: 3,0 PM
Durable equipment	4 840,98	(depreciation)
Consumable and prototyping	15 450,23	several electronic components for beam diagnostic prototyping
Travel	6 390,44	Linac2006, USA, 1 Pers.; WP5-meeting, Jülich, 5 Pers.; beam diagn. fair, Nuremberg, 1 Pers.; HIPPI2006-Meeting, Jülich, 3 Pers.; Spring Seminar Univ. Frankfurt, Rietzlern/A, 3 Pers.

Total direct eligible costs	229 692,54		
Total indirect costs	40 242,78		
Adjustments to previous periods			
Total costs [3]	269 935,32	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	

Justify any deviations with respect to the planned budget

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[2] For TA activities excluding the effort charged under the user fees if the UF cost model is used.

[3] Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	5	Participant short name	IAP-FU
		R3- HIPPI - High Intensity Pulsed Proton Injector	
		Total effort in person-months [1]	51 (39 = 26 university + 13 HIPPI EU)

Cost category	Actual direct eligible costs (€)	Justification of costs *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*
Personnel cost [2]	67 057,75	2 additional staff members (scientists/researchers), as follows: - 1 add. staff member hired from 1.10.2004 until 31.10.2006. Activities within WP3 and WP5 : LORASR code benchmarking : simulation studies; SC CH cavity tuner design : design work. - 1 add. staff member under contract since 11.2005. Activities within WP2 and WP5: Beam dynamics design: simulation studies; CH model and prototype cavity design: design work. 1 working student under contract since 1.01.2006: design and construction of the mechanical setup of the SC CH cavity tuner (WP3). 1 add. staff member (scientist): living expenses for a 3 month guest stay from 04.2006 to 06.2006. Activities within WP2 and WP5 : CH model and prototype cavity design, beam dynamics design.
Durable equipment		
Consumable and prototyping	452,88	Accessories, supplies and components for the mechanical tuner test stand (WP3) and for the n.c. model structure(WP2).
Travel	2 382,42	Participation to the HIPPI Work Package meetings (27.4.-28.4., Jülich, Germany, 2 persons; 18.5.-19.5., Grenoble, France, 1 person) and the HIPPI Annual Meeting (27.9.-29.9., Jülich, Germany, 3 persons). Participation to the General CARE Annual Meeting (15.11.-17.11., Frascati, Italy, 1 person). Attendance to the EPAC 2006 Conference (26.6.-30.6., Edinburgh, UK, 1 person).

Total direct eligible costs	**69 893,05**		
Total indirect costs	**13 978,61**		
Total costs [3]	**83 871,66**	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	300000

Justify any deviations with respect to the planned budget

Personnel cost:
Scheduled budget was spent.

Consumable and prototyping:
All costs (WP2: model cavity; WP3: tuner components) were mainly financed from own resources.
It is planned to finance the "main items" (WP2: prototype cavity; WP3: tuner for SC-CH cavity) from the CARE-HIPPI support. The design phase of those components was longer than initially foreseen. This is why the requested EU funding will be mainly used during the oncoming reporting periods.

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Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	6	Participant short name	DESY

		Management	
		Total effort in person-months (1)	16(9)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Audit certificate		audit certificate	

		N1-ELAN - Electron Linear Accelerator Network	
		Total effort in person-months (1)	2,5(2,5)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Personnel cost (2)			
Durable equipment			
Consumable and prototyping			
Travel	45 054,28	IEEE-SPIE ELHEP.ISE XVII SYMPOSIUM, Warsaw PL, (5 physicists); IEEE-SPIE WILGA Conference, Wilga PL, (5 physicists); WP9 meetings in Paris, Villingen and Lodz on LLRF program; EPAC 2006, Edinburgh GB, (2 physicists); Int. Conf. on Mixed Design of Integrated Circuits and Systems, Gdynia PL (4 physicists); CryoPrague 2006, Prague Czech Rep. (1physicist); Int. Conf. on Charged and Neutral Particles Channelling Phenomena Frascati I, (2 physicist); LINAC 2006 Knoxville USA, (2 physicists); 2nd Int. Conf. on Radiation Physics and Modification of Materials Tomsk Russia, (1 physicist); 22nd Int. Symp. on Discharges and Electrical Insulation in Vacuum Matsue Japan, (1 physicist); TTC meeting KEK Japan, (5 physicist); Int. Workshop on Thin Film Legnaro I, (6 physicists); Annual CARE and JRA1 meeting Frascati I, (10 physicists); 4 GDE/ILC meetings in Bangalore, Geneva, Chicago	

		N3-HHH - High Energy High Intensity Hadrons Beams	
		Total effort in person-months (1)	0,5(0,5)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)			
Durable equipment			
Consumable and prototyping			
Travel	1 779,81	HHH workshop on "Simulation of BPM front-end electronics and Special Mechanical Designs", Lüneburg D, (5 physicists)	

		R1-SRF - Superconducting Radio Frequency
		Total effort in person-months [(1)] 224(48)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*
Personnel cost [(2)]	263 077,82	WP 1 Management&Communication: Administrative tasks (1 physicist 12 person-months); Task 3.2 Seamless cavities: numerical simulation of the necking process and hydroforming process (2 scientists, total 12 person-months); Task 5.2 Electro polishing of multicells: Modelling electro polishing phenomena with COMSOL software, (1 technician 4 person-months); Task 5.4 Dry ice cleaning: an IR heater has been developed and installed (1 technician 4 person-months); Task 6.1 Design of squid scanning system: scanning of artificially produced defects; (1 scientist 4 person-months); Task 6.3 DC field emission scanning: the improvement of surface quality by applying dry ice cleaning, successive field emission scans and local FE, SEM and EDX measurements were performed on Nb samples (1 physicist 9 person-months); Task 9.1 Low level rf control: test of stable reference line (1 engineer 3 person-months);
Durable equipment		
Consumable and prototyping	143 609,29	Task 2.3 Electron beam welding: installation of new rotating drive and box for the UHV motor; Task 3.2 Seamless cavities: hydroforming of three cell units and fabrication of a seamless cavity; Task 5.2 Electro polishing of multicells: process parameter fixed, design for 9-cell cavity oxi-polishing set up finished; Task 5.4 Dry ice cleaning: an optimized high power IR heater was developed, constructed and installed, and meets fully its requirements; Task 6.1 Design of squid scanning system: fabrication of more systematically produced artificial defects is in progress; Task 6.3 DC field emission scanning: field emission scans and local FE, SEM and EDX measurements were performed; Task 9.1 Low level rf control: new LLRF hardware for Gun control has been developed and successfully tested;
Travel	1 471,51	Steering committee meeting at CERN (1 person)

Total direct eligible costs	454 992,71		
Total indirect costs	81 318,54		
Adjustments to previous periods			
Total costs [(3)]	536 311,25	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	1 436 312

Justify any deviations with respect to the planned budget

Spending for JRA1 in 2006 is nearly 90% of received support.

Spending in ELAN is 100% of received support.

Spending in HHH is about 25%. This considerable under spending is due to the very late meeting in December and subsequent accounting of the travel costs to the next year.

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Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	7	Participant short name	FZJ

		Management	
		Total effort in person-months (1)	
Cost category	Actual direct eligible costs (€)	Justification of costs description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Audit certificate	2 500,00	audit certificate	

		N1-ELAN - Electron Linear Accelerator Network	
		Total effort in person-months (1)	1,0
Cost category	Actual direct eligible costs (€)	Justification of costs description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Personnel cost (2)			
Durable equipment			
Consumable and prototyping			
Travel	614,20	1 person Moscow (RU) for two working sessions of WP4 INSTR	

		N2-BENE - Beam for European Neutrino Experiments	
		Total effort in person-months (1)	2,0
Cost category	Actual direct eligible costs (€)	Justification of costs *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)			
Durable equipment			
Consumable and prototyping			
Travel	698,08	1 person Geneva (CERN), 1 person Frascati	

		R3- HIPPI - High Intensity Pulsed Proton Injector	
		Total effort in person-months [(1)]	38.3
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost [(2)]	228 589,66	permanent personnel salary for work on WP3 SC spoke and for work on WP5 BD. Construction work on 352 MHz cavity, investigation of beam dynamics issues, code development for cavity comparison	
Durable equipment			
Consumable and prototyping	30 084,51	material and equipment for WP3 SC spoke. Material tests, metal forming, electron beam welding	
Travel	9 350,26	3 persons Edinburgh (GB) EPAC06, 1 person Paris (F) WP3 spoke coupler, 1 person Grafing (D) numerical methods, 1 person Las Palmas (ES) CST2006, 1 person Frascati (I) CARE06, 1 person Würzburg (D) sc work meeting.	

Total direct eligible costs	271 836,71		
Total indirect costs	210 873,71		
Adjustments to previous periods	-3 172,73		
Total costs [(3)]	479 537,69	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	

Justify any deviations with respect to the planned budget

ELAN: Most of the planned travels are scheduled for 2008.

BENE: Associated contractors and ourselves had not enough personnel to continue our level of engagement. We hope to be better in 2007.

HIPPI: Nearly all activity was used for fabrication of 3spoke cavity. Unplanned quality checks of niobium sheets turned out to be necessary. Big efforts to speed up and avoid further delays.

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[(2)] For TA activities excluding the effort charged under the user fees if the UF cost model is used.
[(3)] Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	8	Participant short name	TUM

		N2-BENE - Beam for European Neutrino Experiments	
		Total effort in person-months (1)	0.5
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)			
Durable equipment			
Consumable and prototyping			
Travel	385,46	participation and presentation of BENE related material at the MPI workshop: Heidelberg, Germany (20.-22.11.06, 1 person)	

Total direct eligible costs	385,46		
Total indirect costs	77,09		
Total costs (3)	462,55	Global estimate of the total costs for AC contractors (not only the eligible costs)	3000

Justify any deviations with respect to the planned budget

(1) AC contractors must include both the total estimated human effort (including permanent staff) and, in brackets, additional staff only.
(2) For TA activities excluding the effort charged under the user fees if the UF cost model is used.
(3) Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	9	Participant short name	FZR

		Management	
		Total effort in person-months (1)	
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Audit certificate	150,00	audit certificate	
		N1-ELAN - Electron Linear Accelerator Network	
		Total effort in person-months (1)	0.5
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Personnel cost (2)	0		
Durable equipment	0		
Consumable and prototyping	0		
Travel	2 579,40	Participation in the CARE 2006 Annual Meeting, Frascati (3 persons)	
		R2-PHIN - Photo Injector	
		Total effort in person-months (1)	16 (3,5)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)	43 047,79	additional staff (temporary contracts), in 2006: 1 scientist working in WP 2, photocathode know-how, development of photocathode preparation equipment, for 5.3 months, 1 technician working in WP2, assembly and test of cathode transfer system, and WP4, SC RF gun, precision mechanics work and assembly of SC RFgun cryostat, for 10.5 months	
Durable equipment	0,00		
Consumable and prototyping	21 520,33	WP2: photo cathodes, vacuum parts, electronic components and materials for photocathode preparation equipment, clean-room materials, WP4: optical components for the UV driver laser of SC RF photo gun, vacuum and mechanical parts of cathode transfer system.	
Travel	1 108,49	WP2, Participation Workshop on High QE Photocathodes for RF Guns, Milan (1 person)	

Total direct eligible costs	68 406,01		
Total indirect costs	13 651,20	**20% of total direct eligible costs**	
Adjustments to previous periods			
Total costs (3)	82 057,21	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	

Justify any deviations with respect to the planned budget

(1) AC contractors must include both the total estimated human effort (including permanent staff) and, in brackets, additional staff only.
(2) For TA activities excluding the effort charged under the user fees if the UF cost model is used.

Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	10	Participant short name	INFN

		N1-ELAN - Electron Linear Accelerator Network	
		Total effort in person-months (1)	3,5
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Personnel cost (2)	0,00		
Durable equipment	0,00		
Consumable and prototyping	0,00		
Travel	7 662,51	**INFN-LNF**: M.Enrica Biagini - GDE Linear Collider Meeting - Bangalore (India) 4/13.03.2006 € 2.676,57; Susanna Guiducci - Posipol 06 Workshop - Prevessin 25/28.04.2006 € 921,16; Michele Castellano - Posipol 06 Workshop - Prevessin 26/28.04.2006 € 826,80; Roberto Boni - Linear Collider Workshop - Vancouver 18/25.07.2006 € 3.237,98.	

		N2-BENE - Beam for European Neutrino Experiments	
		Total effort in person-months (1)	8,0
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)	0,00		
Durable equipment	0,00		
Consumable and prototyping	0,00		
Travel	17 405,82	**INFN-NA**: G. De Lellis - "Open Symposium 2006" - Orsay 29/01.01/02.2006 € 1.105,24; P.Strolin - Worshop CERN Strategy Group - Orsay 27/01.02/02.2006 € 1.175,25; L.S.Esposito - Meeting ISS - Rutherford 24/28.04.2006 € 1.229,74; P. Migliozzi - Meeting ISS - Rutherford 24/28.04.2006 € 1.527,18; G. De Lellis - Meeting for Detectors Proposal - Rutherford 24/28.04.2006 € 1.631,20; P. Strolin -Workshop Neutrino - Rutherford 24/27.04.2006 € 1.226,18; V. Palladino - Fee for "International Conference on Neutrino Physics and Astrophysics" € 449,58; V. Palladino - Meeting Int. Scoping Study- Rutherford 24/29.04.2006 € 1.415,17; V. Palladino - Steering Committee Meeting - CERN and Paris 09/19.04.2006 € 1.232,19; P. Migliozzi - CERN Strategy Group - Orsay 29/01.01/02.2006 € 746,02; P. Strolin - Contatti Scientifici Collaborazione CARE - Cern Prevessin 06/07.06.2006 € 572,27; V. Palladino - BENE Scientific Report - Cern 03/13.01.2006 € 1.990,48; V. Palladino - Simposio CERN & Publishing - Orsay and Cern 29/01.04/02.2006 € 1.661,43; V. Palladino - "Intenational Conference on Neutrino Physics and Astrophysics" - Chicago and Santa Fe 12/20.06.2006 € 1.713,89.	

		N3-HHH - High Energy High Intensity Hadron Beams	
		Total effort in person-months (1)	2,0
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)	0,00		
Durable equipment	0,00		
Consumable and prototyping	0,00		
Travel	829,32	**INFN-GE**: Michela Greco - Workshop WAMDO - Prevessin 03/06.04.2006 € 829,32.	

		R1-SRF - Superconduting Radio Frequency	
		Total effort in person-months (1)	LNF 24.5 (10.5), LNL 24 (12), MI 40(19), RMII 30 (24)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)	209 479,11	**INFN-LNF**: Bruno Buonomo - Contract from 01.01.2006 to 31.12.2006 (30%) - € 10.081,16; Enrica Chiadroni - Contract from 13.06.2006 to 31.12.2006 - € 12.951,06. **INFN-LNL**: Alessandro Minarello - Contract from 01.01.2006 to 31.12.2006 - € 23.615,87. **INFN-RMII**: Jerzy Andrzej Lorkiewicz - Contract from 01.01.2006 to 17.10.2006 and from 24.10.2006 to 31.12.2006 - € 71.638,69; Alessandro Cianchi - Contract from 01.01.2006 to 31.12.2006 - € 43.713,53. **INFN-MI**: Emanuele Cavaliere - Contract from 01.01.2006 to 13.02.2006 - € 5.398,54; Laura Monaco - Contract from 01.02.2006 to 31.12.2006 - € 21.516,94; Nicola Panzeri - Contract from 01.01.2006 to 21.07.2006 (85%) - € 20.563,32.	
Durable equipment	4 494,60	**INFN-LNF**: Depreciation Cost for Notebook Latitude D610M Processor 730 € 270,00. **INFN- LNL**: Depreciation Cost for Switching Power Supply Mod.S4000(40A/100V) € 684,96. **INFN-RMII**: Depreciation Costs for: Gaussmeter GP002 € 225,24; Laser Nd-YAG Lotis-Tii Mod. LS-2131 € 3.314,40.	
Consumable and prototyping	29 364,23	**INFN-RMII**: Purchasing of: Linear Loops and 220v Valves € 1.740,00; UHV Chamber € 13.900,00. **INFN-MI**: Purchasing of → Platform Cable USB € 175,12; CD/DVD Writer, Pendrive, Keyboard Adapter € 404,18; CPU AMD Athlon and 4DDRam € 441,00; Stacking Ceramic Multilayers € 11.040,00; Connectors, Adapters, Cables, Lamps € 1.663,93.	
Travel	17 791,14	**INFN-RMII**: Roberto Russo - Visit to Berkeley Lab. and Partecipation to the Conference ICMCTF 06 - San Francisco & San Diego 25.04/07/05.2006 € 2.806,35. **INFN-LNF**: Rossano Sorchetti - Mounting and Tests on Optical System - Hamburg 26/03.03/04.2006 € 2.226,02; Luciano Cacciotti - Mounting and Tests on Optical System - Hamburg 26/03.03/04.2006 € 2.226,02; Luciano Cacciotti - Mounting and Tests on Optical System- Hamburg 5/15.03.2006 € 2.200,25; Rossano Sorchetti - Mounting and Tests on Optical System - Hamburg 5/13.03.2006 € 2.200,25; Enrica Chiadroni -Diffraction Radiation Experiment at TTF - Hamburg 26/03.03/04.2006 € 2.538,58; Michele Castellano - WP 11 Meeting - Hamburg 04/07.09.2006 € 1.012,13; Enrica Chiadroni - WP 11 Meeting - Hamburg 04/07.09.2006 € 869,81; Luciano Cacciotti -Mounting of JRA1 Experiment - Hamburg 03/10.10.2006 € 1.711,73.	
Subcontracts	2 435,00	**INFN-MI:** Spectrophotometry ICP-AES an AL samples € 215,00; Manifacturing € 1.820,00; Traction Tests on Al samples € 400,00.	

		R2-PHIN - Photo Injector	
		Total effort in person-months (1)	LNF 39.4 (13.4), MI 20 (11.5)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)	82 925,20	**INFN-LNF**: Barbara Preger - Contract from 01.01.2006 to 23.05.2006 - € 17.126,12; Bruno Buonomo - Contract from 01.01.2006 to 31.12.2006 (70%) - € 23.522,71. **INFN-MI**: Simone Cialdi - Contract from 13.01.2006 to 31.12.2006 - € 42.276,37.	
Durable equipment	0,00		
Consumable and prototyping	33 648,17	**INFN-LNF**: Purchasing of ? Lenses and Mirrors € 1.377,00; Input Optics for Streak Camera € 5385,86. **INFN-MI**: Purchasing of ? Spatial Light Modulator € 14.352,50; Pumphead CEO 35W € 7.530,00; Flip Mount, Post holder, Optical Rail, Rail Carrier etc.€ 1.095,32; Polarizer and Mirror € 1.818,00; Small Clamping Fork, Post Holder, Lenses, Mirror etc. € 1.145,49; Beta BBO Crystal Mount € 550,00; Optical Material: QWPO-400-05-2-R10 € 394,00.	
Travel	1 713,98	**INFN-LNF**: Andrea Ghigo - Steering Committee Meeting - Paris 10/13.04.2006 € 840,77; Carlo Vicario - Meeting on Future JRA2 Plans at CNRS - Paris 13/15.06.2006 € 873,21.	

		R3- HIPPI - High Intensity Pulsed Proton Injector	
		Total effort in person-months (1)	9 (1)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)	3 628,83	**INFN-MI**: Nicola Panzeri - Contract from 01.01.2006 to 21.07.2006 (15%) - € 3.628,83.	
Durable equipment	0,00		
Consumable and prototyping	0,00		
Travel	0,00		

		R4- NED - Next European Dipole	
		Total effort in person-months (1)	17 (6)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)	13 467,73	**INFN-MI**: Mirco Coccoli - Contract from 22.02.2006 to 21.08.2006 - € 13.467,73.	
Durable equipment	0,00		
Consumable and prototyping	0,00		
Travel	0,00		

Cost category	Actual direct eligible costs (€)	Management	
		Total effort in person-months [(1)]	0(0)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Audit Certificate	3 851,05	**INFN-LNF:** Cippitani & Di Gioacchino **-** Audit Certificate related to First and Second Annual Report	
Total direct eligible costs	428 696,69		
Total indirect costs	84 482,13		
Adjustments to previous periods	27 725,53	**INFN-RMII: JRA1- Cons.:** Connectors,Cables and Tape € 294,07; Flanges € 495,15; Vacuum-Tight Ceramic-Metal Insulators € 930,00.**INFN-MI: JRA1 - Cons. -** Estensimetri, Collante e Ancoraggi € 398,00; Software Cadence ULTRA 5 € 590,00. **JRA2 - Travel & Sub.**: Alessandro Flacco - Partecipation to Experiments on Proton Generation from Laser Beam - Palaiseau (France) 06/06.01/07.2005 € 318,99; Simone Cialdi - PHIN Meeting - Prevessin 22/25.11.2005 € 618,96. **JRA3** - **Travel & Sub.**: Nicola Panzeri - Annual Meeting HIPPI 2005 - Abingdon (UK) 27/30.09.2005 € 1.168,22. **INFN-SA: N3 - Travel & Sub.**: Stefania Petracca -N3 Collab. Meeting - Prevessin 19/09/2005 € 1.182,28. **INFN-NA: N2 -** BENE Travel & Sub.: Year 2004 € 5.622,31; Year 2005 € 13.281,33 (see attached document).**INFN-LNF: N1 - Travel & Sub.**: Susanna Guiducci - CARE 05 Meeting - Prevessin 23/26.11.2006 € 1.244,90.**JRA2 - Travel & Sub.**: Andrea Ghigo - PHIN Collaboration Meeting - Prevessin 22/26.11.2005 € 1.016,89; Massimo Petrarca - PHIN Collaboration Meeting - Prevessin 22/25.11.2005 € 564,42.	
Total indirect costs related to Adjustments	5 545,10		
Subcontracts related to Adjustments	66 720,00	**INFN-MI: JRA1-** Spectrophotometry ICP - AES on Al samples € 120,00. **INFN-LNL**:**JRA1** Tool Modification for spinning a seamless cavity € 41.600,00. **INFN-RMII**: **JRA1**Analysis of Superconducting property of Nb film samples € 25.000,00.	
Total costs [(3)]	613 169,45	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	1 213 169,00

Justify any deviations with respect to the planned budget

[(1)] AC contractors must include both the total estimated human effort (including permanent staff) and, in brackets, additional staff only.
[(2)] For TA activities excluding the effort charged under the user fees if the UF cost model is used.
[(3)] Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	11	Participant short name	TEU

		N3-HHH - High Energy High Intensity Hadron Beams
		Total effort in person-months (1)
Cost category	Actual direct eligible costs (€)	Justification of costs *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*
Personnel cost (2)		
Durable equipment		
Consumable and prototyping		
Travel	744,75	1 person HHH-Workshop, CERN, april 2006

		R2-PHIN - Photo Injector
		Total effort in person-months (1)
Cost category	Actual direct eligible costs (€)	Justification of costs *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*
Personnel cost (2)	36 431,66	10,0 manmonths:WP2: photocathode diagnostics on layer growth by means of optical measurement, work on photocahtode preparation chamber for fast Mg-cathodes.
Durable equipment		
Consumable and prototyping	1 317,30	few optical components and supports for light transport to photocathode.
Travel		

		R4- NED - Next European Dipole	
		Total effort in person-months [1]	
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost [2]	49 361,30	8.5 manmonths: WP1: deputy coordinator NED, WP3: characterisation of experimental NbSn conductors	
Durable equipment			
Consumable and prototyping	851,50	Liquid helium for conductor characterisation WP3	
Travel	590,14	1 person: NED Steering Committee Meetings CERN (2x) 22-02-2006 and 11-09-2006+ Ciemat-Madrid 31-05-2006	

Total direct eligible costs	89 296,65		
Total indirect costs	103 147,21		
Adjustments to previous periods			
Total costs [3]	192 443,86	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	

Justify any deviations with respect to the planned budget

[1] AC contractors must include both the total estimated human effort (including permanent staff) and, in brackets, additional staff only.
[2] For TA activities excluding the effort charged under the user fees if the UF cost model is used.
[3] Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	12 (AC)	Participant short name	TUL

		Management	
		Total effort in person-months (1)	
Cost category	Actual direct eligible costs (€)	Justification of costs description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Audit certificate	1 250,00	2005 audit certificate (payment 20.01.2006)	

		N1-ELAN - Electron Linear Accelerator Network	
		Total effort in person-months (1)	3
Cost category	Actual direct eligible costs (€)	Justification of costs description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Personnel cost (2)			
Durable equipment			
Consumable and prototyping	2 500,00	organization of CARE session during MIXDES conference (22.06.2006, 12 presented papers, over 20 attendants), organization of open CARE project promotion among the students (over 50 students attended), organization of invited talks of experts in accelerator technology (6.06.2006, 9.06.2006, 22.11.2006 - about 30 attendants each talk)	
Travel			

		R1-SRF - Superconduting Radio Frequency	
		Total effort in person-months [1]	97(40)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost [2]	37 854,06	WP8: Task 8.2 (Magneto-strictive Tuner) 2 researchers (12 months each) - design, production and validation of LLRF control board SIMCON DSP for magnetostrictive and piezo control systems, WP9: in total five researchers: Task 9.1.2 (LLRF Automation): development of Klystron Finite State Machine (1 persons - 9 months), Klystron linearization (1 persons - 9 months), Task 9.2.2 (Radiation Damage Study) - (system for radiation monitoring) development and installation in FLASH tunnel (1 person - 12 months, 1 person - 9 months), development of software based fault tolerance methods for appication in accelerator control (2 persons - 12 months, 1 person - 10 months)	
Durable equipment			
Consumable and prototyping	8 633,63	WP8: Task 8.2 (Magneto-strictive Tuner) - electronic parts for SIMCON DSP board, WP9: Task 9.2.2 (Magneto-strictive Tuner)RadMon system, piezostack control system, downconverter and beam position monitoring system	
Travel	9 966,93	SPIE-Warsaw and Wilga, Poland (5 persons); NSTI-Nanotech, USA (2 persons); RADECS 06, Athens, Greece (1 person); CARE 06 - Frascati, Italy (2 persons); EUREKA 2006 Brussels (1 person)	

Total direct eligible costs	60 204,62		
Total indirect costs	11 790,92		
Adjustments to previous periods			
Total costs [3]	71 995,54	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	124 552,54

Justify any deviations with respect to the planned budget

[1] AC contractors must include both the total estimated human effort (including permanent staff) and, in brackets, additional staff only.
[2] For TA activities excluding the effort charged under the user fees if the UF cost model is used.
[3] Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	13	Participant short name	IPJ

		Management	
		Total effort in person-months (1)	
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Audit certificate	0,00		

		N1-ELAN - Electron Linear Accelerator Network	
		Total effort in person-months (1)	0,4(0,2)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Personnel cost (2)			
Durable equipment			
Consumable and prototyping			
Travel	2 841,53	CARE 06 Ann. Meet. Frascati (2 per), EPAC 06 Edinburg (1 per.)	

		R1-SRF - Superconduting Radio Frequency	
		Total effort in person-months (1)	83(12,4)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)	15 037,35	Additional staff - 1 scientist working in WP4 for 12 months, 1 - partially for 1 month	
Durable equipment	2 289,72	WP4; depreciation costs of turbomolecular pump ATP900 and camera	
Consumable and prototyping	11 893,30	WP4; special equipment: Ni-cathode, TG315 generator; material, services	
Travel	6 838,80	Int. Symp. Matsue (1 per.), Ukraine XI PP&CF Conf (1 per.), Frascati-consultations (2 per.)	
Total direct eligible costs	38 900,70		
Total indirect costs	7 780,14		
Adjustments to previous periods			
Total costs (3)	46 680,84	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	108 359,22
Justify any deviations with respect to the planned budget			

(1) AC contractors must include both the total estimated human effort (including permanent staff) and, in brackets, additional staff only.
(2) For TA activities excluding the effort charged under the user fees if the UF cost model is used.
(3) Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	**RII3-CT-2003-506395**	**Project acronym**	**CARE**
Participant N°	**14**	**Participant short name**	**WUT-ISE**

		Management	
		Total effort in person-months [(1)]	
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Audit certificate	969,16	audit certificate	

		N1-ELAN - Electron Linear Accelerator Network	
		Total effort in person-months [(1)]	
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Personnel cost [(2)]			
Durable equipment			
Consumable and prototyping			
Travel	2 164,54	Participation research team in 18th IEEE-SPIE Joint Symposium on Photonics and Web Engineering, Wilga 2006 -from 29th May until 4th June	

		R1-SRF - Superconduting Radio Frequency	
		Total effort in person-months [(1)]	19,03 (9,12)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost [(2)]	23 851,63	Salary for two employees (full and part time staff); Additional pay for: 1 Professor emeritus, 2 Technicians	
Durable equipment	0,00		
Consumable and prototyping	21 952,91	Purchase of electronic (complete sub-assembles, PCB, connectors, wires and cables) for LLRF blocks -WP9-TO3	
Travel	8 560,68	Participation in Conference "MIXDES" in Gdynia (1 person) from 22nd until 24th June; LINAC2006-Linear Accelerator Conference in Knoxville, in USA (2 people) from 21st until 25th August; Annual Meeting CARE 06, in Frascati (3 people) from 13th until 19th November; costs of the travel ticket for 3 people from Hamburg (DESY),	

Total direct eligible costs	57 498,92		
Total indirect costs	11 305,96		
Adjustments to previous periods			
Total costs [(3)]	68 804,88	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	158 626,45
Justify any deviations with respect to the planned budget			

[(1)] AC contractors must include both the total estimated human effort (including permanent staff) and, in brackets, additional staff only.
[(2)] For TA activities excluding the effort charged under the user fees if the UF cost model is used.
[(3)] Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	15	Participant short name	WUT

		N3-HHH - High Energy High Intensity Hadron Beams	
		Total effort in person-months [1]	0.24 (0.0)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost [2]			
Durable equipment			
Consumable and prototyping			
Travel	757,13	Participation in NED meeting, 1 person, Genewa	
		R4- NED - Next European Dipole	
		Total effort in person-months [1]	
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost [2]			
Durable equipment			
Consumable and prototyping			
Travel			

Total direct eligible costs	757,13		
Total indirect costs	151,43		
Adjustments to previous periods			
Total costs [3]	908,56	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	61 000,00

Justify any deviations with respect to the planned budget

[1] AC contractors must include both the total estimated human effort (including permanent staff) and, in brackets, additional staff only.
[2] For TA activities excluding the effort charged under the user fees if the UF cost model is used.
[3] Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	16	Participant short name	CSIC

		N2-BENE - Beam for European Neutrino Experiments	
		Total effort in person-months (1)	10.8
Cost category	Actual direct eligible costs (€)	Justification of costs *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)			
Durable equipment			
Consumable and prototyping			
Travel	5 711,38	NuFact06 (3 people), NuFactISS (2 people), WP:Physics	
		N3-HHH - High Energy High Intensity Hadron Beams	
		Total effort in person-months (1)	5.0
Cost category	Actual direct eligible costs (€)	Justification of costs *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)			
Durable equipment			
Consumable and prototyping			
Travel	531,42	lumi06 (1 person) WP: BDYN	

Total direct eligible costs	6 242,80		
Total indirect costs			
Adjustments to previous periods			
Total costs (3)	6 242,80	Global estimate of the total costs for AC contractors (not only the eligible costs)	

Justify any deviations with respect to the planned budget

(1) AC contractors must include both the total estimated human effort (including permanent staff) and, in brackets, additional staff only.
(2) For TA activities excluding the effort charged under the user fees if the UF cost model is used.
(3) Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	17	Participant short name	CERN

		N1-ELAN - Electron Linear Accelerator Network	
		Total effort in person-months (1)	11(0)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Personnel cost (2)	0		
Durable equipment	0		
Consumable and prototyping	0		
Travel	12 877,73	Participation in the following meetings: 1) Low Emittance Transport workshop, CERN, Feb. 8-11 2) Polarized Positron Source workshop, CERN, April 26-28 3) Electron accelerator R&D for Energy Frontier, LAL, Orsay, May15-17 4) European Particle Accelerator Conference, UK,June 26-30 5) Workshop on High-Gradient RF, CERN, Sept. 25-27	

		N2-BENE - Beam for European Neutrino Experiments	
		Total effort in person-months (1)	1(0)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)	0		
Durable equipment	0		
Consumable and prototyping	0		
Travel	5 770,75	Participation in the following meetings: 1) The open meeting of the council strategy group in Paris, 31 Juanry 2006 2) Beta-beam meeting, Imperial, London, 5 April 2006 3) The ISS/BENE meeting at Rutherford labs, 24-28 April 2006 4) ISS/NUFACT 06, Irvine, USA, 21-30 August 2006 5) Meetings at LPSC, Grenoble	

		N3-HHH - High Energy High Intensity Hadron Beams	
		Total effort in person-months (1)	32.75(6)
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)	18 764,90	6 months subsistence of a PhD student	
Durable equipment	0		
Consumable and prototyping	4 185,89	rental of small furnitures for network meeting	
Travel	47 265,04	participation to coordination meeting, organization of 6 workshops, co-organization of one international conference and participation to a LARP meeting	

		R2-PHIN - Photo Injector	
		Total effort in person-months [1]	51(3)
Cost category	Actual direct eligible costs (€)	Justification of costs *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost [2]	7 472,06	WP3: Salary of an expert, for the setting-up of RAL Laser at CERN (3 months)	
Durable equipment	0,00		
Consumable and prototyping	142 057,34	WP2: Refurbishment of the preparation chamber and of the DC gun test line for the qualification and commissioning of photocathodes.Materials for photocathode production. WP3: Materials for the construction of the laser and of its control system WP4: CERN compatible vacuum equipment (valves, pumps, gauges) and ancillaries.	
Travel	12 310,10	WP1: participation to Steering commitees, preparation of both technical and financial reports; organization of PHIN meeting. WP3 & WP4: collaboration meetings at LAL and RAL. Technical visits	

		R3- HIPPI - High Intensity Pulsed Proton Injector	
		Total effort in person-months [1]	75 (25)
Cost category	Actual direct eligible costs (€)	Justification of costs *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost [2]	130 380,59	Salaries for M. Pasini (6 months, design and testing of RF structures, WP2), E. Sargsyan (12 months, beam dynamics study, WP3 and 4), R. Wegner (7 months, design of RF strucutres, WP2)	
Durable equipment	0,00		
Consumable and prototyping	0,00		
Travel	6 992,01	Participation of Coordinator and Deputy to the official HIPPI and CARE Meetings: CARE SC meeting in Paris, WP3+4 spring meeting at FZJ Juelich, WP2 spring meeting at LPSC Grenoble, Annual HIPPI Meeting in September at FZJ Juelich. Participation of the ESAC members to the Annual Meeting.	

		R4- NED - Next European Dipole	
		Total effort in person-months [1]	6(0)
Cost category	Actual direct eligible costs (€)	Justification of costs *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost [2]	0,00	WP3: follow-up of the 2 contracts placed to SMI and ALSTOM, discussion of the development plan for step 2 with the 2 firms, characterization of the conductors by critical current measurements and by micrographs done on virgin and deformed samples (effort paid by CERN)	
Durable equipment	0,00		
Consumable and prototyping	0,00	ALSTOM-MSA invoice received in December 2006 for an amount of 44,893.00 €, corresponding to the achievement of Step 1, i.e. the qualification of the initial strand design. The paiement has been done at the beginning of January 2007 and will be accounted for in the 2007 budget	
Travel	0,00		

Total direct eligible costs	388 076,41		
Total indirect costs	77 615,28		
Adjustments to previous periods			
Total costs [3]	465 691,69	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	2 532 437,00
Justify any deviations with respect to the planned budget			

[1] AC contractors must include both the total estimated human effort (including permanent staff) and, in brackets, additional staff only.
[2] For TA activities excluding the effort charged under the user fees if the UF cost model is used.
[3] Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	18	Participant short name	UniGE

		N2-BENE - Beam for European Neutrino Experiments	
		Total effort in person-months (1)	7
Cost category	Actual direct eligible costs (€)	Justification of costs *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)			
Durable equipment			
Consumable and prototyping	0,00 €		
Travel	6 535,51 €	BENE Workshop 2006 Frascati; NUFACT06 Workshop Irvine california; Reports to GDR France; ISS workshop (RAL april 2006); Visit to Bruxells headquarters; Participation to workshop or expriment on muon cooling	
		NB taux de conversion € -- CHF	1,6058
Total direct eligible costs	6 535,51 €		
Total indirect costs	553,56 €		
Total costs (3)	7 089,07 €	Global estimate of the total costs for AC contractors (not only the eligible costs)	

Justify any deviations with respect to the planned budget

(1) AC contractors must include both the total estimated human effort (including permanent staff) and, in brackets, additional staff only.
(2) For TA activities excluding the effort charged under the user fees if the UF cost model is used.
(3) Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	19	Participant short name	PSI

		N1-ELAN - Electron Linear Accelerator Network	
		Total effort in person-months [(1)]	
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Personnel cost [(2)]			
Durable equipment			
Consumable and prototyping			
Travel	2 901,45	Travel Expenses for Network and Collaboration Meetings: - 2 persons for collaboration meeting of JRA-1 during EPAC'06 (Edinburgh) - 1 person CARE Annual Meeting, INFN Frascati	

		R1-SRF - Superconduting Radio Frequency	
		Total effort in person-months [(1)]	14
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost [(2)]	65 248,34	WP9 LLRF: - 1 CARE person (PhD) for work at DESY in LLRF Gun Control - PSI support of PhD work at DESY and Evaluation of RF Gun Regualtion at PSI - HW, FW, SW Support of electronics implementation for gun regulation	
Durable equipment			
Consumable and prototyping			
Travel			

Total direct eligible costs	68 149,79		
Total indirect costs			
Adjustments to previous periods	5 167,58		
Total costs [(3)]	73 317,37	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	

Justify any deviations with respect to the planned budget

[(1)] AC contractors must include both the total estimated human effort (including permanent staff) and, in brackets, additional staff only.
[(2)] For TA activities excluding the effort charged under the user fees if the UF cost model is used.
[(3)] Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	20	Participant short name	CCLRC

		N1-ELAN - Electron Linear Accelerator Network	
		Total effort in person-months (1)	
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Personnel cost (2)			
Durable equipment			
Consumable and prototyping			
Travel	1 389,58	ILC meeting at DESY (Feb, 1 person)	

		N2-BENE - Beam for European Neutrino Experiments	
		Total effort in person-months (1)	
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)			
Durable equipment			
Consumable and prototyping			
Travel	11 115,74	5 BENE related meetings at CERN: (May, Jul, Sep, Dec, total 5 people); NuFact'06 (Aug, 2 people); CARE06 (Nov,3 people)	

		N3-HHH - High Energy High Intensity Hadron Beams	
		Total effort in person-months (1)	
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)			
Durable equipment			
Consumable and prototyping			
Travel	0,00		

		R2- PHIN - Photo Injector	
		Total effort in person-months (1)	8,7
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)	43 679,82	1.0 staff months on WP1, 7.7 on WP3	
Durable equipment			
Consumable and prototyping	489,24	Shipment of equipment to CERN	
Travel	24 061,63	CARE06 (Nov, 1 person); PHIN meetings at CERN (Jun, Aug, total 3 people); expenses for visiting scientist from Budapest (Jan-Aug, Dec)	

		R3- HIPPI - High Intensity Pulsed Proton Injector	
		Total effort in person-months (1)	33,58
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)	144 970,08	14.1 staff months on WP2, 17.1 on WP4, 2.4 on WP5	
Durable equipment			
Consumable and prototyping	15 468,27	Computer software, hardware and licences.	
Travel	13 953,79	HIPPI meetings at CERN (Feb, May Oct, 5 people total); EPAC06 (June, 3 people); HIPPI AGM Julich (Sep, 3 people); LINAC06 (Aug, 1 person)	
		R4- NED - Next European Dipole	
		Total effort in person-months (1)	17,26
Cost category	**Actual direct eligible costs (€)**	**Justification of costs** *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)	71 567,71	0.8 staff months on WP1, 2.9 on WP3, 13.6 on WP4	
Durable equipment			
Consumable and prototyping	7 697,55	Hardware and software for equipment testing	
Travel	12 598,11	NED meetings at CERN (Feb, 2 people; Apr, 1 person; Sep, 1 person; Nov, 2 people) & Madrid (May, 2 people); ICMC Prague (Jul, 2 people); CARE06 (3 people)	

Total direct eligible costs	**346 991,52**		
Total indirect costs	**279 212,45**		
Adjustments to previous periods	**-7 567,22**		
Total costs (3)	**618 636,75**	**Global estimate of the total costs for AC contractors (not only the eligible costs)**	

Justify any deviations with respect to the planned budget

There is an underspend in HIPPI. This arises because 150kEUR of prototype equipment has not yet been charged to the correct budget.

(1) AC contractors must include both the total estimated human effort (including permanent staff) and, in brackets, additional staff only.
(2) For TA activities excluding the effort charged under the user fees if the UF cost model is used.
(3) Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	21	Participant short name	ICL

		N1-ELAN - Electron Linear Accelerator Network	
		Total effort in person-months (1)	0.5(0)
Cost category	Actual direct eligible costs (€)	Justification of costs description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Personnel cost (2)			
Durable equipment			
Consumable and prototyping			
Travel	4 644,48	Participation in ELAN meetings (5 persons)	

		N2-BENE - Beam for European Neutrino Experiments	
		Total effort in person-months (1)	
Cost category	Actual direct eligible costs (€)	Justification of costs *description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)*	
Personnel cost (2)			
Durable equipment			
Consumable and prototyping			
Travel	17 472,13	Participation in BENE meetings (7 persons)	

Total direct eligible costs	22 116,61		
Total indirect costs	4 423,32		
Adjustments to previous periods	-452,70	Overclaim of audit costs	
Total costs (3)	26 087,23	Global estimate of the total costs for AC contractors (not only the eligible costs)	50 000,00

Justify any deviations with respect to the planned budget

(1) AC contractors must include both the total estimated human effort (including permanent staff) and, in brackets, additional staff only.
(2) For TA activities excluding the effort charged under the user fees if the UF cost model is used.
(3) Totals should correspond to the respective figures on FORM C - Financial Statement

Contract N°	RII3-CT-2003-506395	Project acronym	CARE
Participant N°	22	Participant short name	UMA

		Management	
		Total effort in person-months (1)	
Cost category	Actual direct eligible costs (€)	Justification of costs description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Audit certificate	800,00	audit certificate	

		N1-ELAN - Electron Linear Accelerator Network	
		Total effort in person-months (1)	
Cost category	Actual direct eligible costs (€)	Justification of costs description of expenditure and link to the specific work carried out (e.g. tasks, work packages, …)	
Personnel cost (2)			
Durable equipment			
Consumable and prototyping			
Travel	3 696,91	3 ELAN meetings (1 person at Hamburg, 1 person at Frascati, 1 person at DESY), Plasma workshop HEEAUP05 (5 persons, Paris), ELAN-ILC meeting (1 person, DESY)	

Total direct eligible costs	4 496,91		
Total indirect costs	739,38		
Adjustments to previous periods			
Total costs (3)	5 236,29	Global estimate of the total costs for AC contractors (not only the eligible costs)	20 000,00

Justify any deviations with respect to the planned budget

(1) AC contractors must include both the total estimated human effort (including permanent staff) and, in brackets, additional staff only.
(2) For TA activities excluding the effort charged under the user fees if the UF cost model is used.
(3) Totals should correspond to the respective figures on FORM C - Financial Statement

2. Forms C - Financial Statements

Form C – Financial Statements (Appendix 2)

1 CEA

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

(to be completed by each contractor)

Type of instrument	Integrated Infrastructure Initiatives	Type of Action (if necessary)	I3
Project Title (or Acronym)	CARE	Contract n°	RII3-CT-2003-506395
Contractors's legal name	COMMISSARIAT A L'ENERGIE ATOMIQUE		
Legal Type	Governemental		
Contact Person	Roy Aleksan	Telephone	33 1 69083347
Telecopy	33 1 69086428	E-mail	aleksan@dapnia,cea,fr
Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	FC	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	Real
Period from	01/01/2006	TO	31/12/2006

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)	NO
If Yes, please provide the following information	

Third Party 1 (Y1)	Legal name		Cost model used	

If necessary add another Form C

2- Declaration of eligible costs (in €)

	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs	1 246 847,89	0	0	0	159 123,89	0	17 159,61	0	0	0	0	0	1 423 131,38	
Of which subcontracting					4 800,00									
Indirect costs	818 754,14	0	0	0	117 285,76	0	0,00	0	0	0	0		936 039,90	
Adjustments to previous period(s)													0,00	
Total costs	2 065 602,02	0,00	0,00	0,00	276 409,65	0,00	17 159,61	0,00	0,00	0,00	0,00	0,00	2 359 171,28	

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts														

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution resuested is equal to (amount in €)	611 177

6- Audit certificates		
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)		NO
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)		
If No, what are the periods covered by this(those) audit certificate(s) ?	From - to	
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s) ?		

Audit certificate of the contractor (X)			
Legal name of the audit firm		**Cost of the certificate**	
Audit certificate(s) of the third party(ies) (Ys) ***(if necessary)***			
Y1 : Legal name of the audit firm		**Cost of the certificate**	
If necessary add another Form C.		**Total (Z) = (X) +**	

Reminders:
The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium". The required audit certificate (s) is (are) attached to this Financial Statement

7- Conversion rates

Costs incurred in currencies other than EURO shall be reported in EURO.

Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party(ies) ***(if necessary)***	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 1 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate

We certify that:
- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised represen

Contractor's Stamp	Name of the Person responsible for the work	Name of the duly authorised Financial Officer
	Aleksan Roy	**Boyer Muriel**
	Date	Date
	12/02/2007	**12/02/2007**
	Signature	Signature

2 UCLN

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

(to be completed by each contractor)

Type of instrument	Integrated Infrastructure Initiatives	Type of Action (if necessary)	
Project Title (or Acronym)	CARE	Contract n°	RII-CT-2003-506395
Contractors's legal name	Universite Catholique de Louvain (UCL)		
Legal Type	PRIV		
Contact Person	Thierry Delbar	Telephone	(32)10473202
Telecopy	(32)10452183	E-mail	delbar@fynu.ucl.ac.be
Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	AC	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	20%
Period from	01/01/2006	TO	31/12/2006

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)				No
If Yes, please provide the following information				
Third Party 1 (Y1)	Legal name		Cost model used	
Third Party 4 (Y4)	Legal name		Cost model used	

If necessary add another Form C

2- Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indica

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs					300,00		831,73						1131,73	
of which subcontracting														
Indirect costs							166,35						166,35	
Adjustments to previous period(s)														
Total costs					300,00		998,08						1298,08	

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts													0	

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution resuested is equal to (amount in €)	1 298,08

6- Audit certificates			
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)			No
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)			
If No, what are the periods covered by this(those) audit certificate(s) ?		From - to	
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s) ?			
Audit certificate of the contractor (X)			
Legal name of the audit firm	Soc.Civ.SPRL Pierre SOHET & C°	**Cost of the certificate**	0
Audit certificate(s) of the third party(ies) (Ys) ***(if necessary)***			
Y1 : Legal name of the audit firm		**Cost of the certificate**	
If necessary add another Form C.		**Total (Z) = (X) + (Ys)**	0
Reminders: *The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium". The required audit certificate (s) is (are) attached to this Financial Statement*			

7- Conversion rates

Costs incurred in currencies other than EURO shall be reported in EURO.

Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	No
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	No
Third Party(ies) ***(if necessary)***	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 1 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate

We certify that:

- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;

- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised represen

Contractor's Stamp	**Name of the Person responsible for the work**	**Name of the duly authorised Financial Officer**
	Thierry DELBAR	**Brigitte BOSSUT**
	Date	**Date**
	15/01/2007	**15/01/2007**
	Signature	**Signature**

3 CNRS

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

(to be completed by each contractor)

Type of instrument	Integrated Infrastructure Initiatives	Type of Action *(if necessary)*	
Project Title (or Acronym)	CARE	Contract n°	506395
Contractors's legal name	CNRS		
Legal Type	gov		
Contact Person	Terence Garvey	Telephone	33 1 64 46 89 61
Telecopy	01 64 46 83 62	E-mail	garvey@lal.in2p3.fr
Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	FCF	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	20%
Period from	01/01/2006	To	31/12/2006

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)

If Yes, please provide the following information

Third Party 1 (Y1)	Legal name		Cost model used	
Third Party 4 (Y4)	Legal name		Cost model used	

If necessary add another Form C

2- Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indicate only your additional eligible costs, except for Management of the Consortium Activity for which you may indicate your full eligible costs;
- do not declare eligible direct additional costs specifically covered by contributions from third parties as mentioned in Articles II.20 and II.23.a and b of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate your full eligible costs
The costs declared should distinguish between direct and indirect costs
If necessary, adjustments to previous period(s) may be included where appropriate

Type of Activity	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (F)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs	1 569 992,52				0,00		3 177,49						1 573 170,01	
Of which subcontracting														
Indirect costs	313 998,50				0,00		635,50						314 634,00	
Adjustments to previous period(s)					0,00								0,00	
Total costs	1 883 991,02	0,00	0,00	0,00	0,00	0,00	3 812,99	0,00	0,00	0,00	0,00	0,00	1 887 804,01	0,00

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

Type of Activity	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (F)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts														

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution requested is equal to (amount in €)	710 000,00

6- Audit certificates			
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)			no
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)			
If No, what are the periods covered by this(those) audit certificate(s) ?		From - to	
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s) ?			
Audit certificate of the contractor (X)			
Legal name of the audit firm	CNRS, Agent Comptable Principal	**Cost of the certificate**	0
Audit certificate(s) of the third party(ies) (Ys) *(if necessary)*			
Y1 : Legal name of the audit firm		**Cost of the certificate**	
Y2 : Legal name of the audit firm		**Cost of the certificate**	
Y3 : Legal name of the audit firm		**Cost of the certificate**	
Y4 : Legal name of the audit firm		**Cost of the certificate**	
If necessary add another Form C.		**Total (Z) = (X) + (Ys)**	
Reminders: *The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium". The required audit certificate (s) is (are) attached to this Financial Statement*			

7- Conversion rates

Costs incurred in currencies other than EURO shall be reported in EURO.

Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party(ies) *(if necessary)*	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 1 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate

We certify that:

- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Contractor's Stamp	**Name of the Person responsible for the work**	**Name of the duly authorised Financial Officer**
	T. Garvey	**G. Sentise**
	Date	**Date**
	13/02/2007	**15/02/2007**
	Signature	**Signature**

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

(to be completed by each contractor)

Type of instrument	Integrated Infrastructure Initiatives	Type of Action *(if necessary)*	
Project Title (or Acronym)	CARE	Contract n°	506395
Contractors's legal name	CNRS		
Legal Type	gov		
Contact Person	Terence Garvey	Telephone	33 1 64 46 89 61
Telecopy	01 64 46 83 62	E-mail	garvey@lal.in2p3.fr
Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	FCF	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	20%
Period from	January 1st, 2006	To	December 31st, 2006

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No) yes

If Yes, please provide the following information

Third Party / JRA 1 (Y1)	Legal name	Université Paris Sud	Cost model used	FCF
Third Party 2 (Y2)	Legal name		Cost model used	
Third Party 3 (Y3)	Legal name		Cost model used	
Third Party 4 (Y4)	Legal name		Cost model used	

If necessary add another Form C

2- Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indicate only your additional eligible costs, except for Management of the Consortium Activity for which you may indicate your full eligible costs;
- do not declare eligible direct additional costs specifically covered by contributions from third parties as mentioned in Articles II.20 and II.23.a and b of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate your full eligible costs
The costs declared should distinguish between direct and indirect costs
If necessary, adjustments to previous period(s) may be included where appropriate

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (F)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs		13 070,61						25 893,10						38 963,71
Of which subcontracting														
Indirect costs		2 614,12						5 178,62						7 792,74
Adjustments to previous period(s)														0,00
Total costs	0,00	15 684,73	0,00	0,00	0,00	0,00	0,00	31 071,72	0,00	0,00	0,00	0,00		46 756,45

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

	Type of Activity													
	Research and Technological Development / Innovation		Demonstration		Management of the Consortium		Other Specific Activities: Coordination / Networking		Other Specific Activities: Transnational Access / Connectivity		Other Specific Activities		Total (G) =	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts														

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution requested is equal to (amount in €)	38 914,09

6- Audit certificates		
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)		
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)		
If No, what are the periods covered by this(those) audit certificate(s) ?	From - to	
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s) ?		

Audit certificate of the contractor (X)			
Legal name of the audit firm		**Cost of the certificate**	
Audit certificate(s) of the third party(ies) (Ys) ***(if necessary)***			
Y1 : Legal name of the audit firm		**Cost of the certificate**	
Y4 : Legal name of the audit firm		**Cost of the certificate**	
If necessary add another Form C.		**Total (Z) = (X) + (Ys)**	
Reminders: *The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium". The required audit certificate (s) is (are) attached to this Financial Statement*			

7- Conversion rates

Costs incurred in currencies other than EURO shall be reported in EURO.

Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party(ies) ***(if necessary)***	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 1 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate

We certify that:

- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Contractor's Stamp	**Name of the Person responsible for the work**	**Name of the duly authorised Financial Officer**
	T. Garvey	**M. Brigitte Renard**
	Date	**Date**
	09/01/2007	**09/01/2007**
	Signature	**Signature**

4 GSI

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

(to be completed by each contractor)

Type of instrument	Integrated Infrastructure Initiatives	Type of Action *(if necessary)*	n.a.
Project Title (or Acronym)	CARE	Contract n°	RII3-CT-2004-506395
Contractors's legal name	Gesellschaft für Schwerionenforschung mbH		
Legal Type	PNP		
Contact Person	Dr. Lars Groening	Telephone	+ 49 6159 712344
Telecopy	+49 6159 712991	E-mail	la.groening@gsi.de
Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	FC	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	REAL
Period from	01/01/2006	To	31/12/2006

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)			NO
If Yes, please provide the following information			
Third Party 1 (Y1)	Legal name		Cost model used

If necessary add another Form C

2- Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indicate only your additional eligible costs, except for Management of the Consortium Activity for which you may indicate your full eligible costs;
- do not declare eligible direct additional costs specifically covered by contributions from third parties as mentioned in Articles II.20 and II.23.a and b of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate your full eligible costs
The costs declared should distinguish between direct and indirect costs
If necessary, adjustments to previous period(s) may be included where appropriate

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (F)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs	226 535,83						3 156,71						229 692,54	
Of which subcontracting														
Indirect costs	40 242,78						0,00						40 242,78	
Adjustments to previous period(s)													0,00	
Total costs	266 778,61						3 156,71		0,00		0,00		269 935,32	

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (F)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts													0	

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution requested is equal to (amount in €)	**136 546,02**

6- Audit certificates			
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)			**NO**
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)			NO
If No, what are the periods covered by this(those) audit certificate(s) ?		From - to	
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s) ?			

Audit certificate of the contractor (X)			
Legal name of the audit firm	**GSI (internal audit)**	Cost of the certificate	
Audit certificate(s) of the third party(ies) (Ys) *(if necessary)*			
Y1 : Legal name of the audit firm		Cost of the certificate	
If necessary add another Form C.		Total (Z) = (X) + (Ys)	

Reminders:
The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium". The required audit certificate (s) is (are) attached to this Financial Statement

7- Conversion rates

Costs incurred in currencies other than EURO shall be reported in EURO.

Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party(ies) *(if necessary)*	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate

We certify that:
- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Contractor's Stamp	Name of the Person responsible for the work	Name of the duly authorised Financial Officer
	Dr. Lars Groening	**Annette Städter**
	Date	Date
	26 February 2007	**26 February 2007**
	Signature	Signature

5 IAP-FU

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

(to be completed by each contractor)

Type of instrument	Integrated Infrastructure Initiatives	Type of Action (if necessary)	
Project Title (or Acronym)	CARE	Contract n°	RII3-CT-2003-506395
Contractors's legal name	Johann Wolfgang Goethe Universität Frankfurt am Main		
Legal Type	Public research body organized under the laws of Germany		
Contact Person	Christoph Denecke	Telephone	+ 49 69 798 29547
Telecopy	+ 49 69 798 29546	E-mail	Denecke@ltg.uni-frankfurt.de
Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	AC	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	20%
Period from	1.01.2006	TO	31/12/2006

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)				
If Yes, please provide the following information				
Third Party 1 (Y1)	Legal name		Cost model used	

If necessary add another Form C

2- Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indicate only your additional eligible costs, except for Management of the Consortium Activity for which you may indicate your full eligible costs;
- do not declare eligible direct additional costs specifically covered by contributions from third parties as mentioned in Articles II.20 and II.23.a and b of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate your full eligible costs
The costs declared should distinguish between direct and indirect costs
If necessary, adjustments to previous period(s) may be included where appropriate

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs	69893,05												69893,05	
Of which subcontracting														
Indirect costs	13978,61												13978,61	
Adjustments to previous period(s)														
Total costs	83871,66												83871,66	

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts														

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution resuested is equal to (amount in €)	83871,66

6- Audit certificates			
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)			No
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)			
If No, what are the periods covered by this(those) audit certificate(s) ?		From - to	
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s) ?			
Audit certificate of the contractor (X)			
Legal name of the audit firm		**Cost of the certificate**	
Audit certificate(s) of the third party(ies) (Ys) ***(if necessary)***			
Y1 : Legal name of the audit firm		**Cost of the certificate**	
Y4 : Legal name of the audit firm		**Cost of the certificate**	
If necessary add another Form C.		**Total (Z) = (X) + (Ys)**	
Reminders: *The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium". The required audit certificate (s) is (are) attached to this Financial Statement*			

7- Conversion rates

Costs incurred in currencies other than EURO shall be reported in EURO.

Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party(ies) ***(if necessary)***	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 1 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate

We certify that:

- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Contractor's Stamp	Name of the Person responsible for the work	Name of the duly authorised Financial Officer
	U. Ratzinger	**C. Deueche**
	Date	**Date**
	01/02/2007	**15/02/2007**
	Signature	**Signature**

6 DESY

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

(to be completed by each contractor)

Type of instrument	Integrated Infrastructure Initiatives	Type of Action (if necessary)	
Project Title (or Acronym)	CARE	Contract n°	RII3-CT-2003-506395
Contractors's legal name	Stiftung Deutsches Elektronen-Synchrotron		
Legal Type			
Contact Person	Prof. Dr. Dieter Proch	Telephone	(+49)-40-8998-3273
Telecopy	(+49)-40-8998-4302	E-mail	dieter.proch@desy.de
Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	AC	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	Flat rate 20%
Period from	01/01/2006	TO	31/12/2006

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)				No
If Yes, please provide the following information				
Third Party 1 (Y1)	Legal name		Cost model used	
Third Party 4 (Y4)	Legal name		Cost model used	

If necessary add another Form C

2- Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indicate only your additional eligible costs, except for Management of the Consortium Activity for which you may indicate your full eligible costs;
- do not declare eligible direct additional costs specifically covered by contributions from third parties as mentioned in Articles II.20 and II.23.a and b of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate your full eligible costs
The costs declared should distinguish between direct and indirect costs
If necessary, adjustments to previous period(s) may be included where appropriate

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs	408 158,62						46 834,09						454 992,71	
Of which subcontracting	48 400,00												48 400,00	
Indirect costs	71 951,72						9 366,82						81 318,54	
Adjustments to previous period(s)														
Total costs	480 110,34						56 200,91						536 311,25	

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts														

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution resuested is equal to (amount in €)	536 311,25

6- Audit certificates		
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)		No
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)		
If No, what are the periods covered by this(those) audit certificate(s) ?	From - to	

Audit certificate of the contractor (X)			
Legal name of the audit firm		**Cost of the certificate**	
Audit certificate(s) of the third party(ies) (Ys) ***(if necessary)***			
Y1 : Legal name of the audit firm		**Cost of the certificate**	
Y4 : Legal name of the audit firm		**Cost of the certificate**	
If necessary add another Form C.		**Total (Z) = (X) + (Ys)**	
Reminders: *The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium". The required audit certificate (s) is (are) attached to this Financial Statement*			

7- Conversion rates

Costs incurred in currencies other than EURO shall be reported in EURO.

Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	No
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party(ies) ***(if necessary)***	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 1 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate

We certify that:

- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Contractor's Stamp	**Name of the Person responsible for the work**	**Name of the duly authorised Financial Officer**
	Dr. Dieter Proch	**Uwe Wolframm**
	Date	**Date**
	12-févr-07	**12-févr-07**
	Signature	**Signature**

7-FZJ

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

(to be completed by each contractor)

Type of instrument	Integrated Infrastructure Initiatives	Type of Action *(if necessary)*	
Project Title (or Acronym)	CARE	Contract n°	RII3-CT-2003-506395
Contractors's legal name	Forschungszentrum Juelich GmbH		
Legal Type	GmbH		
Contact Person	Dr. Raimund Tölle	Telephone	+49-2461-615615
Telecopy	+49-2461-612670	E-mail	r.toelle@fz-juelich.de
Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	FC	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	Real
Period from	01/01/2006	To	31/12/2006

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)				No
If Yes, please provide the following information				
Third Party 1 (Y1)	Legal name		Cost model used	
Third Party 4 (Y4)	Legal name		Cost model used	

If necessary add another Form C

2- Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indica

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs	268 024,43				2 500,00		1 312,28						271 836,71	0,00
Of which subcontracting													0,00	0,00
Indirect costs	210 873,71												210 873,71	0,00
Adjustments to previous period(s)	-3 443,67						270,94						-3 172,73	0,00
Total costs	475 454,47	0,00	0,00	0,00	2 500,00	0,00	1 583,22	0,00	0,00	0,00	0,00	0,00	479 537,69	0,00

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts													0	0

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution requested is equal to (amount in €)	**112 626,97**

6- Audit certificates		
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)		No
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)		No
If No, what are the periods covered by this(those) audit certificate(s) ?	From - to	
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s) ?		

Audit certificate of the contractor (X)			
Legal name of the audit firm		**Cost of the certificate**	
Audit certificate(s) of the third party(ies) (Ys) ***(if necessary)***			
Y1 : Legal name of the audit firm		**Cost of the certificate**	
Y4 : Legal name of the audit firm		**Cost of the certificate**	
If necessary add another Form C.		**Total (Z) = (X) + (Ys)**	

Reminders:
The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium". The required audit certificate (s) is (are) attached to this Financial Statement

7- Conversion rates

Costs incurred in currencies other than EURO shall be reported in EURO.

Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	Yes
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	No
Third Party(ies) ***(if necessary)***	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 1 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate

We certify that:

- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised represen

Contractor's Stamp	**Name of the Person responsible for the work**	**Name of the duly authorised Financial Officer**
	Dr. Raimund Tölle	**i.A. Jutta Stier i.A. Ruth Henschke**
	Date	**Date**
	20/01/2007	**20/01/2007**
	Signature	**Signature**

8 TUM

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

(to be completed by each contractor)

Type of instrument	Integrated Infrastructure Initiatives	Type of Action (if necessary)	
Project Title (or Acronym)	CARE	Contract n°	RII-CT-2003-506395
Contractors's legal name	Technical University of München		
Legal Type			
Contact Person	Manfred Lindner	Telephone	+49 89 289 12196
Telecopy	(49) 89 289 14583	E-mail	lindner@ph.tum.de
Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	AC	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	20%
Period from	01/01/2006	TO	31/12/2006

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)				No
If Yes, please provide the following information				
Third Party 1 (Y1)	Legal name		Cost model used	
Third Party 4 (Y4)	Legal name		Cost model used	

If necessary add another Form C

2- Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indicate only your additional eligible costs, except for Management of the Consortium Activity for which you may indicate your full eligible costs;
- do not declare eligible direct additional costs specifically covered by contributions from third parties as mentioned in Articles II.20 and II.23.a and b of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate your full eligible costs
The costs declared should distinguish between direct and indirect costs
If necessary, adjustments to previous period(s) may be included where appropriate

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs							385,46						385,46	
Of which subcontracting														
Indirect costs							77,09						77,09	
Adjustments to previous period(s)														
Total costs							462,55						462,55	

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts													0	

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution resuested is equal to (amount in €)	**462,55**

6- Audit certificates		
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)		No
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)		No
If No, what are the periods covered by this(those) audit certificate(s) ?	From - to	
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s) ?		

Audit certificate of the contractor (X)			
Legal name of the audit firm		**Cost of the certificate**	
Audit certificate(s) of the third party(ies) (Ys) ***(if necessary)***			
Y1 : Legal name of the audit firm		**Cost of the certificate**	
Y4 : Legal name of the audit firm		**Cost of the certificate**	
If necessary add another Form C.		**Total (Z) = (X) + (Ys)**	

Reminders:
The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium". The required audit certificate (s) is (are) attached to this Financial Statement

7- Conversion rates

Costs incurred in currencies other than EURO shall be reported in EURO.

Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	No
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	No
Third Party(ies) ***(if necessary)***	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 1 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate

We certify that:
- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Contractor's Stamp	**Name of the Person responsible for the work**	**Name of the duly authorised Financial Officer**
	Prof. Dr. Manfred Lindner	**A. Baur**
	Date	**Date**
	01/03/2007	**01/03/2007**
	Signature	**Signature**

9 FZR

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

(to be completed by each contractor)

Type of instrument	Integrated Infrastructure Initiatives	Type of Action (if necessary)	
Project Title (or Acronym)	CARE	Contract n°	RII3-CT-2003-506395
Contractors's legal name	Forschungszentrum Rossendorf e.V.		
Legal Type	Private public non-commercial		
Contact Person	Dr. Jochen Teichert	Telephone	0049 351 260 3445
Telecopy	0049 351 260 3690	E-mail	j.teichert@fz-rossendorf.de
Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	AC	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	20%
Period from	01/01/2006	TO	31/12/2006

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)				No
If Yes, please provide the following information				
Third Party 1 (Y1)	Legal name		Cost model used	
Third Party 4 (Y4)	Legal name		Cost model used	

If necessary add another Form C

2- Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indicate only your additional eligible costs, except for Management of the Consortium Activity for which you may indicate your full eligible costs;
- do not declare eligible direct additional costs specifically covered by contributions from third parties as mentioned in Articles II.20 and II.23.a and b of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate your full eligible costs
The costs declared should distinguish between direct and indirect costs
If necessary, adjustments to previous period(s) may be included where appropriate

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs	68 256,01				150,00								68 406,01	
subcontracting													0,00	
Indirect costs	13 651,20												13 651,20	
previous period(s)													0,00	
Total costs	81 907,21				150,00								82 057,21	

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+ (D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts													0	0

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution requested is equal to (amount in €)	82 057,21

6- Audit certificates		
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)		No
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)		
If No, what are the periods covered by this(those) audit certificate(s) ?	From - to	

Audit certificate of the contractor (X)			
Legal name of the audit firm		**Cost of the certificate**	
Audit certificate(s) of the third party(ies) (Ys) ***(if necessary)***			
Y1 : Legal name of the audit firm		**Cost of the certificate**	
Y4 : Legal name of the audit firm		**Cost of the certificate**	
If necessary add another Form C.		**Total (Z) = (X) + (Ys)**	
Reminders: *The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium". The required audit certificate (s) is (are) attached to this Financial Statement*			

7- Conversion rates

Costs incurred in currencies other than EURO shall be reported in EURO.
Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party(ies) ***(if necessary)***	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 1 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate

We certify that:
- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Contractor's Stamp	**Name of the Person responsible for the work**	**Name of the duly authorised Financial Officer**
	Dr. Jochen Teichert	Peter Griepentrog
	Date	**Date**
	19/01/2007	19/01/2007
	Signature	**Signature**

10 INFN

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

(to be completed by each contractor)

Type of instrument	Integrated Infrastructure Initiatives	Type of Action (if necessary)	
Project Title (or Acronym)	CARE	Contract n°	RII3-CT-2003-506395
Contractors's legal name	Istituto Nazionale di Fisica Nucleare		
Legal Type	GOV		
Contact Person	Maria Teresa Ghirelli	Telephone	+39 6 94032237
Telecopy	+39 6 94032630	E-mail	ghirelli@lnf.infn.it
Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	AC	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	20%
Period from	01/01/2006	TO	31/12/2006

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)			NO
If Yes, please provide the following information			
Third Party 1 (Y1)	Legal name		Cost model used	
Third Party 4 (Y4)	Legal name		Cost model used	

If necessary add another Form C

2- Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indicate only your additional eligible costs, except for Management of the Consortium Activity for which you may indicate your full eligible costs;
- do not declare eligible direct additional costs specifically covered by contributions from third parties as mentioned in Articles II.20 and II.23.a and b of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate your full eligible costs
The costs declared should distinguish between direct and indirect costs
If necessary, adjustments to previous period(s) may be included where appropriate

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs	398 947,99				3851,05		25 897,65						428 696,69	
Of which subcontracting	2 435,00				3851,05								6 286,05	
Indirect costs	79 302,60						5 179,53						84 482,13	
Adjustments to previous period(s)	74 393,64						25 596,99						99 990,63	
Total costs	552 644,23				3851,05		56 674,17						613 169,45	

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts													0	

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution requested is equal to (amount in €)	**613 169,45**

6- Audit certificates		
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)		**NO**
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)		
If No, what are the periods covered by this(those) audit certificate(s) ?	From - to	
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s) ?		

Audit certificate of the contractor (X)			
Legal name of the audit firm		**Cost of the certificate**	
Audit certificate(s) of the third party(ies) (Ys) ***(if necessary)***			
Y1 : Legal name of the audit firm		**Cost of the certificate**	
Y4 : Legal name of the audit firm		**Cost of the certificate**	
If necessary add another Form C.		**Total (Z) = (X) + (Ys)**	

Reminders:
The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium". The required audit certificate (s) is (are) attached to this Financial Statement

7- Conversion rates
Costs incurred in currencies other than EURO shall be reported in EURO.
Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party(ies) ***(if necessary)***	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 1 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate
We certify that:
- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Contractor's Stamp	**Name of the Person responsible for the work**	**Name of the duly authorised Financial Officer**
	Susanna Guiducci	**Maria Teresa Ghirelli**
	Date	**Date**
	Signature	**Signature**

11 TEU

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

(to be completed by each contractor)

Type of instrument	Integrated Infrastructure Initiatives	Type of Action (if necessary)	
Project Title (or Acronym)	CARE	Contract n°	RII3-CT-2003-506395
Contractors's legal name	UNIVERSITY OF TECHNOLOGY TWENTE		
Legal Type	GOVERNMENTAL		
Contact Person	M. Eertink	Telephone	31534893657
Telecopy	+31 53 4894841	E-mail	g.m.eertink@utwente.nl
Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	FC	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	Real
Period from	January 1st. 2006	TO	December 31st. 2006

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)			No
If Yes, please provide the following information			
Third Party 1 (Y1)	Legal name		Cost model used	
Third Party 4 (Y4)	Legal name		Cost model used	

If necessary add another Form C

2- Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indicate only your additional eligible costs, except for Management of the Consortium Activity for which you may indicate your full eligible costs;
- do not declare eligible direct additional costs specifically covered by contributions from third parties as mentioned in Articles II.20 and II.23.a and b of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate your full eligible costs
The costs declared should distinguish between direct and indirect costs
If necessary, adjustments to previous period(s) may be included where appropriate

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs	88 551,90						744,75						89 296,65	
of which subcontracting														
Indirect costs	103 147,21												103 147,21	
Adjustments to previous period(s)														
Total costs	191 699,11						744,75						192 443,86	

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts													0	

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution resuested is equal to (amount in €)	**88717**

6- Audit certificates		
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)		**NO**
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)		
If No, what are the periods covered by this(those) audit certificate(s) ?	From - to	
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s) ?		

Audit certificate of the contractor (X)			
Legal name of the audit firm		**Cost of the certificate**	
Audit certificate(s) of the third party(ies) (Ys) ***(if necessary)***			
Y1 : Legal name of the audit firm		**Cost of the certificate**	
Y4 : Legal name of the audit firm		**Cost of the certificate**	
If necessary add another Form C.		**Total (Z) = (X) + (Ys)**	

Reminders:
The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium". The required audit certificate (s) is (are) attached to this Financial Statement

7- Conversion rates
Costs incurred in currencies other than EURO shall be reported in EURO.
Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	**No**
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party(ies) ***(if necessary)***	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 1 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate
We certify that:
- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Contractor's Stamp	**Name of the Person responsible for the work**	**Name of the duly authorised Financial Officer**
	ir. A. den Ouden	**A. Groenink**
	Date	**Date**
	22-mars-07	**22-mars-07**
	Signature	**Signature**

12 TUL

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

(to be completed by each contractor)

Type of instrument	Integrated Infrastructure Initiatives	Type of Action (if necessary)	
Project Title (or Acronym)	CARE	Contract n°	RII3-CT-2003-506395
Contractors's legal name	TECHNICAL UNIVERSITY of LODZ, POLAND		
Legal Type	TECHNICAL UNIVERSITY		
Contact Person	Mariusz Grecki	Telephone	0-48-42-631-26-28
Telecopy	0-48-42-636-03-27	E-mail	grecki@dmcs.p.lodz.pl
Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	AC	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	20%
Period from	1.01.2006	TO	31.12.2006

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)			No
If Yes, please provide the following information			
Third Party 1 (Y1)	Legal name		Cost model used	
Third Party 4 (Y4)	Legal name		Cost model used	

If necessary add another Form C

2- Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indicate only your additional eligible costs, except for Management of the Consortium Activity for which you may indicate your full eligible costs;
- do not declare eligible direct additional costs specifically covered by contributions from third parties as mentioned in Articles II.20 and II.23.a and b of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate your full eligible costs
The costs declared should distinguish between direct and indirect costs
If necessary, adjustments to previous period(s) may be included where appropriate

Type of Activity	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs	56 454,62				1 250,00		2 500,00						60 204,62	
Of which subcontracting													0,00	
Indirect costs	11 290,92						500,00						11 790,92	
Adjustments to previous period(s)													0,00	
Total costs	67 745,54				1 250,00		3 000,00						71 995,54	

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

Type of Activity	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts	0	0	0	0	0	0	0	0	0	0	0	0	0	0

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution resuested is equal to (amount in €)	71 995,54

6- Audit certificates		
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)		No
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)		No
If No, what are the periods covered by this(those) audit certificate(s) ?	From - to	
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s) ?		

Audit certificate of the contractor (X)			
Legal name of the audit firm		**Cost of the certificate**	
Y1 : Legal name of the audit firm		**Cost of the certificate**	
Y4 : Legal name of the audit firm		**Cost of the certificate**	
If necessary add another Form C.		**Total (Z) = (X) + (Ys)**	

Reminders:
The cost of an audit certificate is included in the costs declared under the activity “Management of the Consortium”. The required audit certificate (s) is (are) attached to this Financial Statement

7- Conversion rates

Costs incurred in currencies other than EURO shall be reported in EURO.

Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (NO)	No
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES)	Yes
Third Party(ies) ***(if necessary)***	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 1 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor’s Certificate

We certify that:
- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Contractor’s Stamp	**Name of the Person responsible for the work**	**Name of the duly authorised Financial Officer**
	prof. Andrzeij Napieralski	**Jadwiga Machnicka**
	Date	**Date**
	12.02.2007	**12.02.2007**
	Signature	**Signature**

13 IPJ

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

(to be completed by each contractor)

Type of instrument	Integrated Infrastructure Initiatives	Type of Action (if necessary)	
Project Title (or Acronym)	CARE	Contract n°	RII3-CT-2003-506395
Contractors's legal name	The Andrzej Soltan Institute for Nuclear Studies		
Legal Type	gov		
Contact Person	Marek Sadowski	Telephone	48 22 7180536
Telecopy	48 22 7793481	E-mail	msadowski@ipj.gov.pl
Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	AC	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	20%
Period from	January 1st 2006	TO	December 31 2006

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)			No
If Yes, please provide the following information			
Third Party 1 (Y1)	Legal name	Cost model used	
Third Party 4 (Y4)	Legal name	Cost model used	

If necessary add another Form C

2- Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indicate only your additional eligible costs, except for Management of the Consortium Activity for which you may indicate your full eligible costs;
- do not declare eligible direct additional costs specifically covered by contributions from third parties as mentioned in Articles II.20 and II.23.a and b of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate your full eligible costs
The costs declared should distinguish between direct and indirect costs
If necessary, adjustments to previous period(s) may be included where appropriate

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs	36 059,17						2 841,53						38 900,70	
Of which subcontracting														
Indirect costs	7 211,83						568,31						7 780,14	
Adjustments to previous period(s)														
Total costs	43 271,00				0,00		3 409,84						46 680,84	

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+ (D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts													0	

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution resuested is equal to (amount in €)	**46 680,84**

6- Audit certificates		
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)		**NO**
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)		
If No, what are the periods covered by this(those) audit certificate(s) ?	From - to	
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s) ?		

Audit certificate of the contractor (X)			
Legal name of the audit firm		**Cost of the certificate**	
Audit certificate(s) of the third party(ies) (Ys) ***(if necessary)***			
Y1 : Legal name of the audit firm		**Cost of the certificate**	
Y2 : Legal name of the audit firm		**Cost of the certificate**	
Y3 : Legal name of the audit firm		**Cost of the certificate**	
Y4 : Legal name of the audit firm		**Cost of the certificate**	
If necessary add another Form C.		**Total (Z) = (X) + (Ys)**	

Reminders:
The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium". The required audit certificate (s) is (are) attached to this Financial Statement

7- Conversion rates

Costs incurred in currencies other than EURO shall be reported in EURO.

Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	**NO**
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	**YES**
Third Party(ies) ***(if necessary)***	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 1 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate

We certify that:
- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Contractor's Stamp	**Name of the Person responsible for the work**	**Name of the duly authorised Financial Officer**
	Prof. M. Sadowski	**Anna Slapa**
	Date	**Date**
	January 19 2007	**January 19 2007**
	Signature	**Signature**

14 WUT-ISE

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

(to be completed by each contractor)

Type of instrument	Integrated Infrastructure Initiatives	Type of Action (if necessary)	
Project Title (or Acronym)	CARE	Contract n°	RII3-CT-2003-506395
Contractors's legal name	Politechnika Warszawska		
Legal Type	Governmental		
Contact Person	Ryszard Romaniuk	Telephone	+48 22 6607738
Telecopy	+48 22 8252300	E-mail	rrom@ise.pw.edu.pl
Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	AC	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	Flat rate 20%
Period from	01/01/2006	TO	31/12/2006

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)			No
If Yes, please provide the following information			
Third Party 1 (Y1)	Legal name	Cost model used	
Third Party 4 (Y4)	Legal name	Cost model used	

If necessary add another Form C

2- Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indicate only your additional eligible costs, except for Management of the Consortium Activity for which you may indicate your full eligible costs;
- do not declare eligible direct additional costs specifically covered by contributions from third parties as mentioned in Articles II.20 and II.23.a and b of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate your full eligible costs
The costs declared should distinguish between direct and indirect costs
If necessary, adjustments to previous period(s) may be included where appropriate

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs	56 529,76				969,16								57 498,92	
subcontracting	0,00												0,00	
Indirect costs	11 305,96												11 305,96	
previous period(s)														
Total costs	67 835,72				969,16								68 804,88	

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts														

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution resuested is equal to (amount in €)	68 804,88

6- Audit certificates			
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)			No
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)			
If No, what are the periods covered by this(those) audit certificate(s) ?		From - to	
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s) ?			

Audit certificate of the contractor (X)			
Legal name of the audit firm	Horwath JBC Audit Sp. Z.o.o.	Cost of the certificate	969,16
Audit certificate(s) of the third party(ies) (Ys) *(if necessary)*			
Y1 : Legal name of the audit firm		Cost of the certificate	
Y4 : Legal name of the audit firm		Cost of the certificate	
If necessary add another Form C.		Total (Z) = (X) + (Ys)	

Reminders:
The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium". The required audit certificate (s) is (are) attached to this Financial Statement

7- Conversion rates

Costs incurred in currencies other than EURO shall be reported in EURO.
Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	NO
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	YES
Third Party(ies) *(if necessary)*	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 1 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate

We certify that:
- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Contractor's Stamp	Name of the Person responsible for the work	Name of the duly authorised Financial Officer
	Ryszard Romaniuk	**Jadwiga Bajkowska**
	Date	Date
	15/01/2007	**15/01/2007**
	Signature	Signature

15 WUT

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

(to be completed by each contractor)

Type of instrument	Integrated Infrastructure Initiatives	Type of Action *(if necessary)*	
Project Title (or Acronym)	CARE	Contract n°	RII3-CT-2003-506395
Contractors's legal name	WROCLAW UNIVERSITY OF TECHNOLOGY		
Legal Type			
Contact Person	Maciej CHOROWSKI	Telephone	+48 71 320 23 25
Telecopy	+48 71 320 42 28	E-mail	maciej.chorowski@pwr.wroc.pl
Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	AC	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	Flat Rate of 20% of Direct costs, except subcontracting
Period from	January 1st 2006	To	December 31 2006

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)				**No**
If Yes, please provide the following information				
Third Party 1 (Y1)	Legal name		Cost model used	
Third Party 4 (Y4)	Legal name		Cost model used	

If necessary add another Form C

2- Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indicate only your additional eligible costs, except for Management of the Consortium Activity for which you may indicate your full eligible costs;
- do not declare eligible direct additional costs specifically covered by contributions from third parties as mentioned in Articles II.20 and II.23.a and b of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate your full eligible costs
The costs declared should distinguish between direct and indirect costs
If necessary, adjustments to previous period(s) may be included where appropriate

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs							757,13						757,13	
of which subcontracting							0,00						0,00	
Indirect costs							151,43						151,43	
Adjustments to previous period(s)							0,00						0,00	
Total costs							908,56						908,56	

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts													0	

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution requested is equal to (amount in €)	908,56

6- Audit certificates		
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)		No
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)		
If No, what are the periods covered by this(those) audit certificate(s) ?	From - to	
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s) ?		

Audit certificate of the contractor (X)			
Legal name of the audit firm		**Cost of the certificate**	
Audit certificate(s) of the third party(ies) (Ys) *(if necessary)*			
Y1 : Legal name of the audit firm		**Cost of the certificate**	
Y4 : Legal name of the audit firm		**Cost of the certificate**	
If necessary add another Form C.		**Total (Z) = (X) + (Ys)**	
Reminders: *The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium". The required audit certificate (s) is (are) attached to this Financial Statement*			

7- Conversion rates

Costs incurred in currencies other than EURO shall be reported in EURO.

Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	No
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	Yes
Third Party(ies) *(if necessary)*	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 1 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate

We certify that:

- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Contractor's Stamp	**Name of the Person responsible for the work**	**Name of the duly authorised Financial Officer**
	Maciej Chorowski	**Alicja Maniak**
	Date	**Date**
	Signature	**Signature**

16 CSIC

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

(to be completed by each contractor)

Type of instrument	Integrated Infrastructure Initiatives	Type of Action (if necessary)	
Project Title (or Acronym)	CARE	Contract n°	RII3-CT-2003-506395

Contractors's legal name	Consejo Superior de Investigaciones Científicas		
Legal Type			
Contact Person	Angeles Faus-Golfe	Telephone	34 963543545
Telecopy	34 963543488	E-mail	Angeles.Faus-Golfe@uv.es

Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	FC	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	Real

Period from	1 January 2006	TO	31 December 2006

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)	No
If Yes, please provide the following information	

Third Party 1 (Y1)	Legal name		Cost model used	
Third Party 4 (Y4)	Legal name		Cost model used	

If necessary add another Form C

2- Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indicate only your additional eligible costs, except for Management of the Consortium Activity for which you may indicate your full eligible costs;
- do not declare eligible direct additional costs specifically covered by contributions from third parties as mentioned in Articles II.20 and II.23.a and b of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate your full eligible costs
The costs declared should distinguish between direct and indirect costs
If necessary, adjustments to previous period(s) may be included where appropriate

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs							6242,8						6242,8	
subcontracting													0	
Indirect costs													0	
previous period(s)													0	
Total costs							6242,8						6242,8	

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts														

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution resuested is equal to (amount in €)	6242,8

6- Audit certificates		
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)		No
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)		No
If No, what are the periods covered by this(those) audit certificate(s) ?	From - to	
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s) ?		

Audit certificate of the contractor (X)			
Legal name of the audit firm	Audihispana S.A.	**Cost of the certificate**	
Audit certificate(s) of the third party(ies) (Ys) *(if necessary)*			
Y1 : Legal name of the audit firm		**Cost of the certificate**	
Y4 : Legal name of the audit firm		**Cost of the certificate**	
If necessary add another Form C.		**Total (Z) = (X) + (Ys)**	920,69
Reminders: *The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium". The required audit certificate (s) is (are) attached to this Financial Statement*			

7- Conversion rates

Costs incurred in currencies other than EURO shall be reported in EURO.

Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	No
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party(ies) *(if necessary)*	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 1 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate

We certify that:

- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Contractor's Stamp	Name of the Person responsible for the work	Name of the duly authorised Financial Officer
	Angeles Faus-Golfe	**Maria del Mar Garcia Ferrer**
	Date	Date
	12 January 2007	**23 January 2007**
	Signature	Signature

17 CERN

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

Type of instrument	Integrated Infrastructure Initiatives	Type of Action (if necessary)	
Project Title (or Acronym)	CARE	Contract n°	RII3-CT-2003-506395
Contractors's legal name	European Organisation for Nuclear Research		
Legal Type			
Contact Person	Gilbert Guignard	Telephone	+41-22-7675975
Telecopy	+41-22-7679590	E-mail	gilbert.guignard@cern.ch
Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	AC	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	Flat Rate of 20%
Period from	01.01.06	TO	31.12.06

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)				NO
If Yes, please provide the following information				
Third Party 1 (Y1)	Legal name	N/A	Cost model used	
Third Party 4 (Y4)	Legal name	N/A	Cost model used	

If necessary add another Form C

2- Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indicate only your additional eligible costs, except for Management of the Consortium Activity for which you may indicate your full eligible costs;
- do not declare eligible direct additional costs specifically covered by contributions from third parties as mentioned in Articles II.20 and II.23.a and b of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate your full eligible costs
The costs declared should distinguish between direct and indirect costs
If necessary, adjustments to previous period(s) may be included where appropriate

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs	299 212,10	N/A	N/A	N/A	N/A	N/A	88 864,31	N/A	N/A	N/A	N/A	N/A	388 076,41	N/A
Of which subcontracting	0,00	N/A	N/A	N/A	N/A	N/A	0,00	N/A	N/A	N/A	N/A	N/A	0,00	N/A
Indirect costs	59 842,42	N/A	N/A	N/A	N/A	N/A	17 772,86	N/A	N/A	N/A	N/A	N/A	77 615,28	N/A
Adjustments to previous period(s)	0,00	N/A	N/A	N/A	N/A	N/A	0,00	N/A	N/A	N/A	N/A	N/A	0,00	N/A
Total costs	359 054,52	N/A	N/A	N/A	N/A	N/A	106 637,17	N/A	N/A	N/A	N/A	N/A	465 691,69	N/A

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts													N/A	N/A

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	**N/A**
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution resuested is equal to (amount in €)	**465 691,69**

6- Audit certificates		
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)		**YES**
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)		**No**
If No, what are the periods covered by this(those) audit certificate(s) ?	From - to	**01.01.06 TO 31.12.06**
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s) ?		**NIL**

Audit certificate of the contractor (X)			
Legal name of the audit firm	**N/A 2004**	**Cost of the certificate**	**NIL**
Audit certificate(s) of the third party(ies) (Ys) *(if necessary)*			
Y1 : Legal name of the audit firm	**N/A**	**Cost of the certificate**	**N/A**
Y4 : Legal name of the audit firm	**N/A**	**Cost of the certificate**	**N/A**
If necessary add another Form C.		**Total (Z) = (X) + (Ys)**	

Reminders:
The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium". The required audit certificate (s) is (are) attached to this Financial Statement

7- Conversion rates
Costs incurred in currencies other than EURO shall be reported in EURO.

Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.
Euro 1 = CHF 1.6104

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	**NO**
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	**YES**
Third Party(ies) *(if necessary)*	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	**N/A**
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 1 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate
We certify that:
- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Contractor's Stamp	Name of the Person responsible for the work	Name of the duly authorised Financial Officer
	Gilbert Guignard	**Thierry Lagrange**
	Date	**Date**
	January 19, 2007	**January 19, 2007**
	Signature	**Signature**

18 UNI-GE

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

(to be completed by each contractor)

Type of instrument	Integrated Infrastructure Initiatives	Type of Action (if necessary)	
Project Title (or Acronym)	CARE	Contract n°	RII3-CT-2003-506395
Contractors's legal name	University of Geneva		
Legal Type			
Contact Person	Alain Blondel	Telephone	00 41 22 379 6227
Telecopy	41223796992	E-mail	alain.blondel@cern.ch
Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	AC	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	
Period from	01-janv-06	TO	31-déc-06

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)				
If Yes, please provide the following information				
Third Party 1 (Y1)	Legal name		Cost model used	

If necessary add another Form C

2- Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indicate only your additional eligible costs, except for Management of the Consortium Activity for which you may indicate your full eligible costs;
- do not declare eligible direct additional costs specifically covered by contributions from third parties as mentioned in Articles II.20 and II.23.a and b of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate your full eligible costs
The costs declared should distinguish between direct and indirect costs
If necessary, adjustments to previous period(s) may be included where appropriate

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs							6 535,51 €						6 535,51 €	
Of which subcontracting														
Indirect costs							553,56 €						553,56 €	
Adjustments to previous period(s)														
Total costs							7 089,07 €						7 089,07 €	

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+ (D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts														

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution resuested is equal to (amount in €)	0 €

6- Audit certificates			
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)			no
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)			
If No, what are the periods covered by this(those) audit certificate(s) ?		From - to	
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s) ?			
Audit certificate of the contractor (X)			
Legal name of the audit firm		**Cost of the certificate**	
Audit certificate(s) of the third party(ies) (Ys) ***(if necessary)***			
Y1 : Legal name of the audit firm		**Cost of the certificate**	
Y4 : Legal name of the audit firm		**Cost of the certificate**	
If necessary add another Form C.		**Total (Z) = (X) + (Ys)**	
Reminders: *The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium". The required audit certificate (s) is (are) attached to this Financial Statement*			

7- Conversion rates

Costs incurred in currencies other than EURO shall be reported in EURO.

Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts. 1€ = 1.6058 CHF

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	NO
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	YES
Third Party(ies) ***(if necessary)***	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 1 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate

We certify that:

- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Contractor's Stamp	**Name of the Person responsible for the work**	**Name of the duly authorised Financial Officer**
	Alain Blondel	Madame Allison MAUTONE
	Date	**Date**
	02-avr-07	**02-avr-07**
	Signature	**Signature**
	[signature]	

19 PSI

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

(to be completed by each contractor)

Type of instrument	Integrated Infrastructure Initiatives	Type of Action (if necessary)	
Project Title (or Acronym)	CARE	Contract n°	RII3-CT-2003-506395
Contractors's legal name	Paul Scherrer Institute (PSI)		
Legal Type			
Contact Person	Volker Schlott	Telephone	00 41 56 310 4237
Telecopy	0041 56 310 4528	E-mail	volker.schlott@psi.ch
Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	FC	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	Real
Period from	01-janv-05	TO	31-déc-05

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)	No

If Yes, please provide the following information

Third Party 1 (Y1)	Legal name		Cost model used	
Third Party 4 (Y4)	Legal name		Cost model used	

If necessary add another Form C

2- Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indicate only your additional eligible costs, except for Management of the Consortium Activity for which you may indicate your full eligible costs;
- do not declare eligible direct additional costs specifically covered by contributions from third parties as mentioned in Articles II.20 and II.23.a and b of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate your full eligible costs
The costs declared should distinguish between direct and indirect costs
If necessary, adjustments to previous period(s) may be included where appropriate

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs	65 248,34						2 901,45						68 149,79	
Of which subcontracting														
Indirect costs	5 167,58						0,00						5 167,58	
Adjustments to previous period(s)														
Total costs	70 415,92						2 901,45						**73 317,37**	

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (E)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts													0	

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution resuested is equal to (amount in €)	

6- Audit certificates		
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)		**No**
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)		
If No, what are the periods covered by this(those) audit certificate(s) ?	From - to	
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s) ?		

Audit certificate of the contractor (X)			
Legal name of the audit firm		**Cost of the certificate**	
Audit certificate(s) of the third party(ies) (Ys) ***(if necessary)***			
Y1 : Legal name of the audit firm		**Cost of the certificate**	
Y4 : Legal name of the audit firm		**Cost of the certificate**	
If necessary add another Form C.		**Total (Z) = (X) + (Ys)**	

Reminders:
The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium". The required audit certificate (s) is (are) attached to this Financial Statement

7- Conversion rates

Costs incurred in currencies other than EURO shall be reported in EURO.

Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	**No**
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	**Yes**
Third Party(ies) ***(if necessary)***	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 1 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate

We certify that:
- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Contractor's Stamp	**Name of the Person responsible for the work**	**Name of the duly authorised Financial Officer**
	Volker Schlott	**Angela Vatter**
	Date	**Date**
	21-févr-07	**21-févr-06**
	Signature	**Signature**

20 CCLRC

Form C - Model of Financial Statement per Activity for Integrated Initiatives for Infrastructures
(to be completed by each contractor)

Type of instrument	Integrated Initiative for Infrastructures	Type of Action (if necessary)	N.A.
Project title (or Acronym)	CARE	Contract n°	RII3-CT-2003-506395
Contractor's Legal Name	Council for the Central Laboratory of the Research Councils		
Legal Type			
Contact Person	Rose Hayes	Telephone	01235 446908
Telecopy	01235 445848	E-mail	r.a.hayes@rl.ac.uk
Cost Model used (AC/FC or FCF) / (UF: User Fee) (*)	FC	Indirect costs (Real or Flat rate of 20% of Direct costs, except subcontracting)	Real
Period from	01-janv-06	To	31-déc-06

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (e.g.: FC / UF or FCF / UF or AC/UF)

1 - Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract (Yes/No)			
If yes, please provide the following information			
Third Party 1 (Y1) Legal Name		Cost model used	
Third Party 4 (Y4) Legal Name		Cost model used	

If necessary add another Form C

2 - Declaration of eligible costs (in €)
Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- *indicate only your additional eligible costs, except for Management of the Consortium Activity for which you may indicate your full eligible costs;*
- *do not declare eligible additional costs specifically covered by contributions from third parties as mentioned in Articles II.20 and II.23.a and b of the contract.*

If you are a contractor using the full cost model (FC/FCF), indicate your eligible costs.
The costs declared should distinguish between direct and indirect costs
If necessary, adjustments to previous period(s) may be included where appropriate.

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (F)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct Costs	334 486,20						12 505,32						346 991,52	
Of which subcontracting														
Indirect costs	279 212,45												279 212,45	
Adjustments to previous period(s)	-10 260,77						2 693,55						-7 567,22	
Total costs	603 437,88				0,00		15 198,87				0,00		618 636,75	

3- Declaration of receipts (in €)
If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

	Type of Activity													
	Research and (A')		Demonstration (B')		Management of the (C')		Other Specific (D')		Other Specific (E)		Other Specific (F)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total Receipts														

4- Declaration of interest generated by the pre-financing (in €) *To be completed only by the coordinator.*	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial contribution (in €)	
For this period, the FP6 Community financial contribution requested is equal to (amount in €)	**€ 148 113,43**

6- Audit certificates			
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)			**No**
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)			
If No, what are the periods covered by this(those) audit certificate(s) ?		**From - To**	
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s)		**€ 500 Estimate**	
Audit certificate of the contractor (X)			
Legal name of the audit firm		Cost of the certificate	
Audit certificate(s) of the third party(ies) (Ys) (if necessary)			
Y1 : Legal name of the audit firm		**Cost of the certificate**	
Y4 : Legal name of the audit firm		**Cost of the certificate**	
If necessary add another Form C.		**Total (Z) = (X) + (Ys)**	
Reminders: *The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium".* *The required audit certificate(s) is(are) attached to this Financial Statement.*			

7- Conversion rates
Costs incurred in currencies other than EURO shall be reported in EURO.
Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	**NO**
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	**Yes E/R 0.6735**
Third Party(ies) ***(if necessary)*** **Third Party 1 (Y1)**	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 2 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate
We certify that:
- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Contractor's Stamp	Name of the Person responsible for the work	Name of the duly authorised Financial Officer
	Dr Rob Edgecock	**Rose Hayes**
	Date	**Date**
	Signature	**Signature**

21 ICL

Form C - Model of Financial Statement per Activity for Integrated Initiatives for Infrastructures

(to be completed by each contractor)

Type of instrument	Integrated Initiatives for Infrastructures	Type of Action *(if necessary)*	N.A.
Project Title (or Acronym)	CARE	Contract n°	RII3-CT-2003-506395

Contractor's Legal Name	**Imperial College of Science, Technology and Medicine**		
Legal Type	Non profit		
Contact Person	Tom Bowker	Telephone	+44 (0)207 5948775
Telecopy	+44 (0)207 5945543	E-mail	tom.bowker@imperial.ac.uk

Cost model used (AC/FC or FCF) / (UF: User Fee) (*)	AC	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	Flat Rate of 20% of Direct Costs, except subcontracting

Period from	01 January 2006	To	31 December 2006

(*) If UF is used under "other specific activities: transnational access", please mention the two costs models used (eg: FC/UF or FCF/UF or AC/UF)

1 - Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)	No
If Yes, please provide the following information	

Third party 1 (Y1)	Legal Name		Cost model used	
Third party 4 (Y4)	Legal Name		Cost model used	

If necessary add another Form C.

2 - Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indicate only your additional eligible costs, except for Management of the Consortium Activity for which you may indicate your full eligible costs;
- do not declare eligible direct additional costs specifically covered by contributions from third parties as mentioned in Articles II.20 and II.23.a and b of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate your full eligible costs.
The costs declared should distinguish between direct and indirect costs.
If necessary, adjustments to previous period(s) may be included where appropriate.

	Type of Activity													
	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access /Connectivity (E)		Other Specific Activities (F)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs							22 116,61						22 116,61	0,00
Of which subcontracting													0,00	0,00
Indirect costs							4 423,32						4 423,32	0,00
Adjustments to previous period(s)					-452,70								-452,70	0,00
Total costs	0,00	0,00	0,00	0,00	-452,70	0,00	26 539,93	0,00	0,00	0,00	0,00	0,00	26 087,23	0,00

3 - Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

Type of Activity													
Research and Technological Development / Innovation (A')		Demonstration (B')		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access /Connectivity (E)		Other Specific Activities (F)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)

4 - Declaration of interest generated by the pre-financing (in €)

To be completed only by the coordinator.

Did the pre-financing (advance) you received by the Commission for this period earn interest (Yes / No)	
If yes, please indicate the amount (in €)	

5 - Request of FP6 Financial contribution (in €)

For this period, the FP6 Community financial contribution requested is equal to (amount in €).	26 087,23

6 - Audit certificates

According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)			Yes
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)			Yes
If No, what are the periods covered by this(those) audit certificate(s)?		From - To	
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s)?			
Audit certificate of the contractor (X)			
Legal name of the audit firm	Imperial College of Science, Technology & Medicine	**Cost of the certificate**	
Audit certificate(s) of the third party(ies) (Ys) *(if necessary)*			
Y1 : Legal name of the audit firm		**Cost of the certificate**	
Y4 : Legal name of the audit firm		**Cost of the certificate**	
If necessary, add another Form C.		**Total (Z) = (X) + (Ys)**	0,00

Reminders:
The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium".
The required audit certificate(s) is(are) attached to this Financial Statement.

7 - Conversion rates

Costs incurred in currencies other than EURO shall be reported in EURO.
Please mention the conversion rate used (only one choice is possible) - Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	No
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	Yes
Third party(ies) *(if necessary)*	
Third party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third party 2 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another form C.

8 - Contractor's Certificate

We certify that:
- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Contractor's Stamp	Name of the Person responsible for the work	Name of the duly authorised Financial Officer
	Professor Ken Long	Mr Tom Bowker
	Date	**Date**
	Signature	**Signature**

22 UMA

Form C - Model of Financial Statement per Activity for Integrated Infrastructure Initiatives

(to be completed by each contractor)

Type of instrument	Integrated Infrastructure Initiatives	Type of Action *(if necessary)*	
Project Title (or Acronym)	CARE	Contract n°	RII3-CT-2003-506395/DGRes/F
Contractors's legal name	The University Of Manchester		
Legal Type			
Contact Person	Elias Mungwala	Telephone	+44(0)161 275 54109
Telecopy	+44(0)161 275 54109	E-mail	elias.mungwala@manchester.ac.uk
Cost model used (AC/FC or FCF)/ (UF: User Fee)(*)	AC	Indirect costs (Real or Flat Rate of 20% of Direct costs, except subcontracting)	Flat Rate of 20%
Period from	01/01/2006	To	31/12/2006

(*) If UF is used under "other specific activities: transnational access/connectivity", please mention the two cost models used (eg. FC/UF or FCF/UF or AC/UF)

1- Resources (Third party(ies))

Are there any resources made available on the basis of a prior agreement with third parties identified in Annex I of the contract? (Yes / No)				NO
If Yes, please provide the following information				
Third Party 1 (Y1)	Legal name		Cost model used	
Third Party 4 (Y4)	Legal name		Cost model used	

If necessary add another Form C

2- Declaration of eligible costs (in €)

Please complete only the activity covered by the relevant instrument (and type of action) indicated above and as mentioned in Article II.25 and/or in Annexes I and III of the contract.
If you are a contractor using the additional cost model (AC):
- indicate only your additional eligible costs, except for Management of the Consortium Activity for which you may indicate your full eligible costs;
- do not declare eligible direct additional costs specifically covered by contributions from third parties as mentioned in Articles II.20 and II.23.a and b of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate your full eligible costs
The costs declared should distinguish between direct and indirect costs
If necessary, adjustments to previous period(s) may be included where appropriate

Type of Activity	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (F)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Direct costs					800,00		3 696,91						4 496,91	
subcontracting														
Indirect costs							739,38						739,38	
previous period(s)														
Total costs	0,00				800,00		4 436,29		0,00		0,00		5 236,29	

3- Declaration of receipts (in €)

If you are a contractor using the additional cost model (AC), indicate only receipts covered by Article II.23.c of the contract.
If you are a contractor using a full cost model (FC/FCF), indicate receipts covered by Article II.23 of the contract.

Type of Activity	Research and Technological Development / Innovation (A)		Demonstration (B)		Management of the Consortium (C)		Other Specific Activities: Coordination / Networking (D)		Other Specific Activities: Transnational Access / Connectivity (E)		Other Specific Activities (F)		Total (G) = (A)+(B)+(C)+(D)+(E)+(F)	
	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)	Contractor	Third Party(ies)
Total receipts													0	

4- Declaration of interest generated by the pre-financing (in €)	
To be completed only by the coordinator.	
Did the pre-financing (advance) you received by the Commission for this period earn interest? (Yes / No)	
If yes, please indicate the amount (in €)	

5- Request of FP6 Financial Contribution (in €)	
For this period, the FP6 Community financial contribution requested is equal to (amount in €)	**5 236,29**

6- Audit certificates		
According to the contract, does this Financial Statement need an audit certificate (or several in case of Third party(ies)) delivered by independent auditor(s)? (Yes / No)		**YES**
If Yes, does this(those) audit certificate(s) cover only this Financial Statement per Activity? (Yes / No)		**YES**
If No, what are the periods covered by this(those) audit certificate(s) ?	From - to	
What is the total cost of this(those) audit certificate(s) (in €) per independent auditor(s) ?		

Audit certificate of the contractor (X)			
Legal name of the audit firm	**UNIAC**	**Cost of the certificate**	€ 800,00
Audit certificate(s) of the third party(ies) (Ys) ***(if necessary)***			
Y1 : Legal name of the audit firm		**Cost of the certificate**	
Y4 : Legal name of the audit firm		**Cost of the certificate**	
If necessary add another Form C.		**Total (Z) = (X) + (Ys)**	
Reminders: *The cost of an audit certificate is included in the costs declared under the activity "Management of the Consortium". The required audit certificate (s) is (are) attached to this Financial Statement*			

7- Conversion rates

Costs incurred in currencies other than EURO shall be reported in EURO.

Please mention the conversion rate used (only one choice is possible) – Please note that the same principle applies for receipts.

Contractor	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party(ies) ***(if necessary)***	
Third Party 1 (Y1)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 1 (Y2)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 3 (Y3)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	
Third Party 4 (Y4)	
- Conversion rate of the date of incurred actual costs? (YES / NO)	
- Conversion rate of the first day of the first month following the period covered by this Financial Statement? (YES/NO)	

If necessary add another Form C.

8- Contractor's Certificate

We certify that:
- the costs declared above are directly related to the resources used to reach the objectives of the project ;
- the receipts declared above are directly related to the resources used to reach the objectives of the project ;
- the costs declared above fall within the definition of eligible costs specified in Articles II.19, II.20, II.21, II.22 and II.25 of the contract, and, if relevant, in Annex III and Article 9 (special clauses) of the contract ;
- the receipts declared above fall within the definition of receipts specified in Article II.23 of the contract ;
- the interest generated by the pre-financing declared above falls within the definition of Article II.27 of the contract ;
- the necessary adjustments, especially to costs reported in previous Financial Statement(s) per Activity, have been incorporated in the above Statement ;
- the above information declared is complete and true ;
- there is full supporting documentation to justify the information hereby declared. It will be made available at the request of the Commission and in the event of an audit by the Commission and/or by the Court of Auditors and/or their authorised representatives.

Contractor's Stamp	**Name of the Person responsible for the work**	**Name of the duly authorised Financial Officer**
	Prof. Roger Barlow	**Elias Mungwala**
	Date	**Date**
	9.02.2007	**09.02.2007**
	Signature	**Signature**

3. Summary financial report

Summary financial report (Appendix 3).

Summary Financial Report

Type of Instrument	I3	Project Title (or Acronym)	CARE	Contract N°	RII3-CT-2003-506395
Reporting period number	3	From (dd/mm/yyyy) 01/01/2006	To (dd/mm/yyyy) 31/12/2006	Page	1/1

Contractor n°	Organisation Short Name	Cost model(s) used: For Transnational Access	Cost model(s) used: For any other activities	Eligible costs (in €)	Research and Technological Development / Innovation (A): Contractor	(A) AC Third party(ies)	(A) FC/FCF Third party(ies)	Demonstration (B): Contractor	(B) AC Third party(ies)	(B) FC/FCF Third party(ies)	Management of the consortium (C): Contractor	(C) AC Third party(ies)	(C) FC/FCF Third party(ies)	Other Specific Activities: Coordination (D): Contractor	(D) AC Third party(ies)	(D) FC/FCF Third party(ies)	Other Specific Activities: Transnational Access (E): Contractor	(E) AC Third party(ies)	(E) UF Third party(ies)	Other Specific Activities (F): Contractor	(F) AC Third party(ies)	(F) FC/FCF Third party(ies)	Total eligible costs (G)=(A)+(B)+(C)+(D)+(E)+(F): Contractor	(G) AC Third party(ies)	(G) FC/FCF Third party(ies)	Receipts: Contractor	Receipts: AC Third party(ies)	Receipts: FC/FCF Third party(ies)
1	CEA		FC	Direct eligible costs	1 246 847,89						159 123,89			17 159,61									1 423 131,38	0,00	0,00			
				of which direct eligible costs of subcontracting							4 800,00												*4 800,00*	*0,00*	*0,00*			
				Indirect eligible costs	818 754,14						117 285,76			0,00									936 039,90	0,00	0,00			
				Adjustment on previous period(s)																			0,00	0,00	0,00			
				Total eligible costs	*2 065 602,02*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*276 409,65*	*0,00*	*0,00*	*17 159,61*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	2 359 171,28	0,00	0,00			
2	UCLN		AC	Direct eligible costs							300,00			831,73									1 131,73	0,00	0,00			
				of which direct eligible costs of subcontracting																			*0,00*	*0,00*	*0,00*			
				Indirect eligible costs										166,35									166,35	0,00	0,00			
				Adjustment on previous period(s)																			0,00	0,00	0,00			
				Total eligible costs	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*300,00*	*0,00*	*0,00*	*998,08*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	1 298,08	0,00	0,00			
3	CNRS		FCF	Direct eligible costs	1 569 992,52		13 070,61							3 177,49		25 893,10							1 573 170,01	0,00	38 963,71			
				of which direct eligible costs of subcontracting																			*0,00*	*0,00*	*0,00*			
				Indirect eligible costs	313 998,50		2 614,12							635,50		5 178,62							314 634,00	0,00	7 792,74			
				Adjustment on previous period(s)																			0,00	0,00	0,00			
				Total eligible costs	*1 883 991,02*	*0,00*	*15 684,73*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*3 812,99*	*0,00*	*31 071,72*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	1 887 804,01	0,00	46 756,45			
4	GSI		FC	Direct eligible costs	226 535,83									3 156,71									229 692,54	0,00	0,00			
				of which direct eligible costs of subcontracting																			*0,00*	*0,00*	*0,00*			
				Indirect eligible costs	40 242,78																		40 242,78	0,00	0,00			
				Adjustment on previous period(s)																			0,00	0,00	0,00			
				Total eligible costs	*266 778,61*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*3 156,71*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	269 935,32	0,00	0,00			
5	IAP-FU		AC	Direct eligible costs	69893,05																		69 893,05	0,00	0,00			
				of which direct eligible costs of subcontracting																			*0,00*	*0,00*	*0,00*			
				Indirect eligible costs	13978,61																		13 978,61	0,00	0,00			
				Adjustment on previous period(s)																			0,00	0,00	0,00			
				Total eligible costs	83871,66	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	83 871,66	0,00	0,00			
6	DESY		AC	Direct eligible costs	408 158,62									46 834,09									454 992,71	0,00	0,00			
				of which direct eligible costs of subcontracting	48 400,00																		*48 400,00*	*0,00*	*0,00*			
				Indirect eligible costs	71 951,72									9 366,82									81 318,54	0,00	0,00			
				Adjustment on previous period(s)																			0,00	0,00	0,00			
				Total eligible costs	*480 110,34*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*56 200,91*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	536 311,25	0,00	0,00			
7	FZJ		FC	Direct eligible costs	268 024,43						2 500,00			1 312,28									271 836,71	0,00	0,00			
				of which direct eligible costs of subcontracting																			*0,00*	*0,00*	*0,00*			
				Indirect eligible costs	210 873,71																		210 873,71	0,00	0,00			
				Adjustment on previous period(s)	-3 443,67									270,94									-3 172,73	0,00	0,00			
				Total eligible costs	*475 454,47*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*2 500,00*	*0,00*	*0,00*	*1 583,22*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	479 537,69	0,00	0,00			
8	TUM		AC	Direct eligible costs										385,46									385,46	0,00	0,00			
				of which direct eligible costs of subcontracting																			*0,00*	*0,00*	*0,00*			
				Indirect eligible costs										77,09									77,09	0,00	0,00			
				Adjustment on previous period(s)																			0,00	0,00	0,00			
				Total eligible costs	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*462,55*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	462,55	0,00	0,00			

9	FZR		AC	Direct eligible costs	68 256,01						150,00													68 406,01	0,00	0,00			
				of which direct eligible costs of subcontracting																				0,00	0,00	0,00			
				Indirect eligible costs	13 651,20																			13 651,20	0,00	0,00			
				Adjustment on previous period(s)																				0,00	0,00	0,00			
				Total eligible costs	81 907,21	0,00	0,00	0,00	0,00	0,00	150,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	82 057,21	0,00	0,00			
10	INFN		AC	Direct eligible costs	398 947,99						3851,05			25 897,65									428 696,69	0,00	0,00			
				of which direct eligible costs of subcontracting	2 435,00																		2 435,00	0,00	0,00			
				Indirect eligible costs	79 302,60									5 179,53									84 482,13	0,00	0,00			
				Adjustment on previous period(s)	74 393,64									25 596,99									99 990,63	0,00	0,00			
				Total eligible costs	552 644,23	0,00	0,00	0,00	0,00	0,00	3 851,05	0,00	0,00	56 674,17	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	613 169,45	0,00	0,00			
11	TEU		FC	Direct eligible costs	88 551,90									744,75									89 296,65	0,00	0,00			
				of which direct eligible costs of subcontracting																			0,00	0,00	0,00			
				Indirect eligible costs	103 147,21																		103 147,21	0,00	0,00			
				Adjustment on previous period(s)																			0,00	0,00	0,00			
				Total eligible costs	191 699,11	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	744,75	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	192 443,86	0,00	0,00			
12	TUL		AC	Direct eligible costs	56 454,62						1 250,00			2 500,00									60 204,62	0,00	0,00			
				of which direct eligible costs of subcontracting																			0,00	0,00	0,00			
				Indirect eligible costs	11 290,92									500,00									11 790,92	0,00	0,00			
				Adjustment on previous period(s)																			0,00	0,00	0,00			
				Total eligible costs	67 745,54	0,00	0,00	0,00	0,00	0,00	1 250,00	0,00	0,00	3 000,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	71 995,54	0,00	0,00			
13	IPJ		AC	Direct eligible costs	36 059,17									2 841,53									38 900,70	0,00	0,00			
				of which direct eligible costs of subcontracting																			0,00	0,00	0,00			
				Indirect eligible costs	7 211,83									568,31									7 780,14	0,00	0,00			
				Adjustment on previous period(s)																			0,00	0,00	0,00			
				Total eligible costs	43 271,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	3 409,84	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	46 680,84	0,00	0,00			
14	WUT_ISE		AC	Direct eligible costs	56 529,76						969,16												57 498,92	0,00	0,00			
				of which direct eligible costs of subcontracting	0,00						0,00												0,00	0,00	0,00			
				Indirect eligible costs	11 305,96						0,00												11 305,96	0,00	0,00			
				Adjustment on previous period(s)																			0,00	0,00	0,00			
				Total eligible costs	67 835,72	0,00	0,00	0,00	0,00	0,00	969,16	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	68 804,88	0,00	0,00			
15	WUT		AC	Direct eligible costs										757,13									757,13	0,00	0,00			
				of which direct eligible costs of subcontracting										0,00									0,00	0,00	0,00			
				Indirect eligible costs										151,43									151,43	0,00	0,00			
				Adjustment on previous period(s)										0,00									0,00	0,00	0,00			
				Total eligible costs	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	908,56	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	908,56	0,00	0,00			
16	CSIC		FC	Direct eligible costs										6242,8									6 242,80	0,00	0,00			
				of which direct eligible costs of subcontracting																			0,00	0,00	0,00			
				Indirect eligible costs																			0,00	0,00	0,00			
				Adjustment on previous period(s)																			0,00	0,00	0,00			
				Total eligible costs	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	6 242,80	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	6 242,80	0,00	0,00			
17	CERN		AC	Direct eligible costs	299212									88864,31									388 076,41	0,00	0,00			
				of which direct eligible costs of subcontracting	0									0									0,00	0,00	0,00			
				Indirect eligible costs	59842,42									17772,862									77 615,28	0,00	0,00			
				Adjustment on previous period(s)	0									0									0,00	0,00	0,00			
				Total eligible costs	359 054,52	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	106 637,17	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	465 691,69	0,00	0,00			

18	UNIGE		AC	Direct eligible costs										6 535,51 €									6 535,51	0,00	0,00			
				of which direct eligible costs of subcontracting																			*0,00*	*0,00*	*0,00*			
				Indirect eligible costs										553,56 €									553,56	0,00	0,00			
				Adjustment on previous period(s)																			0,00	0,00	0,00			
				Total eligible costs	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*7 089,07*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	7 089,07	0,00	0,00			
19	PSI		FC	Direct eligible costs	65 248,34									2 901,45									68 149,79	0,00	0,00			
				of which direct eligible costs of subcontracting																			*0,00*	*0,00*	*0,00*			
				Indirect eligible costs	5 167,58																		5 167,58	0,00	0,00			
				Adjustment on previous period(s)																			0,00	0,00	0,00			
				Total eligible costs	*70 415,92*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*2 901,45*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	73 317,37	0,00	0,00			
20	CCLRC		FC	Direct eligible costs	334 486,20						0,00			12 505,32									346 991,52	0,00	0,00			
				of which direct eligible costs of subcontracting																			*0,00*	*0,00*	*0,00*			
				Indirect eligible costs	279 212,45																		279 212,45	0,00	0,00			
				Adjustment on previous period(s)	-10 260,77									2 693,55									-7 567,22	0,00	0,00			
				Total eligible costs	*603 437,88*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*15 198,87*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	618 636,75	0,00	0,00			
21	ICL		AC	Direct eligible costs										22 116,61									22 116,61	0,00	0,00			
				of which direct eligible costs of subcontracting																			*0,00*	*0,00*	*0,00*			
				Indirect eligible costs										4 423,32									4 423,32	0,00	0,00			
				Adjustment on previous period(s)							-452,70												-452,70	0,00	0,00			
				Total eligible costs	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*-452,70*	*0,00*	*0,00*	*26 539,93*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	26 087,23	0,00	0,00			
22	UMA		AC	Direct eligible costs							800,00			3 696,91									4 496,91	0,00	0,00			
				of which direct eligible costs of subcontracting																			*0,00*	*0,00*	*0,00*			
				Indirect eligible costs										739,38									739,38	0,00	0,00			
				Adjustment on previous period(s)																			0,00	0,00	0,00			
				Total eligible costs	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*800,00*	*0,00*	*0,00*	*4 436,29*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	*0,00*	5 236,29	0,00	0,00			
Total eligible costs					7 293 819,27	0,00	15 684,73	0,00	0,00	0,00	285 777,16	0,00	0,00	317 156,96	0,00	31 071,72	0,00	0,00	0,00	0,00	0,00	0,00	7 896 753,39	0,00	46 756,45	0,00	0,00	0,00
							7 309 504,00			0,00			285 777,16			348 228,68			0,00			0,00			7 943 509,84			0,00
Requested EC contribution for the reporting period (in €) without taking into account receipts							0,00			0,00			0,00			0,00			0,00			0,00			3 854 912,54			
Requested EC contribution for the reporting period (in €) taking into account receipts [=Periodic Invoice]																							3 854 912,54					
Amount of the financial interests generated by the prefinancing																												

C. REPORT ON THE DISTRIBUTION OF THE COMMUNITY FINANCIAL CONTRIBUTION

Report on the distribution between contractors made during the reporting period of the Community financial contribution

Report on the Distribution of the Community's contribution

Type of Instrument	I3	Project Title (or Acronym)	CARE	Contract N°	RII3-CT-2003-506395

Part I

	Community's prefinancing (or payment) sent to the coordinator (1)																
	Reporting Period 1 (2)		Reporting Period 2 (2)		Reporting Period 3 (2)		Reporting Period 4 (2)		Reporting Period 5 (2)		Reporting Period 6 (2)		Reporting Period 7 (2)		Final payment		Total Amount (I) (3)
	From EC	To CEA	From EC	To CEA	From	To	From	To	From	To	From	To	From	To			
	Date	Amount (A)	Date	Amount (B)	Date	Amount (C)	Date	Amount (D)	Date	Amount (E)	Date	Amount (F)	Date	Amount (G)	Date	Amount (H)	
Total (X)	15/03/2004	5 235 000,00	24/06/2005	4 927 837,00	19/07/2006	2 605 444,45											12 768 281,45

Part II

			Distribution of the Community's prefinancing (or payment) between contractors according to the consortium decision(s) (4)																
			Reporting Period 1		Reporting Period 2		Reporting Period 3		Reporting Period 4		Reporting Period 5		Reporting Period 6		Reporting Period 7		Final payment		Total Amount (I') (6)
Contractor n°	Organisation Short Name	Country Code	Date(s) (5)	Amount(s) (A') (5)	Date(s) (5)	Amount(s) (B') (5)	Date(s) (5)	Amount(s) (C') (5)	Date(s) (5)	Amount(s) (D') (5)	Date(s) (5)	Amount(s) (E') (5)	Date(s) (5)	Amount(s) (F') (5)	Date(s) (5)	Amount(s) (G') (5)	Date(s) (5)	Amount(s) (H') (5)	
1	CEA	F	9/04/2004	653 490,00 €	24/06/2005	1 253 107,00	21/07/2006	105 444,45											2 012 041,45 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	653 490,00 €	Total	1 253 107,00	Total	105 444,45	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	2 012 041,45 €
2	UCLN	B	19/04/02004	1 425,00 €	1/07/2005	1 200,00	21/07/2006	2 000,00											4 625,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	1 425,00 €	Total	1 200,00	Total	2 000,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	4 625,00 €
3	CNRS	F	30/04/2004	831 242,00 €	1/07/2005	746 540,00	21/07/2006	350 000,00											1 927 782,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	831 242,00 €	Total	746 540,00	Total	350 000,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	1 927 782,00 €
4	GSI	D	19/04/2004	133 554,00 €	1/05/2005	167 860,00	21/07/2006	50 000,00											351 414,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	133 554,00 €	Total	167 860,00	Total	50 000,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	351 414,00 €
5	IAP-FU	D	3/05/2004	108 732,00 €	1/07/2005	137 110,00	21/07/2006	120 000,00											365 842,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	108 732,00 €	Total	137 110,00	Total	120 000,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	365 842,00 €
6	DESY	D	19/04/2004	638 912,00 €	1/07/2005	234 790,00	21/07/2006	500 000,00											1 373 702,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	638 912,00 €	Total	234 790,00	Total	500 000,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	1 373 702,00 €
7	FZJ	D	22/04/2004	124 405,00 €	1/07/2005	214 400,00	21/07/2006	170 000,00											508 805,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	124 405,00 €	Total	214 400,00	Total	170 000,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	508 805,00 €
8	TUM	D	30/04/2004	2 325,00 €	1/07/2005	1 050,00	21/07/2006	3 000,00											6 375,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	2 325,00 €	Total	1 050,00	Total	3 000,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	6 375,00 €
9	FZR-ELBE	D	19/04/2004	147 726,00 €	1/07/2005	109 740,00	21/07/2006	105 000,00											362 466,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	147 726,00 €	Total	109 740,00	Total	105 000,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	362 466,00 €
10	INFN	I	19/04/2004	780 160,00 €	1/07/2005	345 570,00	21/07/2006	350 000,00											1 475 730,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	780 160,00 €	Total	345 570,00	Total	350 000,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	1 475 730,00 €

Report on the Distribution of the Community's contribution

Type of Instrument	I3	Project Title (or Acronym)	CARE	Contract N°	RII3-CT-2003-506395

Part II — Distribution of the Community's prefinancing (or payment) between contractors according to the consortium decision(s) (4)

Contractor n°	Organisation Short Name	Country Code	Reporting Period 1 Date(s) (5)	Reporting Period 1 Amount(s) (A') (5)	Reporting Period 2 Date(s) (5)	Reporting Period 2 Amount(s) (B') (5)	Reporting Period 3 Date(s) (5)	Reporting Period 3 Amount(s) (C') (5)	Reporting Period 4 Date(s) (5)	Reporting Period 4 Amount(s) (D') (5)	Reporting Period 5 Date(s) (5)	Reporting Period 5 Amount(s) (E') (5)	Reporting Period 6 Date(s) (5)	Reporting Period 6 Amount(s) (F') (5)	Reporting Period 7 Date(s) (5)	Reporting Period 7 Amount(s) (G') (5)	Final payment Date(s) (5)	Final payment Amount(s) (H') (5)	Total Amount (I') (6)
11	TEU	PL	19/04/2004	111 545,00 €	1/07/2005	83 400,00	21/07/2006	40 000,00											234 945,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	111 545,00 €	Total	83 400,00	Total	40 000,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	234 945,00 €
12	TUL Lodz	PL	20/04/2004	100 904,00 €	1/07/2005	61 250,00	21/07/2006	60 000,00											222 154,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	100 904,00 €	Total	61 250,00	Total	60 000,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	222 154,00 €
13	IPJ	PL	20/04/2004	93 885,00 €	1/07/2005	86 640,00	21/07/2006	30 000,00											210 525,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	93 885,00 €	Total	86 640,00	Total	30 000,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	210 525,00 €
14	PW (WUT-ISE)	PL	20/04/2004	146 526,00 €	1/07/2005	134 830,00	21/07/2006	80 000,00											361 356,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	146 526,00 €	Total	134 830,00	Total	80 000,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	361 356,00 €
15	WUT	PL	20/04/2004	40 119,00 €	1/07/2005	12 000,00	21/07/2006	5 000,00											57 119,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	40 119,00 €	Total	12 000,00	Total	5 000,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	57 119,00 €
16	CSIC	SP	30/04/2004	11 473,00 €	1/07/2005	11 670,00	21/07/2006	14 000,00											37 143,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	11 473,00 €	Total	11 670,00	Total	14 000,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	37 143,00 €
17	CERN	CH	19/04/2004	1 069 328,00 €	1/07/2005	1 117 320,00	21/07/2006	400 000,00											2 586 648,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	1 069 328,00 €	Total	1 117 320,00	Total	400 000,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	2 586 648,00 €
18	UNI-GE	CH		0,00		0,00		0,00											0,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	0,00 €	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	0,00 €
19	PSI	CH		0,00		0,00		0,00											0,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	0,00 €	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	0,00 €
20	CCLRC	GB	20/04/2004	209 029,00 €	1/07/2005	189 990,00	21/07/2006	180 000,00											579 019,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	209 029,00 €	Total	189 990,00	Total	180 000,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	579 019,00 €
21	ICL	GB	30/04/2004	20 472,00 €	1/07/2005	11 820,00	21/07/2006	30 000,00											62 292,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	20 472,00 €	Total	11 820,00	Total	30 000,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	62 292,00 €
22	UMA	GB	20/04/2004	9 748,00 €	1/07/2005	7 550,00	21/07/2006	11 000,00											28 298,00 €
																			0,00 €
																			0,00 €
																			0,00 €
			Total	9 748,00 €	Total	7 550,00	Total	11 000,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	28 298,00 €

Report on the Distribution of the Community's contribution

Type of Instrument	I3	Project Title (or Acronym)	CARE	Contract N°	RII3-CT-2003-506395

Part II — Distribution of the Community's prefinancing (or payment) between contractors according to the consortium decision(s) (4)

Contractor n°	Organisation Short Name	Country Code	Reporting Period 1		Reporting Period 2		Reporting Period 3		Reporting Period 4		Reporting Period 5		Reporting Period 6		Reporting Period 7		Final payment		Total Amount (I') (6)
			Date(s) (5)	Amount(s) (A') (5)	Date(s) (5)	Amount(s) (B') (5)	Date(s) (5)	Amount(s) (C') (5)	Date(s) (5)	Amount(s) (D') (5)	Date(s) (5)	Amount(s) (E') (5)	Date(s) (5)	Amount(s) (F') (5)	Date(s) (5)	Amount(s) (G') (5)	Date(s) (5)	Amount(s) (H') (5)	
Total (Y)			Total	5 235 000,00 €	Total	4 927 837,00	Total	2 605 444,45	Total	0,00	Total	0,00	Total	0,00	Total	0,00	Total	0,00	12 768 281,45 €

Part III — Difference between Community's prefinancing (or payment) sent to the coordinator and Total Distribution of the Community's prefinancing (or payment) between contractors according to the consortium decision(s) (4)

	Reporting Period 1	Reporting Period 2	Reporting Period 3	Reporting Period 4	Reporting Period 5	Reporting Period 6	Reporting Period 7	Final payment	Total Amount
Community's prefinancing (or payment) not yet distributed between contractors (Z) (7)	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

I certify that the information set out in this(these) form(s) is accurate and correct and agreed by all contractors.

Name (8)	Surname (8)	Date (dd/mm/yyyy)	Signature of the administrative official authorised to commit the organisation of the coordinator (8)
Aleksan	Roy	15/02/2007	

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Explanatory notes

(1): To be filled in only by the Commission services.
(2): Established in conformity with articles 4.2 and 6 of the contract.
(3): (I) = (A) + (B) + (C) + (D) + (E) + (F) + (G) + (H)
(4): To be filled in only by the coordinator.
(5): Insert the dates (dd/mm/yyyy) and the amounts (x,xxx.xx €) transferred to a contractor (including the coordinator) for a reporting period. If there are more than one transfer to a contractor during a reporting period, identify each date and each relating transferred amount.
(6): (I') = (A') + (B') + (C') + (D') + (E') + (F') + (G') + (H')
(7): (Z) = (X) - (Y)
(8): One the following persons : authorised contact person or first or second administrative official authorised to sign the contract, as mentioned in your Contract Preparation Form (Form A2b)

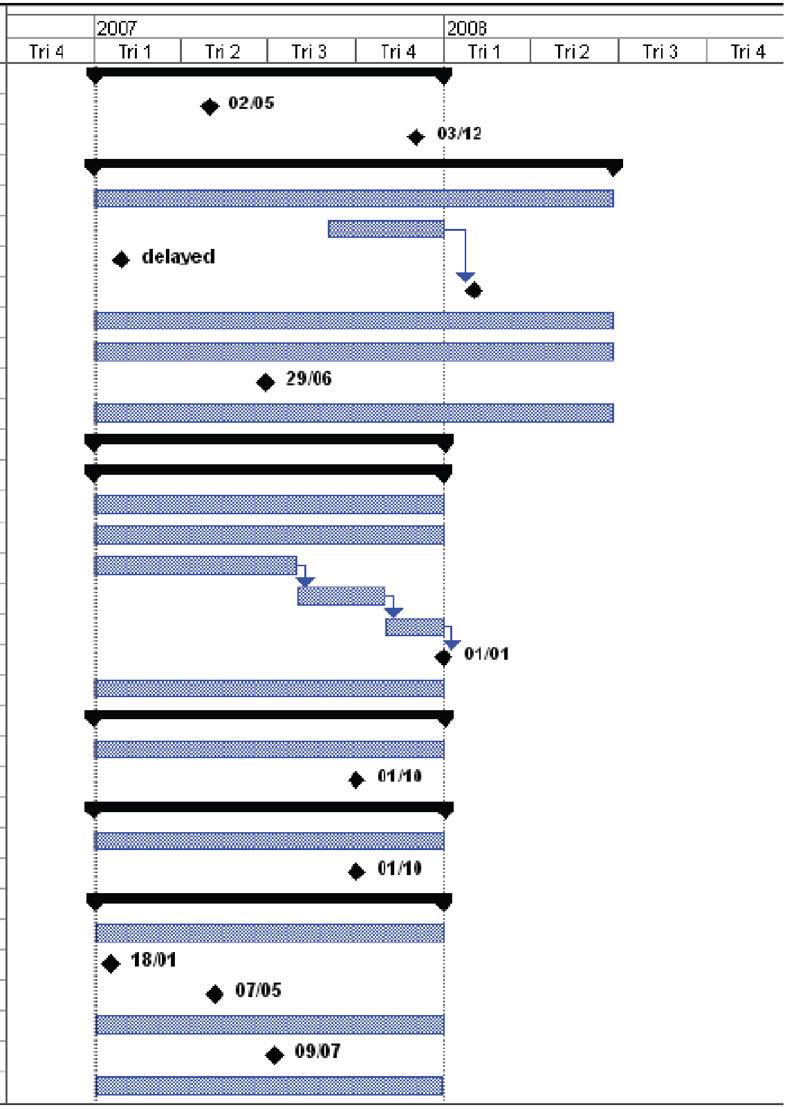
D. Detailed Implementation Plan for the next 18 months

The following Gantt charts present the updated detailed implementation plan for the next 18 months for the three CARE networking activities and the four CARE joint research activities. They are supplemented by tables providing the corresponding financial information.

NETWORKING ACTIVITIES (other than Management)

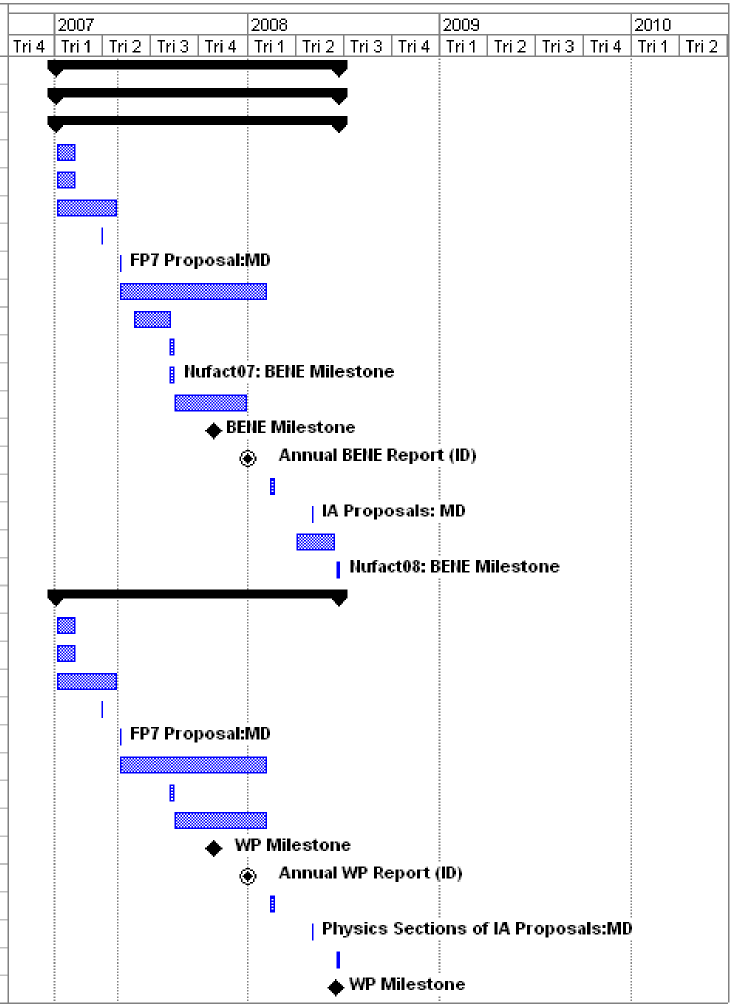
N1 Electron Linear Accelerator Network (ELAN)

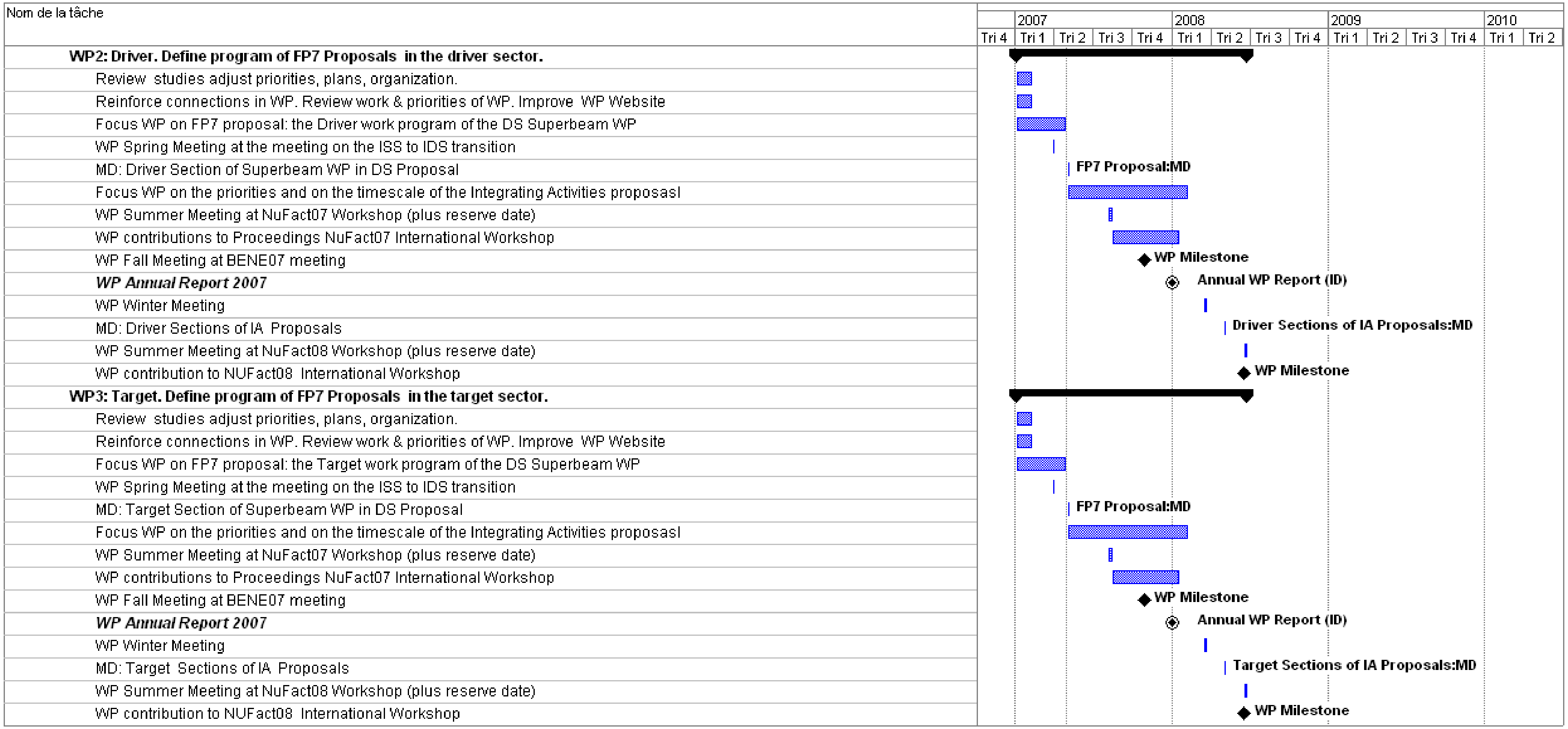
N°	Task Name
1	Review of network activity
2	Annual Meeting
3	Annual Report
4	**WP 1**
5	Progress on CTF3
6	Annual review of CTF3 results
7	Proceedings of CTF3 collaboration
8	Proceedings of CTF3 collaboration
9	Progress on LTECNC topics
10	Review of structure prototype results
11	Review report
12	Review on sources including outcome of PHN
13	**WP 2**
14	**ILC Technology Development**
15	Monitor ILC preparation
16	Participate to ILC RDB Task Forces
17	Monitor first round of S0 testing
18	Evaluate common formats for preparation, handling and tests protoco
19	Build Database for SRF with ILC as a model
20	MS: Database
21	Preparation of FP7 European Proposals
22	**WP 3**
23	Coordinate R&D
24	EDYN/INSTR workshop
25	**WP 4**
26	Coordinate R&D
27	EDYN/INSTR workshop
28	**WP5**
29	Preparation of FP7 European Proposals
30	Meeting
31	Meeting
32	Monitor progress of on-going projects
33	Meeting
34	Build database of plasma accelerators



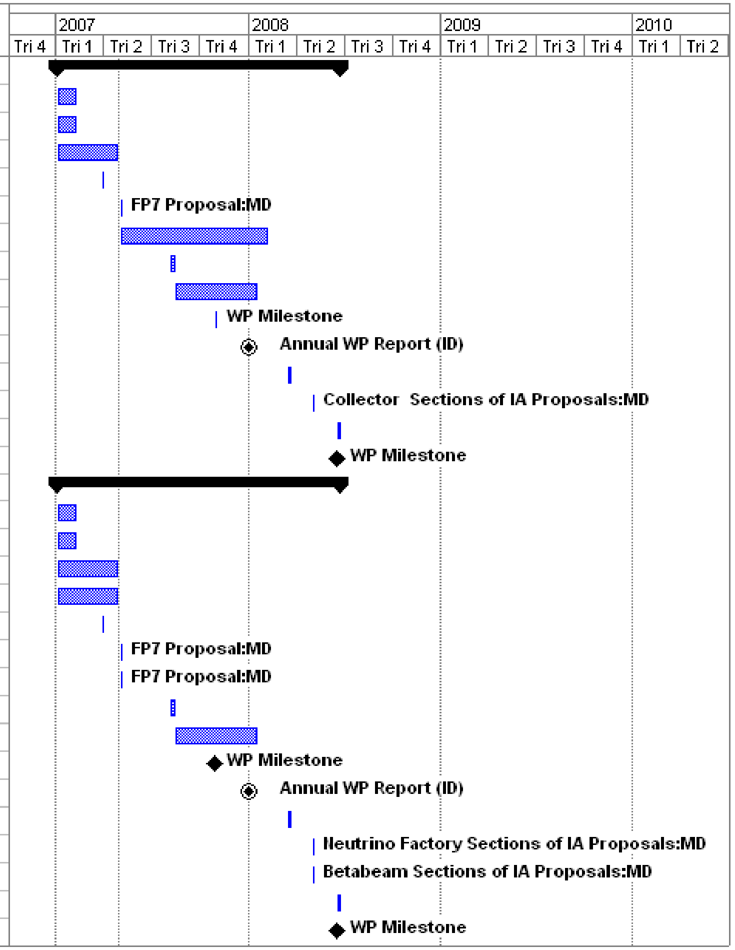
N2 Beam for European Neutrino Physics (BENE)

Nom de la tâche
N2: BENE Networking Activities: proceeds towards FP7 Proposals in 2007/8
All Work Packages
Assemble FP7 Proposals in 2007/8 with the largest possible continental collaborations.
Review results, state-of art of technologies. Review & adjust priorities, plans, organization.
Reinforce connection between Labs & universities in all Work Packages. Improve Web Site
Focus WPs on the priorities and on the timescale of the Design Study proposal
Plenary Spring Meeeting on the transition from Int. Scoping (ISS) to Design (IDS) Studies
MD: Deliver FP7 Proposals
Focus WPs on the priorities and on the timescale of the Integrating Activities proposals
prepare BENE contribution fromall WPs to NuFact07 International Workshop
BENE Summer Meeting at NuFact07 Workshop
MS: NUFact07 Int. Workshop: launch IDS, update Road Map
Contributions to Proceedings NuFact07 International Workshop
MS: Annual CARE07/BENE07 meeting
ID: BENE Annual Report 2007
BENE Winter Meeting : Draft of IA Proposals
MD: Deliver FP7 IA Proposals
prepare BENE contribution to NuFact08 International Workshop
BENE Summer Meeting at NuFact08 Workshop, in Europe! again after the canonic 3 years
WP1: Physics. Document consensual evaluation of physics options and work program in the FP7 Proposal.
Review studies adjust priorities, plans, organization.
Reinforce connections in WP. Review work & priorities of WP. Improve WP Website
Focus WP on FP7 proposal: the work program of the DS Physics & Detector WP (based on assessments consensual so far)
WP Spring Meeting at the meeting on the ISS to IDS transition
MD: Physics and Detector Section of DS Proposal
Focus WP on the priorities and on the timescale of the Integrating Activities proposals
WP Summer Meeting at NuFact07 Workshop (plus reserve date)
WP contributions to Proceedings NuFact07 International Workshop
WP Fall Meeting at BENE07 meeting
WP Annual Report 2007
WP Winter Meeting
MD: Physics & Detector Section of IA Proposal(s)
WP Summer Meeting at NuFact08 Workshop (plus reserve date)
WP contribution to NUFact08 International Workshop




Nom de la tâche
2007
2008
2009
2010
Tri 4 Tri 1 Tri 2 Tri 3 Tri 4 Tri 1 Tri 2 Tri 3 Tri 4 Tri 1 Tri 2 Tri 3 Tri 4 Tri 1 Tri 2
WP2: Driver. Define program of FP7 Proposals in the driver sector.
Review studies adjust priorities, plans, organization.
Reinforce connections in WP. Review work & priorities of WP. Improve WP Website
Focus WP on FP7 proposal: the Driver work program of the DS Superbeam WP
WP Spring Meeting at the meeting on the ISS to IDS transition
MD: Driver Section of Superbeam WP in DS Proposal
Focus WP on the priorities and on the timescale of the Integrating Activities proposasl
WP Summer Meeting at NuFact07 Workshop (plus reserve date)
WP contributions to Proceedings NuFact07 International Workshop
WP Fall Meeting at BENE07 meeting
WP Annual Report 2007
WP Winter Meeting
MD: Driver Sections of IA Proposals
WP Summer Meeting at NuFact08 Workshop (plus reserve date)
WP contribution to NUFact08 International Workshop
WP3: Target. Define program of FP7 Proposals in the target sector.
Review studies adjust priorities, plans, organization.
Reinforce connections in WP. Review work & priorities of WP. Improve WP Website
Focus WP on FP7 proposal: the Target work program of the DS Superbeam WP
WP Spring Meeting at the meeting on the ISS to IDS transition
MD: Target Section of Superbeam WP in DS Proposal
Focus WP on the priorities and on the timescale of the Integrating Activities proposasl
WP Summer Meeting at NuFact07 Workshop (plus reserve date)
WP contributions to Proceedings NuFact07 International Workshop
WP Fall Meeting at BENE07 meeting
WP Annual Report 2007
WP Winter Meeting
MD: Target Sections of IA Proposals
WP Summer Meeting at NuFact08 Workshop (plus reserve date)
WP contribution to NUFact08 International Workshop
FP7 Proposal:MD
WP Milestone
Annual WP Report (ID)
Driver Sections of IA Proposals:MD
WP Milestone
FP7 Proposal:MD
WP Milestone
Annual WP Report (ID)
Target Sections of IA Proposals:MD
WP Milestone

Nom de la tâche
WP4: Collector. Define program of FP7 Proposals in the collector sector.
Review studies adjust priorities, plans, organization.
Reinforce connections in WP. Review work & priorities of WP. Improve WP Website
Focus WP on FP7 proposal: the Collector work program of the DS Superbeam WP
WP Spring Meeting at the meeting on the ISS to IDS transition
MD: Collector Section of Superbeam WP in DS Proposal
Focus WP on the priorities and on the timescale of the Integrating Activities proposasl
WP Summer Meeting at NuFact07 Workshop (plus reserve date)
WP contributions to Proceedings NuFact07 International Workshop
WP Fall Meeting at BENE07 meeting
WP Annual Report 2007
WP Winter Meeting
MD: Collector Sections of IA Proposals
WP Summer Meeting at NuFact08 Workshop (plus reserve date)
WP contribution to NUFact08 International Workshop
WP5: Novel Neutrino Beams. Define program of FP7 Proposals in the Neutrino Factory and Betabeam sectors.
Review studies adjust priorities, plans, organization.
Reinforce connections in WP. Review work & priorities of WP. Improve WP Website
Focus WP on FP7 proposal: the work program of the DS Neutrino Factory WP
Focus WP on FP7 proposal: the work program of the DS Betabeam WP
WP Spring Meeting at the meeting on the ISS to IDS transition
MD: Neutrino Factory WP in DS Proposal
MD: Betabeam WP in DS Proposal
WP Summer Meeting at NuFact07 Workshop (plus reserve date)
WP contributions to Proceedings NuFact07 International Workshop
WP Fall Meeting at BENE07 meeting
WP Annual Report 2007
WP Winter Meeting
MD: Neutrino Factory Sections of IA Proposals
MD: Betabeam Sections of IA Proposals
WP Summer Meeting at NuFact08 Workshop (plus reserve date)
WP contribution to NUFact08 International Workshop



N3 High Energy High Intensity Hadron Beams (HHH)

Nom de la tâche

N3: HHH Networking Activities

All Work Packages

WP1 Accelerator Magnet Technology (AMT)

Coordinate conductor development and tests

Development of Web based database for SC Cables and Magnets

Codes and models for design, stability and protection studies for AMT1 and AMT4

Comparison of different IR options (AMT4) and steering of LARP magnet developments

MS: AMT workshop on Coil Insulation & Impregnation Techniques (THERMOMAG)

Studies of pulsed SC magnets for GSI and LHC injectors

Comparative studies of alternatives using low field magnets for AMT2 and AMT3

MS: AMT workshop on HF magnets

Determination of scaling law for magnet and cryogenic cost for AMT5

MS: Preliminary report on scaling law for magnet and cryogenic cost (roadmap)

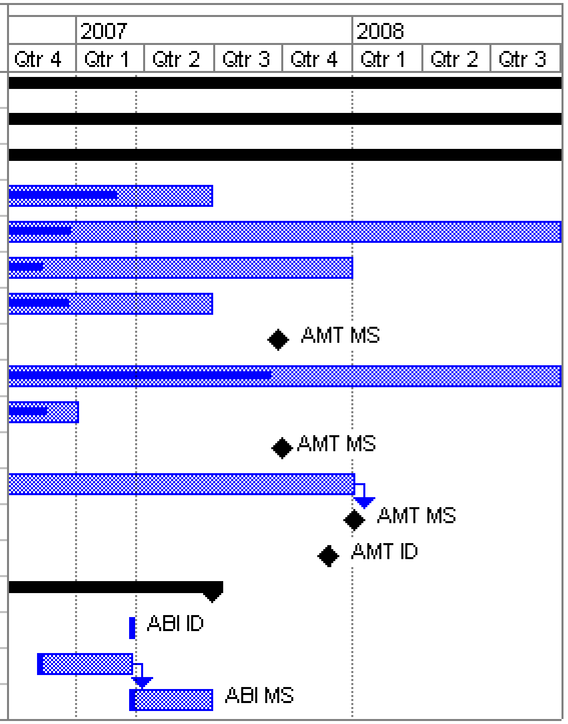
ID: Interim report on AMT activities and reporting at the general CARE meeting

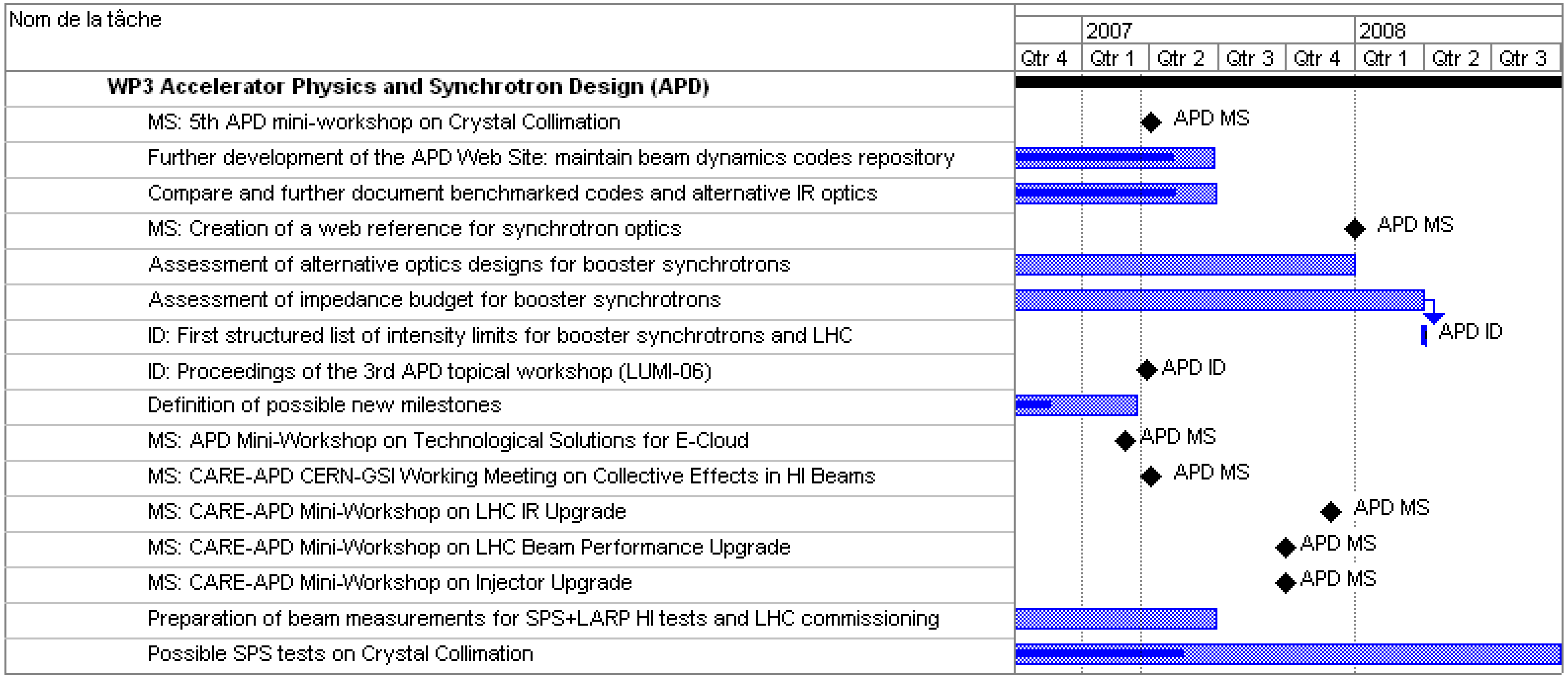
WP2 Accelerator Beam Instrumentation (ABI)

ID: Proceedings of the 4th ABI topical workshop

Definition of possible new milestones

Contribution to beam measurements and preparation for LHC commissioning

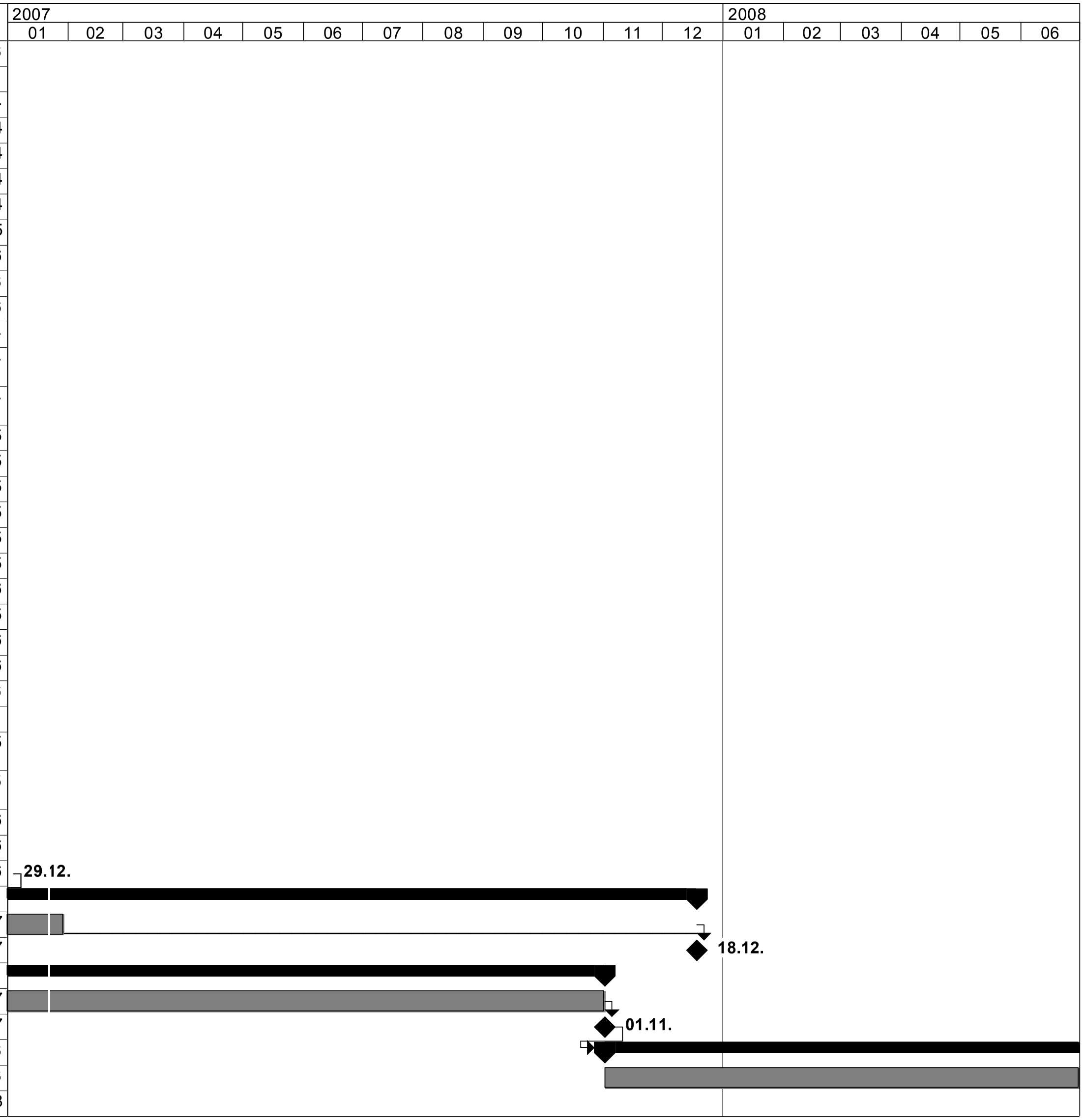



Nom de la tâche
2007
2008
Qtr 4
Qtr 1
Qtr 2
Qtr 3
Qtr 4
Qtr 1
Qtr 2
Qtr 3
WP3 Accelerator Physics and Synchrotron Design (APD)
MS: 5th APD mini-workshop on Crystal Collimation
APD MS
Further development of the APD Web Site: maintain beam dynamics codes repository
Compare and further document benchmarked codes and alternative IR optics
MS: Creation of a web reference for synchrotron optics
APD MS
Assessment of alternative optics designs for booster synchrotrons
Assessment of impedance budget for booster synchrotrons
ID: First structured list of intensity limits for booster synchrotrons and LHC
APD ID
ID: Proceedings of the 3rd APD topical workshop (LUMI-06)
APD ID
Definition of possible new milestones
MS: APD Mini-Workshop on Technological Solutions for E-Cloud
APD MS
MS: CARE-APD CERN-GSI Working Meeting on Collective Effects in HI Beams
APD MS
MS: CARE-APD Mini-Workshop on LHC IR Upgrade
APD MS
MS: CARE-APD Mini-Workshop on LHC Beam Performance Upgrade
APD MS
MS: CARE-APD Mini-Workshop on Injector Upgrade
APD MS
Preparation of beam measurements for SPS+LARP HI tests and LHC commissioning
Possible SPS tests on Crystal Collimation

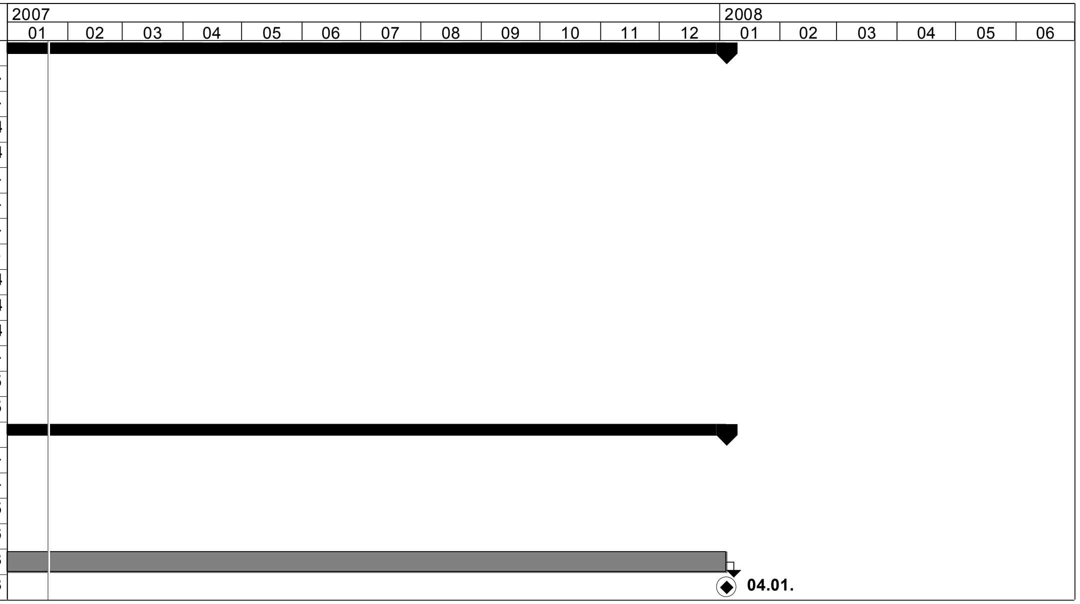
JOINT RESEARCH ACTIVITIES

JRA1: Superconducting Radio Frequency (SRF)

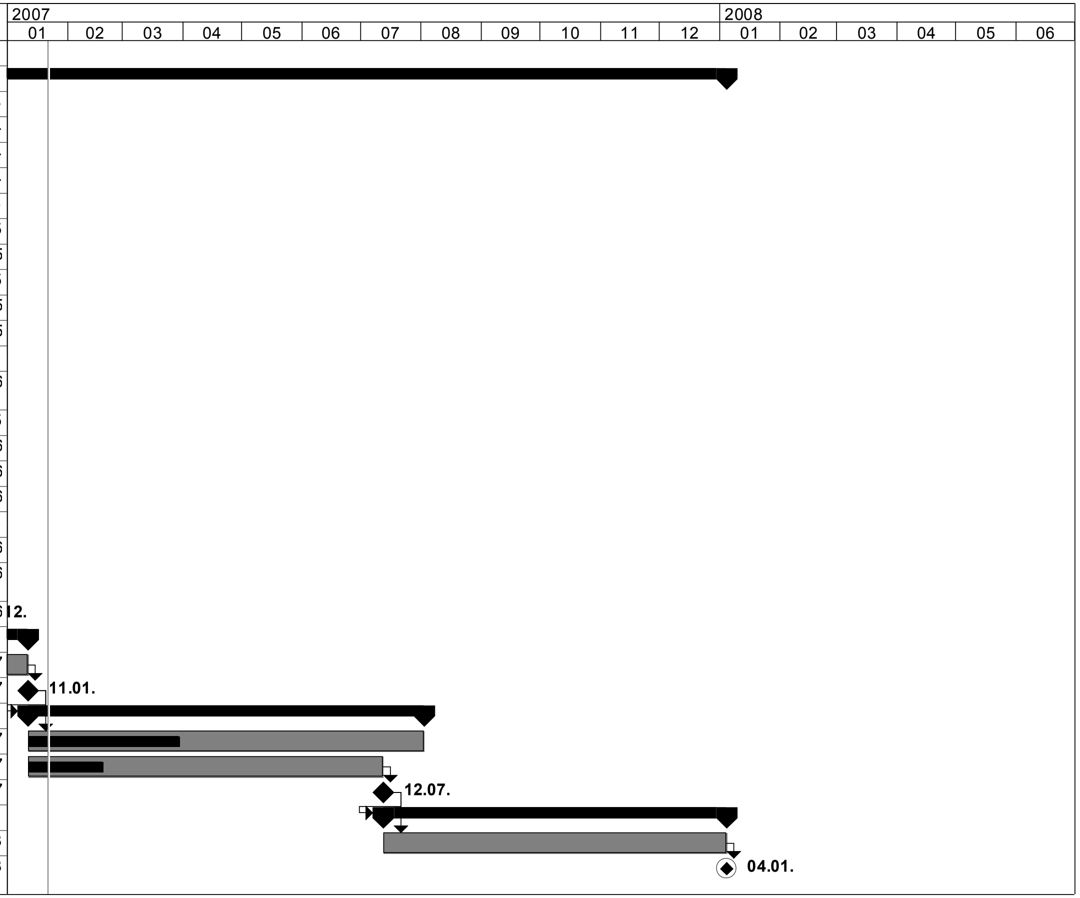
N°	Task Name	Ende
2	**WP 2 IMPROVED STANDARD CAVITY FABRICATION**	**Mi 17.12.08**
2.1	**Reliability Analysis**	**Fr 29.09.06**
2.1.1	Review of data bank: cavity fabrication	Fr 13.02.04
2.1.2	Review of data bank :cavity treatment	Di 30.03.04
2.1.3	Review of data bank: cavity VT performance	Do 13.05.04
2.1.4	Review of data bank: string assembly	Do 05.08.04
2.1.5	Review of data bank: string performance	Do 28.10.04
2.1.6	Establish correlations	Do 10.02.05
2.1.7	**Final report on reliability issue**	Fr 29.09.06
2.2	**Improved component design**	**Mi 17.12.08**
2.2.1	**Documentation retrieving**	**Mo 31.07.06**
2.2.1.1	Start up meetings	Mo 09.02.04
2.2.1.2	Access and study of Jlab, DESY, LLAN, KEK experience	Mi 13.10.04
2.2.1.3	**Summary report on the status of the art on ancillaries**	Mi 13.10.04
2.2.1.4	Sealing material and shape design	Fr 29.07.05
2.2.1.5	Flange preliminary design	Fr 24.06.05
2.2.1.6	Material and geometric compatibility	Fr 02.09.05
2.2.1.7	Final assembly design	Fr 09.09.05
2.2.1.8	End plate preliminary design	Fr 09.09.05
2.2.1.9	**Report about new design for components**	Fr 16.09.05
2.2.1.10	Stiffness optimization	Fr 10.02.06
2.2.1.11	Manufacturing procedure analysis	Fr 22.07.05
2.2.1.12	Final assembly design	Fr 17.02.06
2.2.1.13	Other ancillaries design	Fr 24.02.06
2.2.1.14	**Final Report for new components**	Mo 31.07.06
2.2.2	**Review of criticality in welding procedures**	**Fr 29.12.06**
2.2.2.1	Review of available parameters on vendor welding machine	Fr 21.10.05
2.2.2.2	Definition of prototype requirements for tests	Mo 11.07.05
2.2.2.3	Welding test on specimens	Fr 24.02.06
2.2.2.4	Analysis of the results	Fr 11.08.06
2.2.2.5	**Report about welding parameters**	Fr 29.12.06
2.2.3	**Finalize new component design**	**Di 18.12.07**
2.2.3.1	Do drawings	Di 18.12.07
2.2.3.2	**New components design finished**	Di 18.12.07
2.2.4	**Finalize new cavity design**	**Do 01.11.07**
2.2.4.1	Make drawings	Do 01.11.07
2.2.4.2	**New cavity design finished**	Do 01.11.07
2.2.5	**Fabrication of new cavity**	**Mi 17.12.08**
2.2.5.1	Fabrication	Mi 17.12.08
2.2.5.2	New cavity finished	Do 11.09.08



N°	Task Name	Ende
2.3	**EB welding**	**Fr 04.01.08**
2.3.1	**Design tooling**	**Mi 15.12.04**
2.3.1.1	Tools for flange welding	Fr 20.02.04
2.3.1.2	Tools for pipe welding	Di 13.04.04
2.3.1.3	Tools for stiffening rings	Do 03.06.04
2.3.1.4	Tools for single cell welding	Mo 23.08.04
2.3.1.5	Tools for 9-cells	Mi 15.12.04
2.3.1.6	**Tools design finished**	Mi 15.12.04
2.3.2	**Tools production**	**Fr 11.03.05**
2.3.2.1	Tools for flange welding	Di 30.03.04
2.3.2.2	Tools for pipe welding	Do 13.05.04
2.3.2.3	Tools for stiffening rings	Do 15.07.04
2.3.2.4	Tools for single cell welding	Mi 27.10.04
2.3.2.5	Tools for 9-cells	Fr 11.03.05
2.3.2.6	**Tools fabrication finished**	Fr 11.03.05
2.3.3	**Welding**	**Fr 04.01.08**
2.3.3.1	Commissioning welding machine	Fr 16.04.04
2.3.3.2	Test welding	Fr 03.09.04
2.3.3.3	**Start production welding of components**	Fr 11.03.05
2.3.3.4	Single cell welding	Fr 24.11.06
2.3.3.5	Multicell welding	Fr 04.01.08
2.3.3.6	**Welding of prototypes of components finished**	Fr 04.01.08

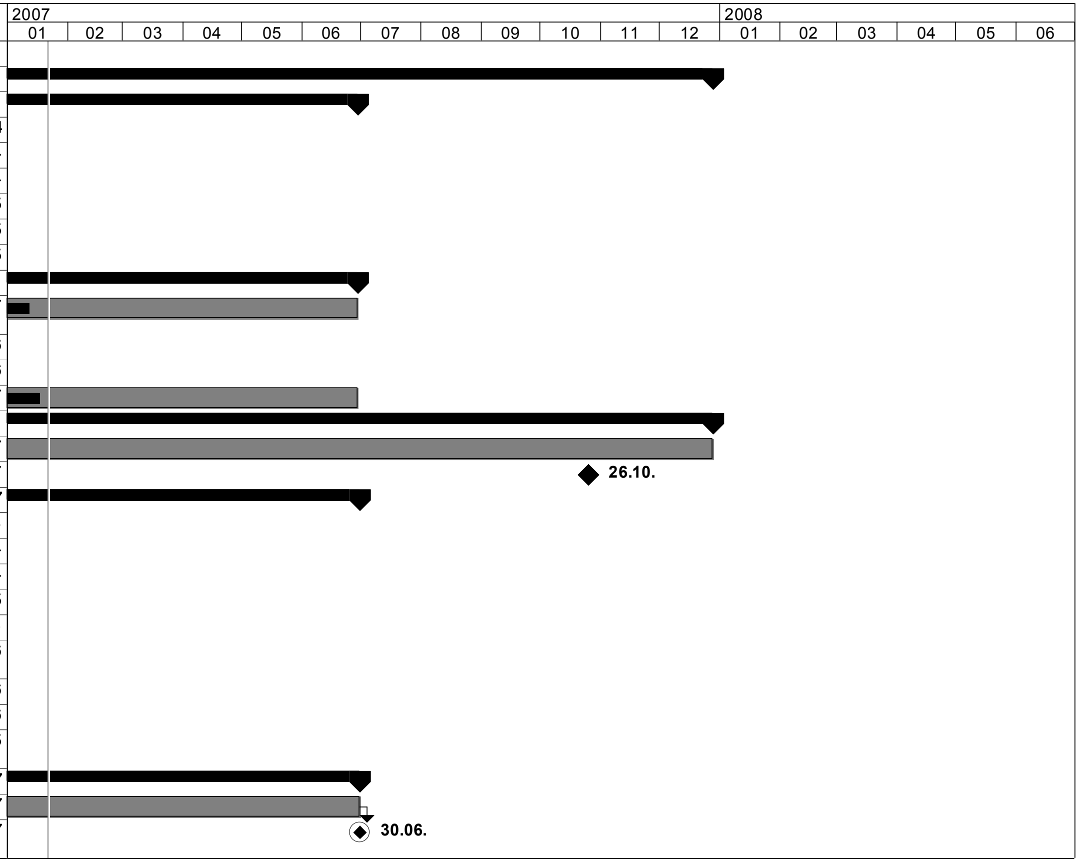


N°	Task Name	Ende
3	**WP3 SEAMLESS CAVITY PRODUCTION**	**Fr 04.01.08**
3.1	**Seamless by spinning**	**Fr 04.01.08**
3.1.1	**Design spinning machine**	**Fr 17.09.04**
3.1.1.1	Drawings of the matrices	Fr 16.04.04
3.1.1.2	Drawings of the support system	Fr 17.09.04
3.1.1.3	**Drawings of spinning machine finished**	Fr 17.09.04
3.1.2	**Fabrication of spinning machine**	**Do 10.11.05**
3.1.2.1	Fabrication of machine parts	Fr 29.04.05
3.1.2.2	Software for the machine	Do 31.03.05
3.1.2.3	Assembly of machine	Fr 29.07.05
3.1.2.4	Commissioning of the machine	Do 10.11.05
3.1.2.5	**Spinning machine ready**	Do 10.11.05
3.1.3	**Evaluation of spinning parameters**	**Do 18.05.06**
3.1.3.1	Drawings of the support system and turning mechanism	Do 26.01.06
3.1.3.2	Drawings of the necking mechanism	Fr 26.08.05
3.1.3.3	Fabrication of the tube necking machine	Do 23.03.06
3.1.3.4	Commissioning of the machine	Do 18.05.06
3.1.3.5	**Spinning parameters defined**	Do 18.05.06
3.1.4	**Spinning of 1-celll cavities**	**Do 07.12.06**
3.1.4.1	Material and fabrication of bulk Nb test tubes	Do 07.09.06
3.1.4.2	Material and fabrication of bimetallic NbCu test tubes	Do 07.12.06
3.1.4.3	**1-cell spinning parameters defined**	Do 07.12.06
3.1.5	**Extension of spinning apparatus to multicells**	**Do 11.01.07**
3.1.5.1	Computer simulation of the necking	Do 11.01.07
3.1.5.2	**Start of Multi-cell spinning**	Do 11.01.07
3.1.6	**Spinning of multi-cell cavities cavities**	**Do 02.08.07**
3.1.6.1	Computer simulation of the spinning	Do 02.08.07
3.1.6.2	Spinning of bulk Nb 9-cell cavities	Do 12.07.07
3.1.6.3	**Parameters of multi-cell spinning defined**	Do 12.07.07
3.1.7	**Series production of multi-cell cavities**	**Fr 04.01.08**
3.1.7.1	Spinning	Fr 04.01.08
3.1.7.2	**Multi-cell cavities finished**	Fr 04.01.08

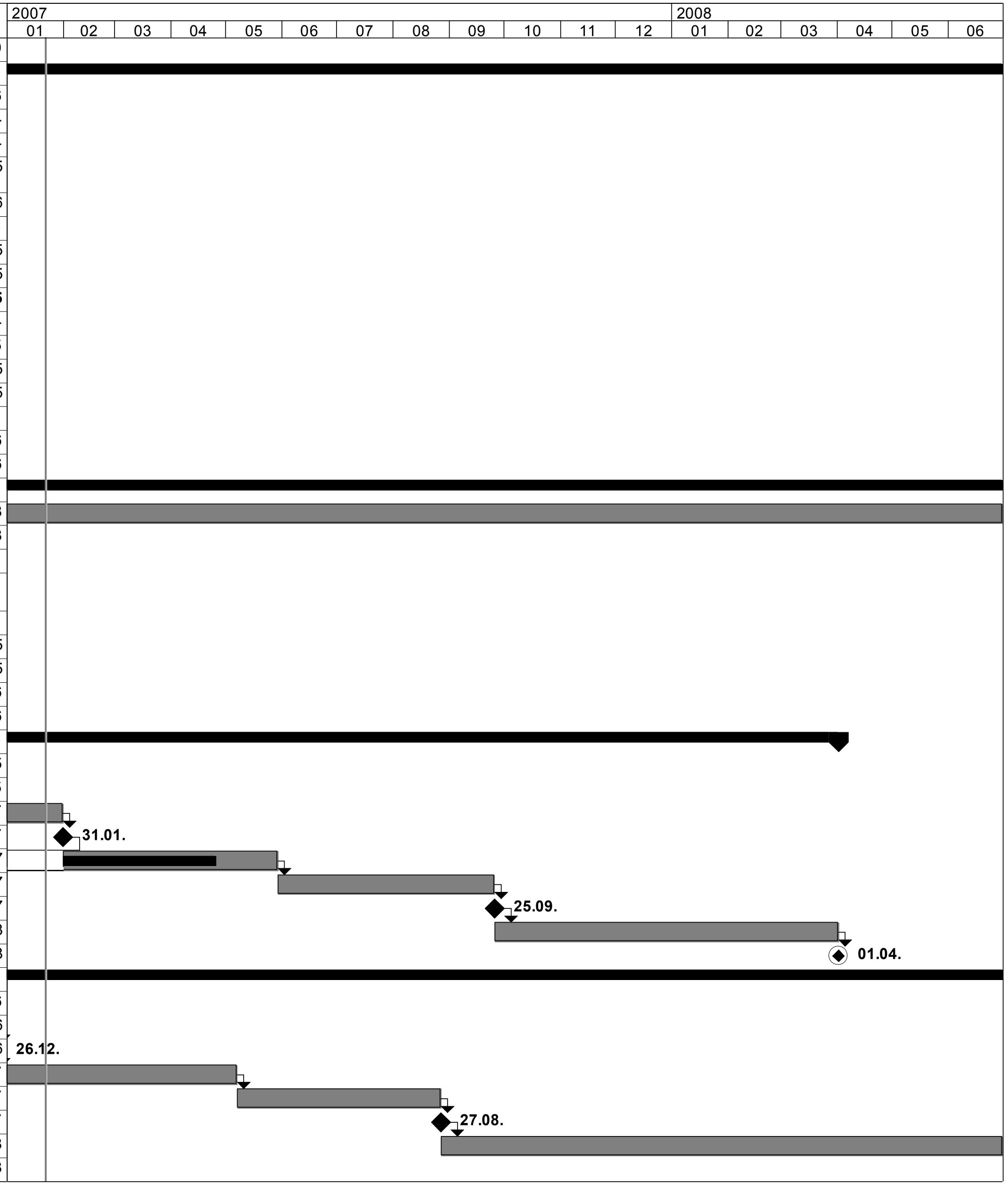


N°	Task Name	Ende
3.2	**Seamless by hydroforming**	**Fr 16.11.07**
3.2.1	**Design hydro forming machine**	**Fr 17.09.04**
3.2.1.1	Drawings of the matrices	Fr 17.09.04
3.2.1.2	Drawings of the support system	Fr 17.09.04
3.2.1.3	**Drawings matrix & support finished**	Fr 17.09.04
3.2.2	**Construction of hydro forming machine**	**Fr 01.07.05**
3.2.2.1	Hydraulic for machine	Mi 14.07.04
3.2.2.2	Software for the machine	Fr 17.09.04
3.2.2.3	Machine fabrication	Mo 21.03.05
3.2.2.4	Commissioning of the machine	Fr 01.07.05
3.2.2.5	**Hydro forming machine ready**	Fr 01.07.05
3.2.3	**Construction of tube necking machine**	**Do 24.02.05**
3.2.3.1	Drawings of the support system and turning mechanism	Fr 27.08.04
3.2.3.2	Drawings of the necking mechanism	Fr 27.08.04
3.2.3.3	Fabrication of the tube necking machine	Do 24.02.05
3.2.3.4	Software for the tube necking machine	Do 30.12.04
3.2.3.5	**Construction tube necking machine finished**	Do 24.02.05
3.2.4	**Development of seamless tubes for 9-cell cavities**	**Fr 01.07.05**
3.2.4.1	Material and fabrication of bulk Nb test tubes	Fr 01.07.05
3.2.4.2	Material and fabrication of bimetallic NbCu test tubes	Fr 01.07.05
3.2.4.3	**Seamless tubes ready**	Fr 01.07.05
3.2.5	**Development of tube necking**	**Fr 15.12.06**
3.2.5.1	Computer simulation of the necking	Fr 30.06.06
3.2.5.2	Experiments on tube necking at iris	Fr 15.12.06
3.2.5.3	**Tube necking machine operational**	Fr 15.12.06
3.2.6	**Hydro forming of seamless cavities**	**Fr 16.11.07**
3.2.6.1	Computer simulation of the hydro forming	Fr 24.11.06
3.2.6.2	Hydro forming of bulk Nb 9-cell cavities	Fr 16.11.07
3.2.6.3	**Hydro formed 9-cell cavities ready**	Fr 16.11.07

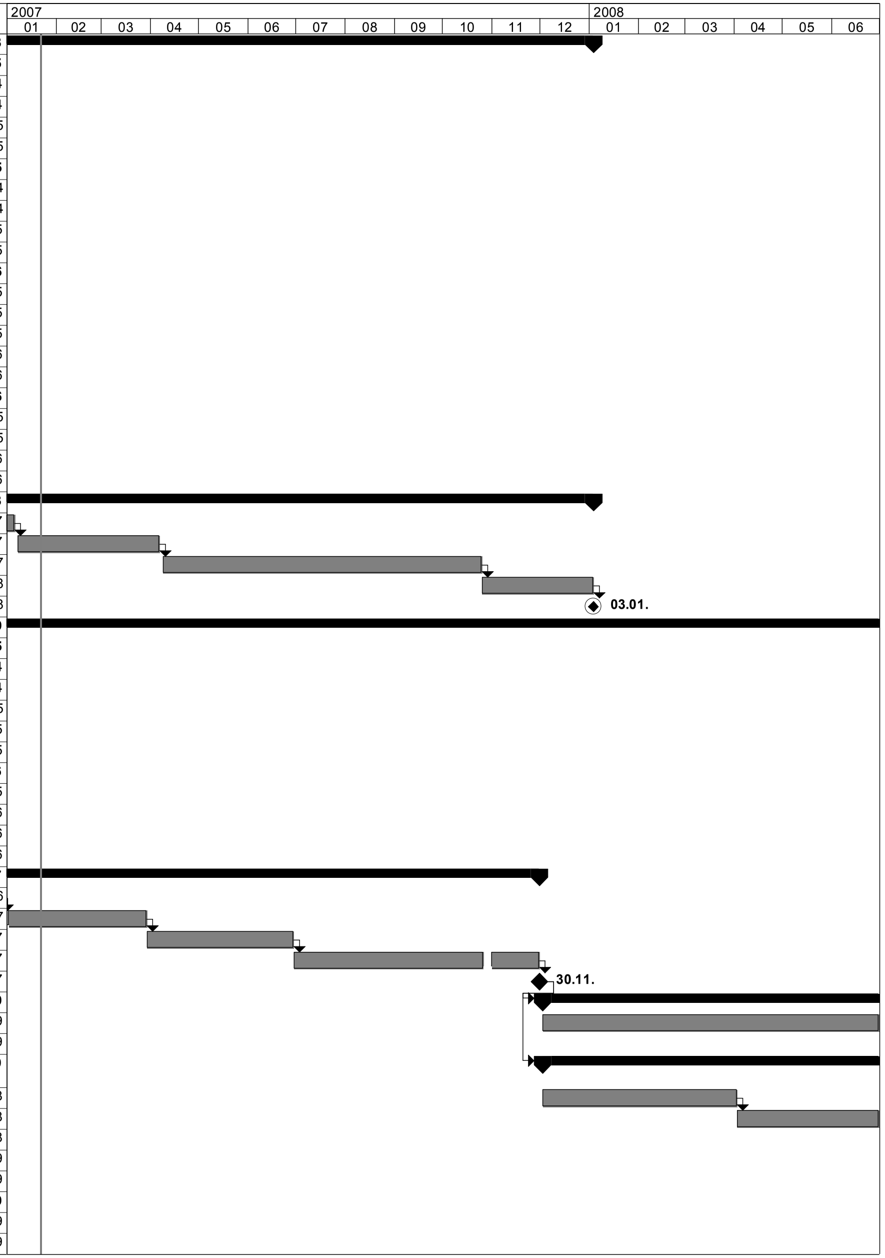
N°	Task Name	Ende
4	**WP4 THIN FILM CAVITY PRODUCTION**	**Fr 28.12.07**
4.1	**Linear-arc cathode coating**	**Fr 28.12.07**
4.1.1	**Installation & commissioning of coating apparatus**	**Fr 29.06.07**
4.1.1.1	Modification of a prototype facility for single cells	Di 14.09.04
4.1.1.2	Optimization of a triggering system	Mo 11.10.04
4.1.1.3	**Prototype facility ready**	Mo 11.10.04
4.1.1.4	Study of arc current reduction and stabilization	Mo 07.02.05
4.1.1.5	Optimization of pow ering system	Mo 14.03.05
4.1.1.6	**Coating apparatus operational**	Mo 14.03.05
4.1.1.7	**Coating single cells**	**Fr 29.06.07**
4.1.1.7.1	Coating of single cells w ithout micro droplet filtering	Fr 29.06.07
4.1.1.7.2	Design and construction of a micro droplet filter sys	Fr 30.06.06
4.1.1.7.3	**Droplet filter ready**	Fr 30.06.06
4.1.1.7.4	Coating of single cell w ith micro droplet filtering	Fr 29.06.07
4.1.2	**Coating multi-cell**	**Fr 28.12.07**
4.1.2.1	Design and commissioning	Fr 28.12.07
4.1.2.2	First multicell coating	Fr 26.10.07
4.2	**Planar-arc cathode coating**	**Sa 30.06.07**
4.2.1	**Modification of a planar-arc & trigger system**	**Fr 27.05.05**
4.2.1.1	Modification	Fr 16.04.04
4.2.1.2	Optimization of the laser triggering system	Fr 03.09.04
4.2.1.3	**Planar arc system fully tested**	Fr 27.05.05
4.2.2	**Routine Operation of planar arc system**	**Fr 30.06.06**
4.2.2.1	Characterization of samples coated at different conditions	Fr 30.06.06
4.2.2.2	Characterization of Nb-coated sapphire samples	Fr 30.06.06
4.2.2.3	Characterization of Nb-coated copper samples	Fr 30.06.06
4.2.2.4	**Summary report on quality of planar arc coating**	Fr 27.05.05
4.2.3	**Studies of other HTC superconducting coating**	**Sa 30.06.07**
4.2.3.1	Study of superconducting properties	Sa 30.06.07
4.2.3.2	**Report on quality of superconducting properties**	Sa 30.06.07



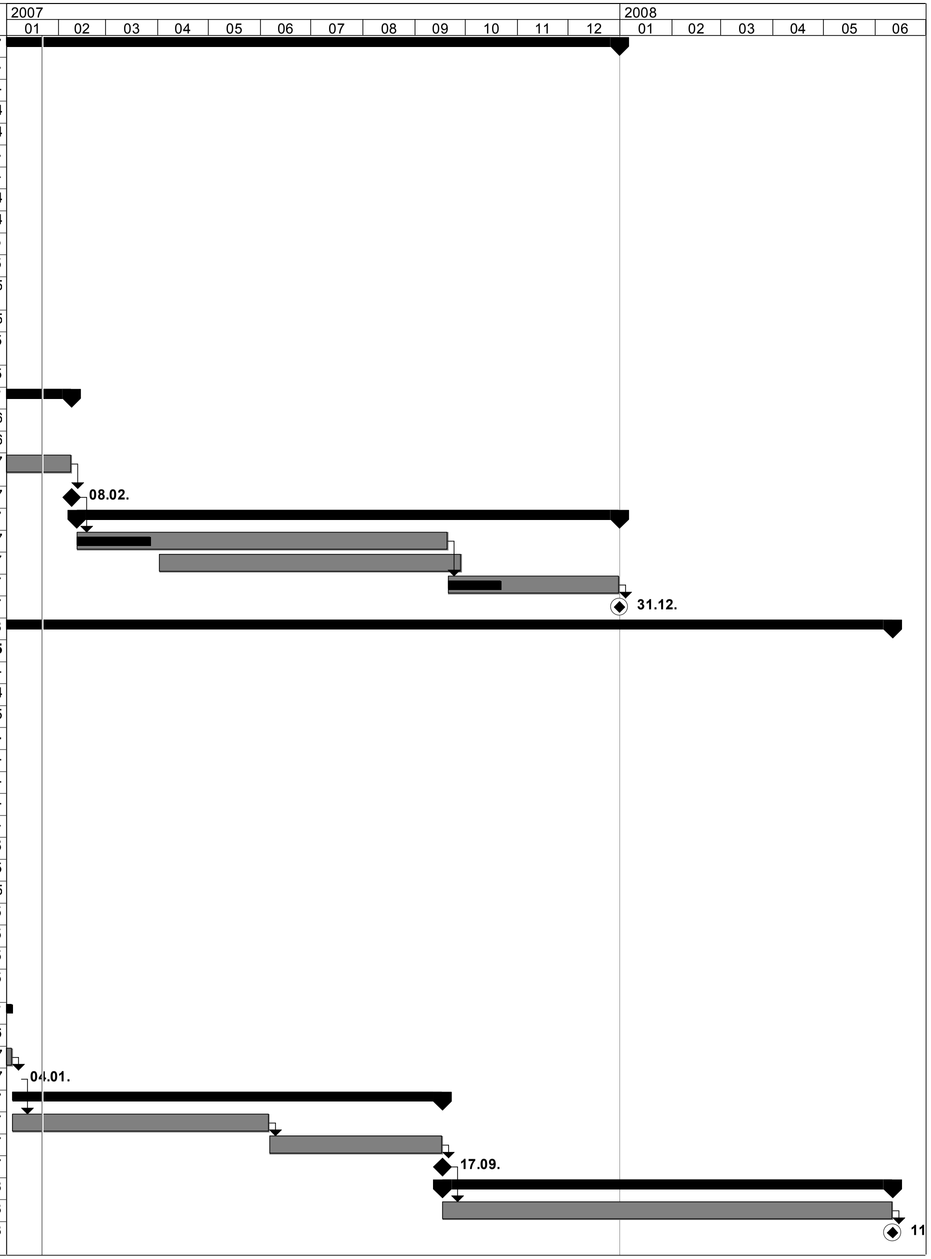
N°	Task Name	Ende
5	**WP5 SURFACE PREPARATION**	**Mi 30.12.09**
5.1	**EP on single cells**	**Fr 29.08.08**
5.1.1	**EP on samples**	**So 15.01.06**
5.1.1.1	Establishing method of surface characterization	Fr 28.05.04
5.1.1.2	**Surface characterization fixed**	Fr 28.05.04
5.1.1.3	Series of EP with samples for surface investigations	Do 31.03.05
5.1.1.4	**Best EP parameters**	So 15.01.06
5.1.2	**Single cell cavities**	**Do 31.03.05**
5.1.2.1	Order Nb and fabricate 3 cavities	Do 31.03.05
5.1.2.2	**3 cavities fabricated**	Do 31.03.05
5.1.3	**Build EP chemistry for single cells**	**Sa 31.12.05**
5.1.3.1	Design of EP set-up	Fr 27.02.04
5.1.3.2	Fabrication of EP set-up	Mo 28.02.05
5.1.3.3	Commissioning of EP set-up	Sa 31.12.05
5.1.3.4	**First operation of EP set-up**	Sa 31.12.05
5.1.4	**Operation of single cell EP**	**Fr 09.06.06**
5.1.4.1	Continous single cell operation	Fr 09.06.06
5.1.4.2	**Define working parameters for single cells**	Fr 09.06.06
5.1.5	**Continuous operation, search for best parameters**	**Fr 29.08.08**
5.1.5.1	Parametrising EP procedure	Fr 29.08.08
5.1.5.2	**EP parameters fixed**	Fr 29.08.08
5.2	**EP on multi-cells**	**Fr 19.09.08**
5.2.1	**Transfer of parameters from 1 cell to multi cell equipment**	**Do 30.11.06**
5.2.2	**Laser roughness**	**Fr 20.01.06**
5.2.2.1	Evaluate existing systems	Do 05.05.05
5.2.2.2	Specify laser system	Do 08.09.05
5.2.2.3	Built laser system	Fr 20.01.06
5.2.2.4	**Roughness measurement finished**	Fr 20.01.06
5.2.3	**Oxipolishing as final chemical cleaning**	**Di 01.04.08**
5.2.3.1	Laboratory studies	Fr 22.04.05
5.2.3.2	Design of OP system	Mi 18.05.05
5.2.3.3	Setup one-cell system	Mi 31.01.07
5.2.3.4	**Proof-of-Principle experiment Oxipolishing**	Mi 31.01.07
5.2.3.5	Design OP for nine-cells	Di 29.05.07
5.2.3.6	Build OP for 9-cells	Di 25.09.07
5.2.3.7	**OP for 9-cells ready**	Di 25.09.07
5.2.3.8	Study op with 9-cell cavities	Di 01.04.08
5.2.3.9	Evaluate experiments	Di 01.04.08
5.2.4	**Transfer Electropolishing technology to industry**	**Fr 19.09.08**
5.2.4.1	Qualify industry with one-cells	Fr 02.06.06
5.2.4.2	Industrial design study on setup for multi-cells	Di 26.12.06
5.2.4.3	**Report on industrial design**	Di 26.12.06
5.2.4.4	Fabricate EP multi-cell industrial prototype	Mo 07.05.07
5.2.4.5	Commission EP multi-cell industrial prototype	Mo 27.08.07
5.2.4.6	**EP multi-cell industrial prototype ready**	Mo 27.08.07
5.2.4.7	Operate EP multi-cell industrial prototype	Fr 19.09.08
5.2.4.8	**Final report on industrial EP**	Fr 19.09.08



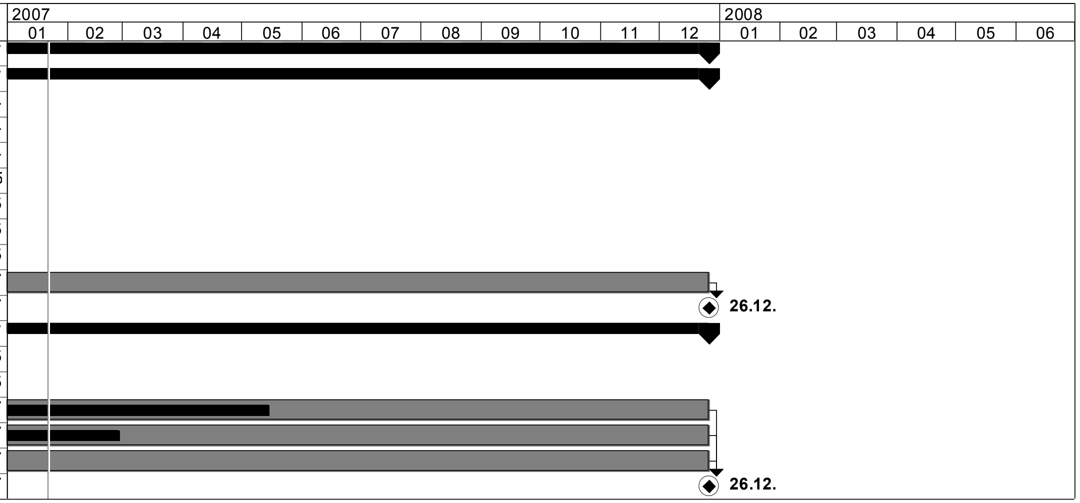
N°	Task Name	Ende
5.3	**Automated EP (AEP)**	**Do 03.01.08**
5.3.1	**Prototype EP installation**	**Di 08.02.05**
5.3.1.1	Design installation	Fr 05.03.04
5.3.1.2	Fabricate/ order components	Fr 02.07.04
5.3.1.3	Assemble EP installation	Di 08.02.05
5.3.1.4	**First operation of automated EP**	Di 08.02.05
5.3.2	**EP computer control**	**Mo 21.02.05**
5.3.2.1	Design control architecture	Di 27.04.04
5.3.2.2	Developed software	Di 10.08.04
5.3.2.3	Test of software	Mo 21.02.05
5.3.2.4	**Software ready**	Mo 21.02.05
5.3.3	**Operation of AEP prototype**	**Mo 13.02.06**
5.3.3.1	Correlate surface finish/ conductance	Mo 13.06.05
5.3.3.2	Determine optimum conductance	Mi 14.09.05
5.3.3.3	Optimize automated operation	Fr 02.12.05
5.3.3.4	Design report on AEP	Mo 13.02.06
5.3.3.5	**Automated EP is defined**	Mo 13.02.06
5.3.4	**Alternative electrolytes**	**Mo 30.10.06**
5.3.4.1	Review of EP chemistry	Di 24.05.05
5.3.4.2	**Proposal for alternative electrolytes**	Di 24.05.05
5.3.4.3	Experiments with alternative electrolytes	Mo 30.10.06
5.3.4.4	**Conclude experimental results**	Mo 30.10.06
5.3.5	**Define best AEP**	**Do 03.01.08**
5.3.5.1	Compare standard/new electrolyte method	Fr 05.01.07
5.3.5.2	Modify AEP installation for best electrolyte	Fr 06.04.07
5.3.5.3	Operate modified AEP	Do 25.10.07
5.3.5.4	Design report on best AEP	Do 03.01.08
5.3.5.5	**Conclude on best electrolyte**	Do 03.01.08
5.4	**Dry ice cleaning**	**Mi 30.12.09**
5.4.1	**Installation of full system for 1-3 cell cavities**	**Mo 11.04.05**
5.4.1.1	Installation of CO2 piping	Mi 31.03.04
5.4.1.2	Installation of motion system	Mi 30.06.04
5.4.1.3	Installation of control system	Di 08.02.05
5.4.1.4	Commissioning	Mo 11.04.05
5.4.1.5	**Installation finished**	Mo 11.04.05
5.4.2	**Optimization of cleaning parameters**	**Fr 14.07.06**
5.4.2.1	Sample cleaning	Fr 09.09.05
5.4.2.2	1-cell cavity cleaning	Mi 08.02.06
5.4.2.3	Fix best cleaning parameters	Fr 14.07.06
5.4.2.4	**Cleaning parameters fixed**	Fr 14.07.06
5.4.3	**VT 9-cell cleaning apparatus**	**Fr 30.11.07**
5.4.3.1	Design 9-cell apparatus VT	Do 28.12.06
5.4.3.2	Fabricated 9-cell apparatus	Do 29.03.07
5.4.3.3	Installation of 9-cell apparatus	Fr 29.06.07
5.4.3.4	Commissioning of 9-cell apparatus	Fr 30.11.07
5.4.3.5	**VT Cleaning Installation finished**	Fr 30.11.07
5.4.4	**VT Cleaning of 9-cell cavities**	**Mi 30.12.09**
5.4.4.1	Continuous cleaning	Mi 30.12.09
5.4.4.2	**Evaluation of experimental results**	Mi 30.12.09
5.4.5	**Design & construction of H 9-cell cleaning apparatus**	**Fr 03.04.09**
5.4.5.1	Design 9-cell apparatus VT	Mi 02.04.08
5.4.5.2	Fabricated 9-cell apparatus	Mo 04.08.08
5.4.5.3	Installation of 9-cell apparatus	Mo 03.11.08
5.4.5.4	Commissioning of 9-cell apparatus	Fr 03.04.09
5.4.5.5	**Start H 9-cell cleaning**	Fr 03.04.09
5.4.6	**Cleaning of horizontal nine-cell cavity**	**Mi 30.12.09**
5.4.6.1	Continuous cleaning	Mi 30.12.09
5.4.6.2	**Evaluation of experimental results**	Mi 30.12.09



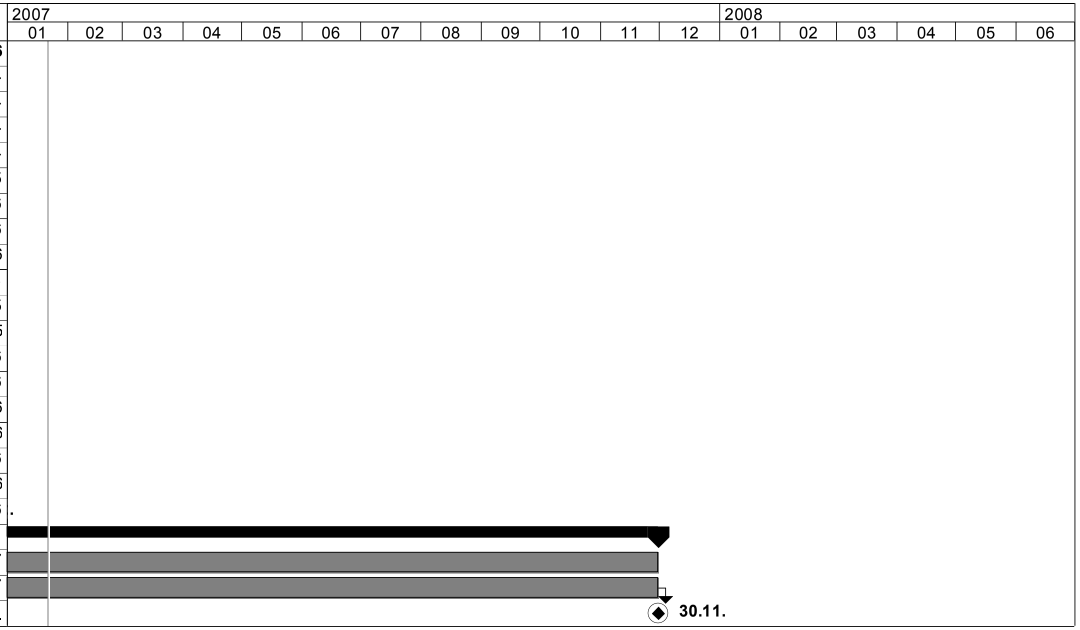
N°	Task Name	Ende
6.1	**SQUID scanning**	**Mo 31.12.07**
6.1.1	**Produce calibration defects**	**Do 12.08.04**
6.1.1.1	Production of surface defects	Fr 18.06.04
6.1.1.2	Production of bulk defects	Do 12.08.04
6.1.1.3	**Calibration defects finished**	Do 12.08.04
6.1.2	**Design components of Squid scanner**	**Di 30.11.04**
6.1.2.1	Design of the scanning table and support	Mi 30.06.04
6.1.2.2	Design of the SQUID cooling system	Di 30.11.04
6.1.2.3	**Design Scanner finished**	Di 30.11.04
6.1.3	**Construction of scanning apparatus**	**Fr 16.12.05**
6.1.3.1	Fabrication of the SQUID	Mi 30.03.05
6.1.3.2	Fabrication and purchase of components for SQUID apparatus	Do 30.06.05
6.1.3.3	Software for the SQUID scanner	Do 30.06.05
6.1.3.4	Commissioning and calibration of scanning apparatus	Fr 16.12.05
6.1.3.5	**Scanning apparatus operational**	Fr 16.12.05
6.1.4	**Scanning of sheets with artificial defects**	**Do 08.02.07**
6.1.4.1	Scanning of sheets with artificial surface defects	Do 01.06.06
6.1.4.2	Scanning of sheets with artificial bulk defects	Do 16.11.06
6.1.4.3	Development of algorithm for material defects classification	Do 08.02.07
6.1.4.4	**Classification of defects finished**	Do 08.02.07
6.1.5	**Scanning of production sheets**	**Mo 31.12.07**
6.1.5.1	Scanning of sheets of different producers	Do 20.09.07
6.1.5.2	Identification of defects by (EDX, SURFA etc.)	Fr 28.09.07
6.1.5.3	Conclusive comparison with eddy current data	Mo 31.12.07
6.1.5.4	**Final report on SQUID scanning**	Mo 31.12.07
6.2	**Flux gate magnetometry**	**Mi 11.06.08**
6.2.1	**Produce calibration defects**	**Sa 01.01.05**
6.2.1.1	Production of surface defects	Fr 07.05.04
6.2.1.2	Production of bulk defects	Do 01.07.04
6.2.1.3	**Calibration defects finished**	Sa 01.01.05
6.2.2	**Design components of flux gate head**	**Mo 20.12.04**
6.2.2.1	Design electronics	Fr 16.04.04
6.2.2.2	Design of flux gate head	Fr 17.12.04
6.2.2.3	Design of operations software	Fr 04.06.04
6.2.2.4	**Design flux gate head finished**	Mo 20.12.04
6.2.3	**Fabrication of flux gate detector**	**Mo 19.12.05**
6.2.3.1	Fabrication of flux gate head	Fr 29.04.05
6.2.3.2	Fabrication of mechanics	Di 12.07.05
6.2.3.3	Implementation of software	Mo 19.09.05
6.2.3.4	Commissioning of flux gate detector	Mo 21.11.05
6.2.3.5	Calibration of flux gate detector	Mo 19.12.05
6.2.3.6	**Flux gate detector operational**	Mo 19.12.05
6.2.4	**Commissioning of flux gate detector**	**Do 04.01.07**
6.2.4.1	Operational tets tests	Fr 21.07.06
6.2.4.2	Evaluation of test results	Do 04.01.07
6.2.4.3	**Flux gate scanner commissioned**	Do 04.01.07
6.2.5	**Operation of flux gate detector**	**Mo 17.09.07**
6.2.5.1	Regular operation	Mi 06.06.07
6.2.5.2	Report of operation	Mo 17.09.07
6.2.5.3	**Conclusion of flux gate scanning operation**	Mo 17.09.07
6.2.6	**Comparison with SQUID scanner**	**Mi 11.06.08**
6.2.6.1	Compare measurements	Mi 11.06.08
6.2.6.2	**Conclude SQUID scanner vs. flux gate detector**	Mi 11.06.08



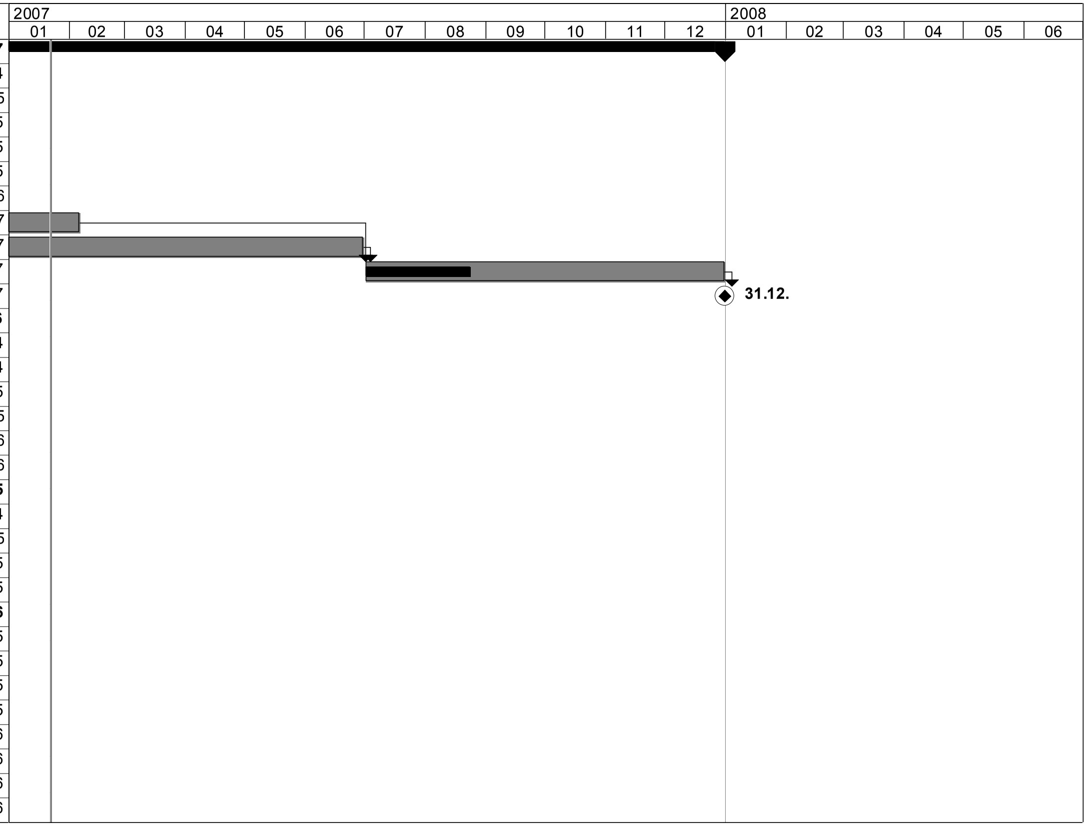
N°	Task Name	Ende
6.3	**DC field emission studies of Nb samples**	**Mi 26.12.07**
6.3.1	**Quality control scans**	**Mi 26.12.07**
6.3.1.1	Modification of Scanning apparatus	Fr 02.04.04
6.3.1.2	Calibration of Scanning apparatus	Fr 04.06.04
6.3.1.3	**Start scanning activity**	Fr 04.06.04
6.3.1.4	BCP and HPR samples	Do 26.05.05
6.3.1.5	EP and HPR samples	Mi 03.08.05
6.3.1.6	BCP/EP and DIC samples	Fr 10.06.05
6.3.1.7	**First report on BCP/EP and DIC surface**	Fr 10.06.05
6.3.1.8	Continue QA scanning	Mi 26.12.07
6.3.1.9	**Evaluation of scanning results**	Mi 26.12.07
6.3.2	**Detailed measurements on strong emitters**	**Mi 26.12.07**
6.3.2.1	Calibrate apparatus for high current	Mi 30.11.05
6.3.2.2	**Start strong emitter evaluation**	Mi 30.11.05
6.3.2.3	I/V curves and current limits	Mi 26.12.07
6.3.2.4	SEM and AES	Mi 26.12.07
6.3.2.5	Influence of heat treatment and ion impact	Mi 26.12.07
6.3.2.6	**Evaluate strong emitter investigations**	Mi 26.12.07



N°	Task Name	Ende
7.1	**New Prototype Coupler**	**Sa 15.07.06**
7.1.1	RF Simulations of Coupler	Mi 30.06.04
7.1.2	Report on Simulation	Mi 30.06.04
7.1.3	Detailed Engineering Drawings	Fr 31.12.04
7.1.4	Engineering complete	Fr 31.12.04
7.1.5	Call for tenders	Fr 01.04.05
7.1.6	Prototype Fabrication in Industry	Mi 31.05.06
7.1.7	Low Power tests	Fr 30.06.06
7.1.8	**Ready for High Power Tests**	Sa 15.07.06
7.2	**Fabrication of TiN Coating System**	**Fr 01.12.06**
7.2.1	Mechanical design of vacuum chamber	Fr 29.04.05
7.2.2	Fabrication drawings	Di 30.08.05
7.2.3	Construction of vacuum chamber	Fr 01.09.06
7.2.4	Define vacuum needs	Fr 30.06.06
7.2.5	Appropriation of vacuum equipment	Sa 30.09.06
7.2.6	Design of electronic circuitry	Do 30.03.06
7.2.7	Fabrication of electronics in industry	Fr 29.09.06
7.2.8	Installation and Test at Orsay	Do 30.11.06
7.2.9	**First Window Coating**	Fr 01.12.06
7.3	**Conditioning Studies of Proto-type Couplers**	**Fr 30.11.07**
7.3.1	Conditioning of couplers	Fr 30.11.07
7.3.2	Evaluate conditioning results	Fr 30.11.07
7.3.3	**Final report on conditioning**	**Fr 30.11.07**



N°	Task Name	Ende
8.1	**UMI TUNER**	**Mo 31.12.07**
8.1.1	Control electronics	Fr 02.07.04
8.1.2	Mechanical tuner design, leverage system/motor	Do 29.09.05
8.1.3	Integration piezo design	Mo 09.05.05
8.1.4	Choice of transducer/actuator	Mi 10.08.05
8.1.5	**Report UMI tuner**	Mi 10.08.05
8.1.6	Tuner fabrication	Di 07.02.06
8.1.7	Piezo fabrication and bench tests	Di 06.02.07
8.1.8	Cavity-tuner-coupler integration	Sa 30.06.07
8.1.9	Pulsed RF tests	Mo 31.12.07
8.1.10	**Evaluation of tuner operation**	Mo 31.12.07
8.2	**Magneto-strictive Tuner**	**Di 31.01.06**
8.2.1	Complete specification	Fr 30.01.04
8.2.2	Conceptual design	Mi 31.03.04
8.2.3	Prototype and performance evaluation	Fr 04.02.05
8.2.4	Finalize tuner and drive electronics design	Do 14.04.05
8.2.5	Test of tuner	Di 31.01.06
8.2.6	**Report on magneto-strictive Tuner**	Di 31.01.06
8.3	**CEA Tuner**	**Mi 01.06.05**
8.3.1	Design Piezo + Tuning System	Fr 18.06.04
8.3.2	Fabrication	Do 31.03.05
8.3.3	Installation RF	Mi 01.06.05
8.3.4	**Start of Integrated Experitments**	Mi 01.06.05
8.4	**IN2P3 Activity**	**Mo 07.08.06**
8.4.1	Characterize actuators/piezo-sensors at low temperature	Mo 21.03.05
8.4.2	Report on actuator/piezo sensor	Mo 21.03.05
8.4.3	Test radiation hardness of piezo tuners	Mo 15.08.05
8.4.4	Report on radiation hardness tests	Mo 15.08.05
8.4.5	Integration of pieco and cold tuner	Mi 12.04.06
8.4.6	Cryostat tests	Fr 21.04.06
8.4.7	Tests w ith pulsed RF	Mo 07.08.06
8.4.8	**Report on IN2P3 tuner activities**	Mo 07.08.06

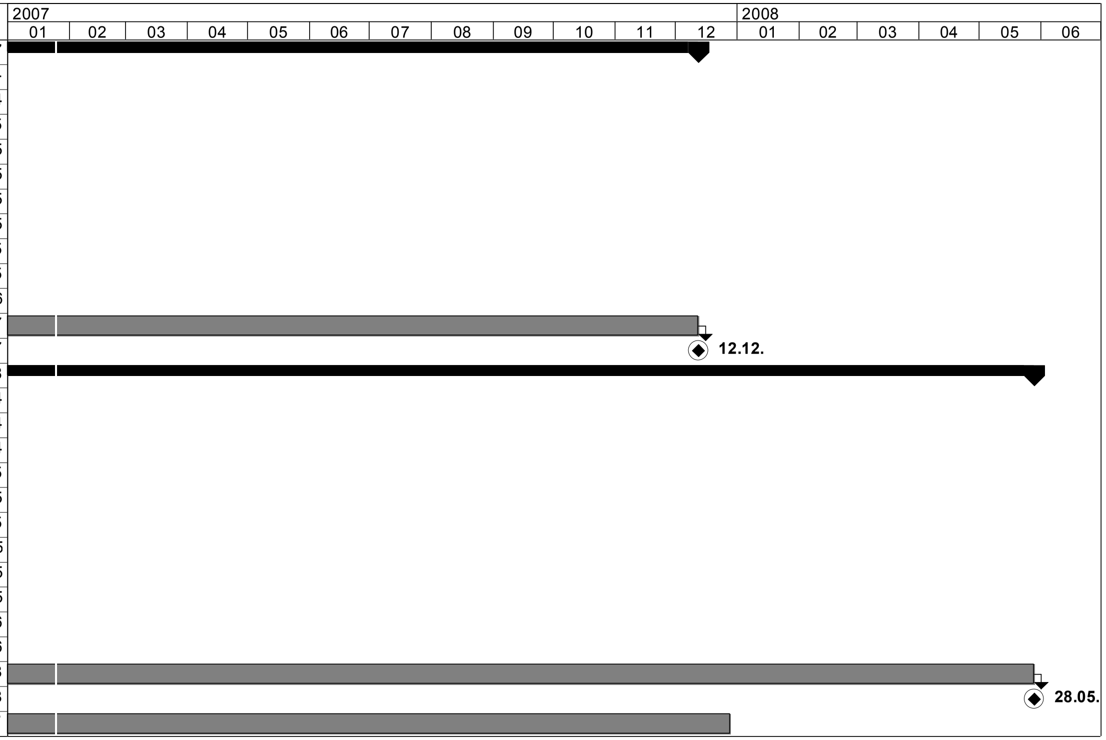


N°	Task Name	Ende	2007												2008					
			01	02	03	04	05	06	07	08	09	10	11	12	01	02	03	04	05	06
9.1	**Operability and technical performance**	**Fr 08.12.06**																		
9.1.1	**Transient detector**	**Fr 08.12.06**																		
9.1.1.1	Define requirements	Fr 30.01.04																		
9.1.1.2	Electronics design	Fr 27.02.04																		
9.1.1.3	Build prototype and evaluate	Fr 30.07.04																		
9.1.1.4	Final design of detector	Fr 01.10.04																		
9.1.1.5	Installation and commissioning	Mi 09.02.05																		
9.1.1.6	Test with beam	Fr 08.12.06																		
9.1.1.7	**Report on transient detector test**	Fr 08.12.06	**12.**																	
9.1.2	**LLRF Automation**	**Fr 23.06.06**																		
9.1.2.1	Dialogue with industrial experts	Fr 27.02.04																		
9.1.2.2	Develop full specification	Fr 26.03.04																		
9.1.2.3	Implement FMS for subsystems	Fr 29.10.04																		
9.1.2.4	Test and evaluation	Mi 23.02.05																		
9.1.2.5	Implement improvements	Di 26.04.05																		
9.1.2.6	Evaluation and acceptance by operators	Fr 23.06.06																		
9.1.2.7	**Report on LLRF atomization design**	Fr 23.06.06																		
9.1.3	**Control optimization**	**Fr 13.10.06**																		
9.1.3.1	Specification of system	Fr 02.04.04																		
9.1.3.2	Conceptual design of controller	Fr 30.04.04																		
9.1.3.3	Performance simulation	Fr 27.08.04																		
9.1.3.4	Implementation in DSP hardware	Mi 02.02.05																		
9.1.3.5	Implementation and tests on TTF	Fr 13.10.06																		
9.1.3.6	**Evaluation of test results**	Fr 13.10.06																		
9.1.4	**Exceptional handling routines**	**Fr 02.12.05**																		
9.1.4.1	Specification	Fr 23.01.04																		
9.1.4.2	Design of exceptional handler	Fr 30.04.04																		
9.1.4.3	Implementation and test on TTF	Fr 02.12.05																		
9.1.4.4	**Report on exceptional handler operation**	Fr 02.12.05																		
9.2	**LLRF cost and reliability study**	**Fr 27.10.06**																		
9.2.1	**Cost and reliability study**	**Fr 29.09.06**																		
9.2.1.1	Identify cost drivers of present LLRF	Fr 27.02.04																		
9.2.1.2	Develop cost reduction ideas	Fr 02.04.04																		
9.2.1.3	Build prototypes and evaluate	Fr 21.01.05																		
9.2.1.4	Final design of LLRF system	Fr 29.09.06																		
9.2.1.5	**Complete design of LLRF system for reduced cost**	Fr 29.09.06																		
9.2.2	**Radiation damage study**	**Fr 27.10.06**																		
9.2.2.1	Identify critical electronics issues	Fr 27.02.04																		
9.2.2.2	Evaluate TESLA radiation	Fr 02.04.04																		
9.2.2.3	Develop tests for components	Fr 28.05.04																		
9.2.2.4	Procure and assembles test set up	Fr 23.07.04																		
9.2.2.5	Data acquisition from radiation tests	Fr 29.10.04																		
9.2.2.6	Analyze results and develop countermeasures	Mi 09.02.05																		
9.2.2.7	Implement countermeasures and verify	Fr 27.10.06																		
9.2.2.8	**Report on radiation damage studies**	Fr 27.10.06																		

N°	Task Name	Ende	2007												2008					
			01	02	03	04	05	06	07	08	09	10	11	12	01	02	03	04	05	06
9.3	**Hardware**	**Mi 01.03.06**																		
9.3.1	**Multichannel downconvertor**	**Mi 26.01.05**																		
9.3.1.1	Study and compare technologies	Fr 27.02.04																		
9.3.1.2	Select optimum PCB design	Fr 23.04.04																		
9.3.1.3	Build prototype and evaluate	Fr 02.07.04																		
9.3.1.4	Finalize multichannel downconverter	Fr 03.09.04																		
9.3.1.5	Determine characteristics	Mi 26.01.05																		
9.3.2	**Third generation RF control**	**Mo 11.04.05**																		
9.3.2.1	Integrate system generator with VHDL	Fr 30.01.04																		
9.3.2.2	Complete specification	Fr 02.04.04																		
9.3.2.3	Demonstrate simulator	Fr 04.06.04																		
9.3.2.4	Final design of RF electronic board	Fr 28.01.05																		
9.3.2.5	Evaluate performance	Mo 11.04.05																		
9.3.3	**Stable frequency distribution**	**Mi 01.03.06**																		
9.3.3.1	Complete specification	Mi 04.02.04																		
9.3.3.2	Concept ional design of frequency	Fr 05.03.04																		
9.3.3.3	Build prototype and evaluate	Fr 06.08.04																		
9.3.3.4	Final design	Fr 22.10.04																		
9.3.3.5	Procurement and assembly of subsystems	Fr 28.01.05																		
9.3.3.6	Installation and commissioning	Fr 18.03.05																		
9.3.3.7	Performance test with beam	Mi 01.03.06																		
9.3.3.8	**Report on new LLRF hardware components**	Mi 01.03.06																		
9.4	**Software**	**Fr 06.10.06**																		
9.4.1	**Data management development**	**Mi 14.09.05**																		
9.4.1.1	Specification	Fr 30.04.04																		
9.4.1.2	Conceptional design with DOOCS	Fr 09.07.04																		
9.4.1.3	Prototype	Fr 10.09.04																		
9.4.1.4	User evaluation	Fr 05.11.04																		
9.4.1.5	Finalize design	Fr 31.12.04																		
9.4.1.6	Implementation in TTF	Mi 14.09.05																		
9.4.1.7	**Report on data management developments**	Mi 14.09.05																		
9.4.2	**RF gun control**	**Fr 06.10.06**																		
9.4.2.1	Write specification	Fr 30.01.04																		
9.4.2.2	Design of controller	Fr 23.04.04																		
9.4.2.3	Procurement and assembly	Fr 27.08.04																		
9.4.2.4	Installation and test	Fr 06.10.06																		
9.4.2.5	**Report on RF gun control tests**	Fr 06.10.06																		

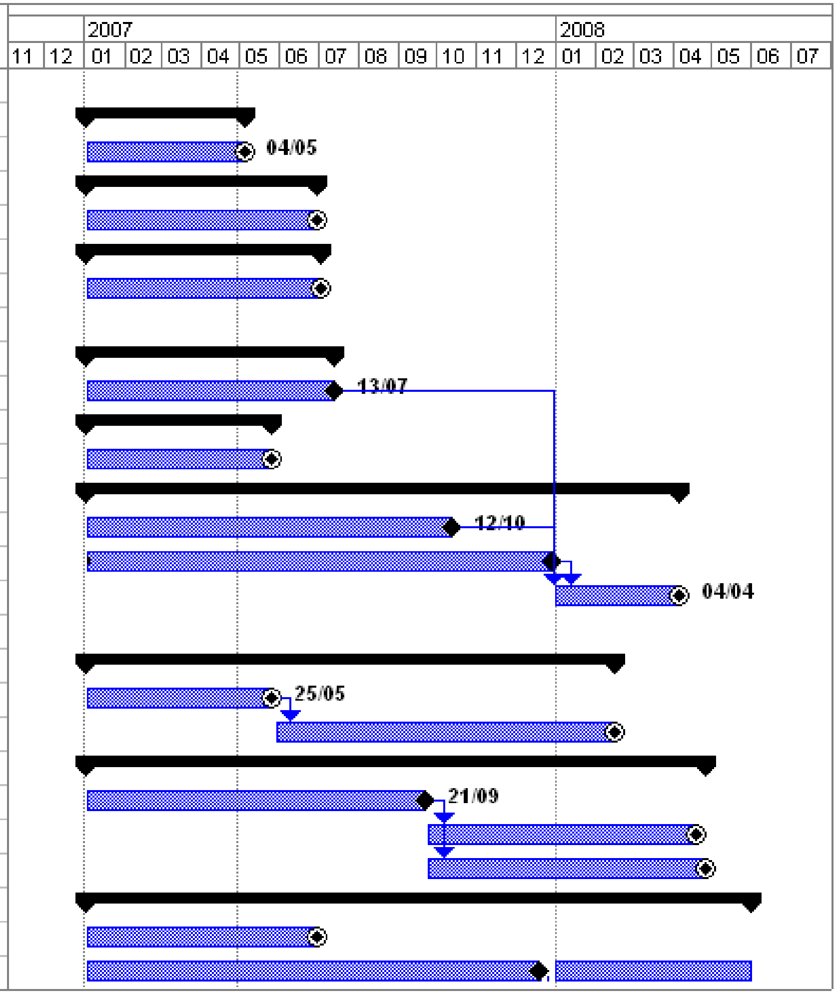
Nr.	PSP-Code	Nom de la tâche	Ende
1	**10**	**WP10 CRYOSTAT INTEGRATION TESTS**	**Mi 18.07.07**
2	**10-1**	**Installation Moving**	**Fr 26.01.07**
3	10-1.2	Vertical cryostats moving	Mo 26.06.06
4	10-1.1	CRYHOLAB - Liquefier - Klystron moving, commissioning	Fr 26.01.07
5	**10-2**	**CRYHOLAB Adaptation to 9 cell**	**Fr 09.09.05**
6	10-2.1	Mechanical adaptations (design-manufacturing-mounting)	Fr 29.10.04
7	10-2.2	Low performance cavity and coupler transfert from DESY & LAL	Di 30.11.04
8	10-2.3	Assembly in Cryholab and Cryogenic test	Fr 28.01.05
9	10-2.4	High performance coupler - High Power Pulsed Test	Fr 02.09.05
10	10-2.5	Magnetic shielding with cryoperm	Fr 09.09.05
11	**10-3**	**Integration tests in cryostat (1st test)**	**Mo 17.04.06**
12	10-3.1	CEA Cold Tunning System + Piezo (Assembly & warm tests)	Fr 07.10.05
13	10-3.4	Installation of 9-cell & coupler - Cooldown	Di 15.11.05
14	10-3.3	Cold test (CTS + NOLIAC) in CryHoLab	Mo 03.04.06
15	10-3.2	Evaluate experimental results	Mo 17.04.06
16	**10-5**	**Integration tests in cryostat (2sd test)**	**Mo 05.06.06**
17	10-5.7	Installation of CTS + Piezo PICMA	Mo 17.04.06
18	10-5.5	Cold test (CTS + PICMA) in CryHoLab	Mo 22.05.06
19	10-5.6	Evaluate experimental results	Mo 05.06.06
20	**10-4**	**Integration tests in cryostat (3rd test)**	**Di 01.05.07**
21	10-4.4	Mechanical adaptation	Fr 26.05.06
22	10-4.3	Installation of CTS + MSM Energen	Fr 09.02.07
23	10-4.1	Cold test (CTS + ENERGEN) in CryHoLab	Di 17.04.07
24	10-4.2	Evaluate experimental results	Di 01.05.07
25	**10-6**	**Integration tests in cryostat (4th test)**	**Mi 18.07.07**
26	10-6.1	New Coupler TTF V from LAL	Mi 04.07.07
27	10-6.2	Evaluate experimental results	Mi 18.07.07

N°	Task Name	Ende
11.1	**Beam position monitor**	**Mi 12.12.07**
11.1.1	**Present BPM installed in TTF module**	Mi 30.06.04
11.1.2	Cryogenic measurements on BPM	Fr 06.08.04
11.1.3	Beam tests of BPM on TTF	Mo 03.10.05
11.1.4	Design of BPM Cavity	Fr 25.03.05
11.1.5	Design of BPM cavity ready	Fr 25.03.05
11.1.6	Fabrication of BPM Cavity	Fr 23.12.05
11.1.7	BMP cavity ready	Fr 23.12.05
11.1.8	Development of new hybrid coupler and electronics	Mo 05.09.05
11.1.9	Design of Digital Signal Processing	Mi 17.08.05
11.1.10	**New BPM ready for Installation**	So 01.01.06
11.1.11	Beam Tests with new BPM	Mi 12.12.07
11.1.12	**Evaluation of BPM operation**	Mi 12.12.07
11.2	**Beam Emittance Monitor**	**Mi 28.05.08**
11.2.1	Slit width simulations	Fr 02.04.04
11.2.2	Slit design	Fr 02.07.04
11.2.3	Optics simulations	Fr 02.07.04
11.2.4	Optics appropriations	Mo 15.08.05
11.2.5	System assembly and tests	Fr 30.09.05
11.2.6	Mechanical assembly at TTF	Mi 02.11.05
11.2.7	Optical assembly at TTF	Do 01.12.05
11.2.8	Integration of controls into TTF	Sa 31.12.05
11.2.9	**Ready for beam test in TTF**	Sa 31.12.05
11.2.10	Beam tests at TTF	Fr 02.06.06
11.2.11	Evaluate first beam test result	Fr 02.06.06
11.2.12	Successive measurements	Mi 28.05.08
11.2.13	**Final evaluation**	Mi 28.05.08
11.3	**HOM BMP Monitor**	**Fr 28.12.07**



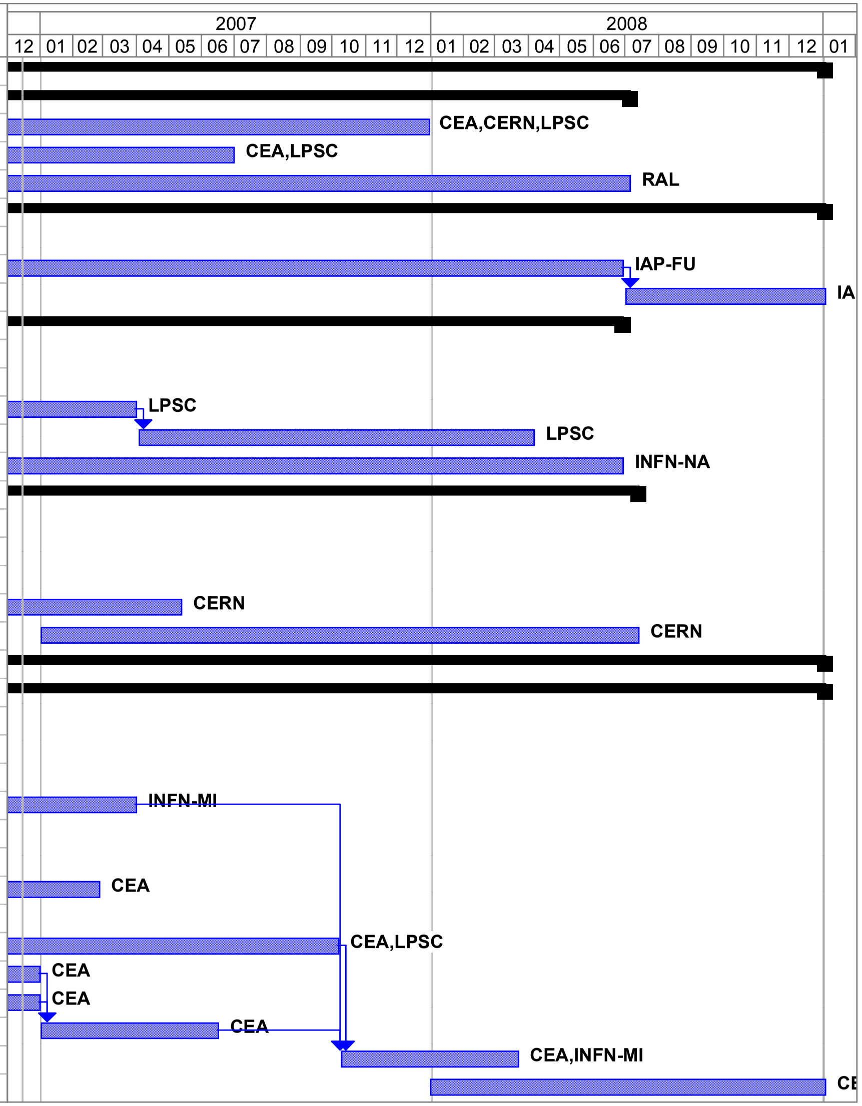
JRA2: Charge Production in Photo-Injector (PHIN)

Task Name	Milestones	Main Deliverables
WP2 Charge Production		
High efficiency photocathode for 3 GHz RF gun		
photocathode 3 GHz high field R&D		**Photocathode ready**
Photocathode for SC cavity		
Photocathodes test		**Final Report**
Laser driven plasma source		
250 MeV laser driven plasma source R&D		
WP3 Laser		
Laser System		
Oscillator + amplifier test		**Final report**
Pulse shaping system		
Pulse shaping comparison		**Pulse shaper ready**
UV generation and Feedbacks		
UV Harmonic generator test		**UV crystals ready**
Laser-RF Feedback development		**Feedback test**
Overall system assembly and tests		**Laser System ready**
WP4 GUN		
SC RF gun		
SC RF gun realisation		**SC RF gun ready**
SC RF gun test		**Final Report**
3 GHz RF gun		
Two 3 GHz RF guns construction		**3 GHz RF guns ready**
CTF3 3GHz RF gun test at CERN		**Final report**
NEPAL 3 GHz RF gun testat Orsay		**Final report**
Spectrometer for e- beam		
1-250 MeV Spectrometer test		**Final report**
0.1-1Gev Spectrometer development	Inter. Report	

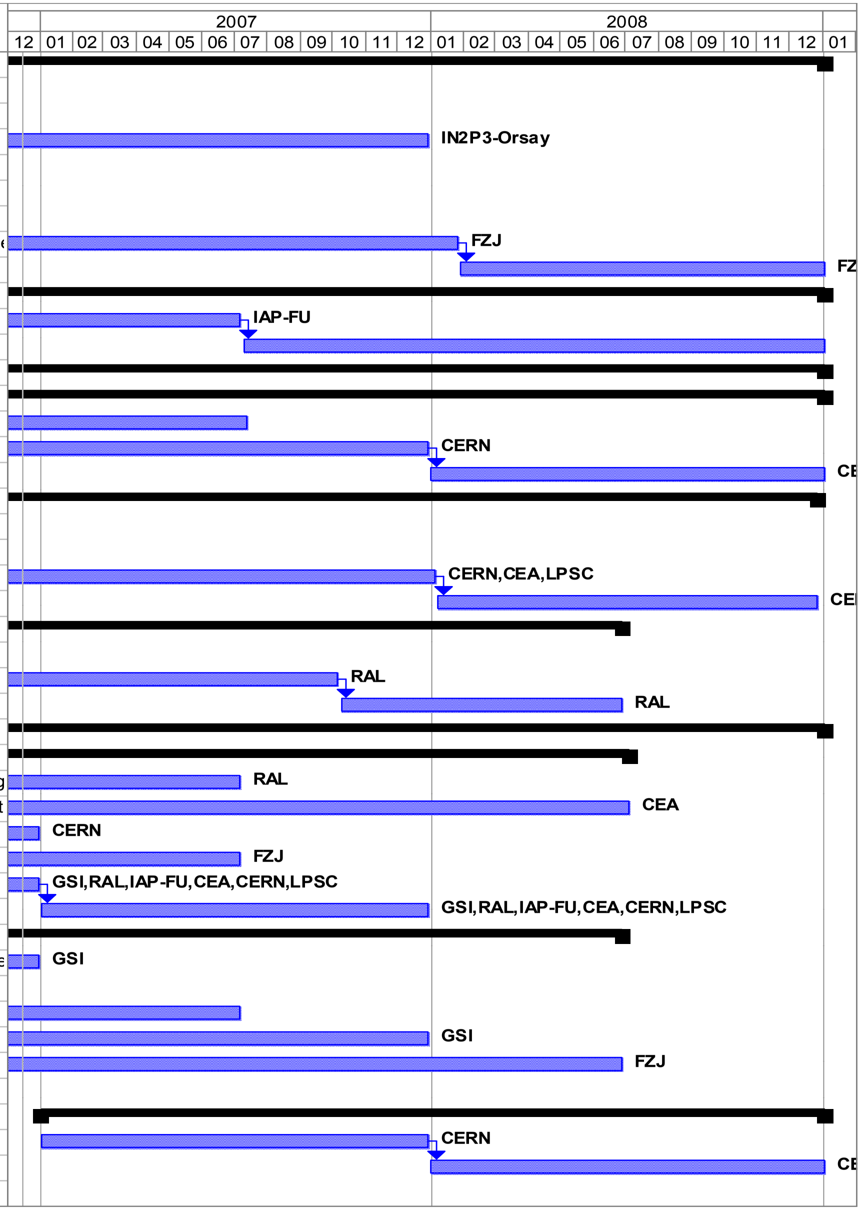


JRA3: High Intensity Proton injector (HIPPI)

ID	Task Name
1	**WP2: NORMAL CONDUCTING STRUCTURES**
2	**2.1 Drift Tube Linac**
3	2.1.1 DTL design
4	2.1.5 DTL coupler prototype construction and testing
5	2.1.4 DTL beam dynamics design
6	**2.2 H-mode Drift Tube Linac**
7	2.2.6 CH-prototype design
8	2.2.7 CH-prototype construction
9	2.2.9 CH-prototype testing
10	**2.3 Side Coupled Linac**
11	2.3.1 RF model RF design
12	2.3.2 RF model mechanical design
13	2.3.3 RF model construction
14	2.3.4 RF model tests
15	2.3.5 SCL module design
16	**2.4 Cell Coupled Drift Tube Linac**
17	2.4.1 Pre-prototype construction
18	2.4.2 Pre-prototype high-power RF tests
19	2.4.3 Contribution to ISTC prototype construction
20	2.4.4 Revision of design after prototype testing
21	2.4.5 Testing of ISTC prototype
22	**WP3: SUPERCONDUCTING STRUCTURES**
23	**3.1 ELLIPTICAL CAVITIES**
24	3.1.2 Tuner design
25	3.1.3 Integration of piezo design
26	3.1.4 Tuner construction
27	3.1.13 Cavity A assembly with tuner
28	3.1.5 Design cavity B
29	3.1.6 Construction cavity B
30	3.1.13 Preparation, vert. test & welding cavity B
31	3.1.7 Power coupler design & engineering
32	3.1.9 RF couplers construction & preparation
33	3.1.8 RF source order & construction
34	3.1.10 Modulator preparation for 700 MHz test stand
35	3.1.11 RF source testing
36	3.1.12 Low power pulsed tests
37	3.1.14 High power pulsed tests

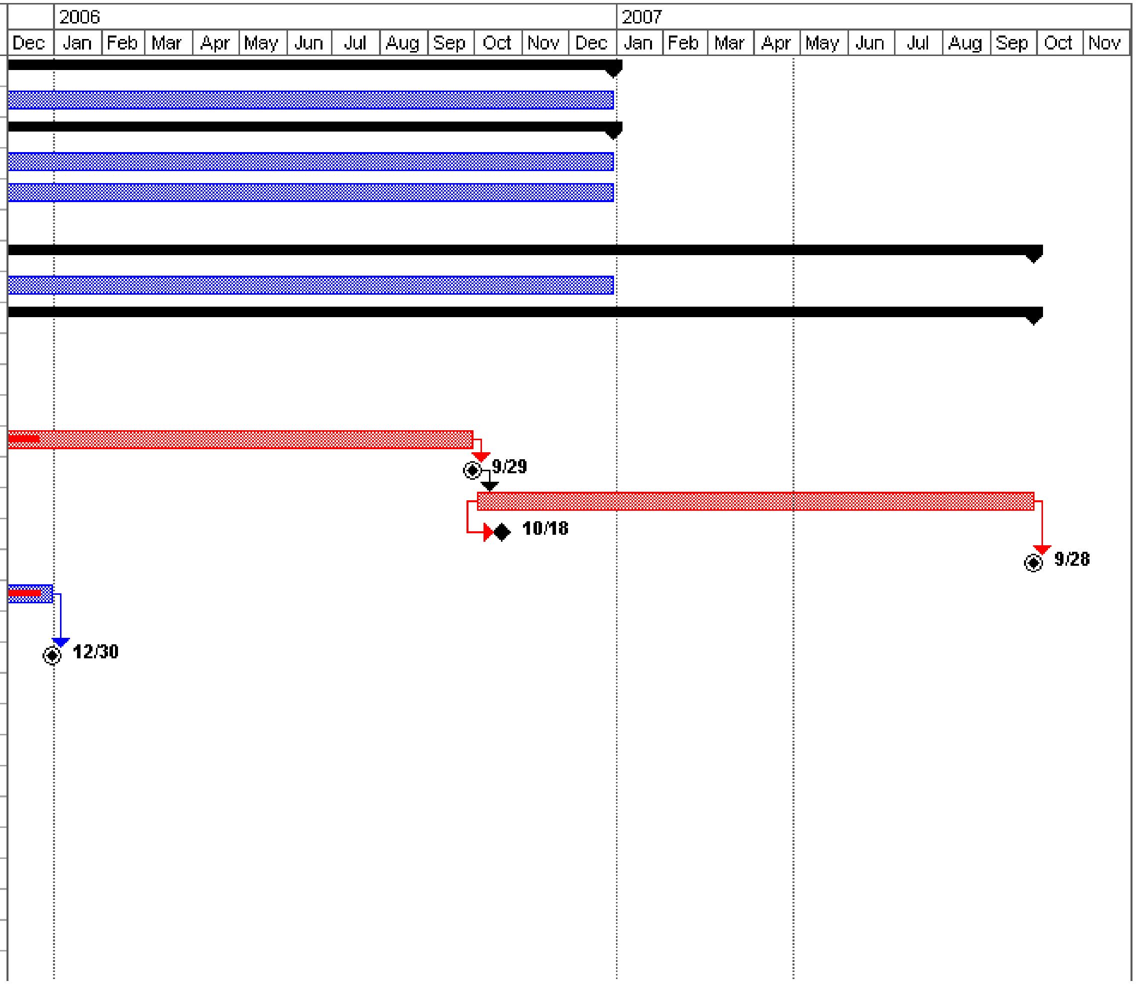


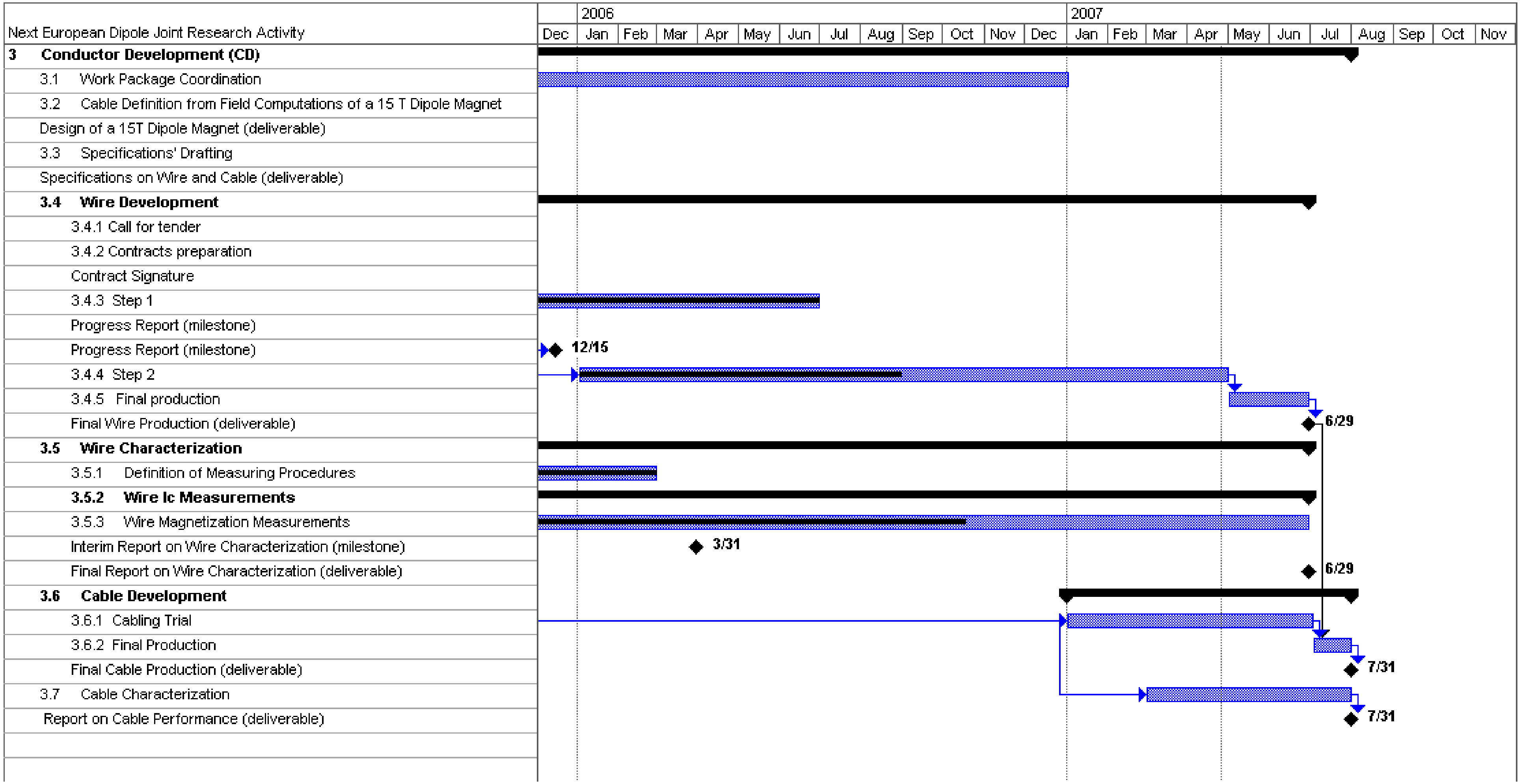
ID	Task Name
38	**3.2 SPOKE CAVITIES**
39	3.2.4 Design of coupler prototype
40	3.2.5 Construction of coupler prototype
41	3.2.9 Test of coupler prototype
42	3.2.6 RF design of 352 MHz multi-gap resonator
43	3.2.7 Engineering of resonator, coupler and tuner
44	3.2.8 Final design of 352 MHz multi-gap prototype
45	3.2.10 Manufacturing of 352MHz multi-gap prototype
46	3.2.11 Evaluation of 352MHz multi-gap prototype
47	**3.3 CH RESONATOR**
48	3.3.2 Construction of CH tuning system
49	3.3.3 Measurement of tuning system
50	**WP4: CHOPPING**
51	**4.1 CHOPPER STRUCTURE A**
52	4.1.3 Driver construction, testing
53	4.1.6 Prototype testing w/o beam
54	4.1.7 Prototype testing with beam
55	**4.2 CHOPPER LINE**
56	4.2.1 Dump design
57	4.2.2 Dump construction
58	4.2.3 Beam line assembling
59	4.2.4 Beam line measurements
60	**4.3 CHOPPER STRUCTURE B**
61	4.3.2 Prototype design
62	4.3.3 Prototype construction
63	4.3.4 Prototype testing
64	**WP5: BEAM DYNAMICS**
65	**5.1 Code development**
66	5.1.1 3D space charge routines development, testing
67	5.1.3 Neutralization and ECR source modelization st
68	5.1.5 Code preparation for 3 MeV test stand
69	5.1.6 Code preparation and analysis for SC linacs
70	5.1.7 Code comparison and benchmarking
71	5.1.8 Code benchmarking with experiment
72	**5.3 Diagnostics and collimation**
73	5.3.4 Non-interceptive bunch measurement const., te
74	5.3.5 Halo monitor design, construction
75	5.3.9 Test and improvement of halo monitor
76	5.3.6 On-line transmission control
77	5.3.7 Beam profile monitor design
78	5.3.8 Collimators study
79	**5.4 Experiment at CERN**
80	5.4.1 Preparation, simulations
81	5.4.2 Measurements at CEA
82	**5.5 Comparative assessment of dynamics and meas.**



JRA4: New European Dipole (NED)

Next European Dipole Joint Research Activity
1 Management and Communication (M&C)
1.1 Activity Coordination
1.2 Meetings
1.2.1 Steering Committee Meetings
1.2.2 External Scientific Advisory Committee Meetings
2 Thermal Studies and Quench Protection (TSQP)
2.1 Work Package Coordination
2.2 Heat Transfer Measurements
2.2.1 Drafting of Test Facility Specifications
2.2.2 Cryostat Design and Fabrication
2.2.3 Cryogenic Module Design and Fabrication
2.2.4 Facility Integration and Qualification
Commisioning of Heat Transfer Facility (deliverable)
2.2.5 Measurements and Analyses
Interim Report on Heat Transfer Measurements (milestone)
Final Report on Heat Transfer Measurements (deliverable)
2.3 Quench Protection Computation
Interim Report on Quench Performance (milestone)
Final Report on Quench Protection (deliverable)




Next European Dipole Joint Research Activity
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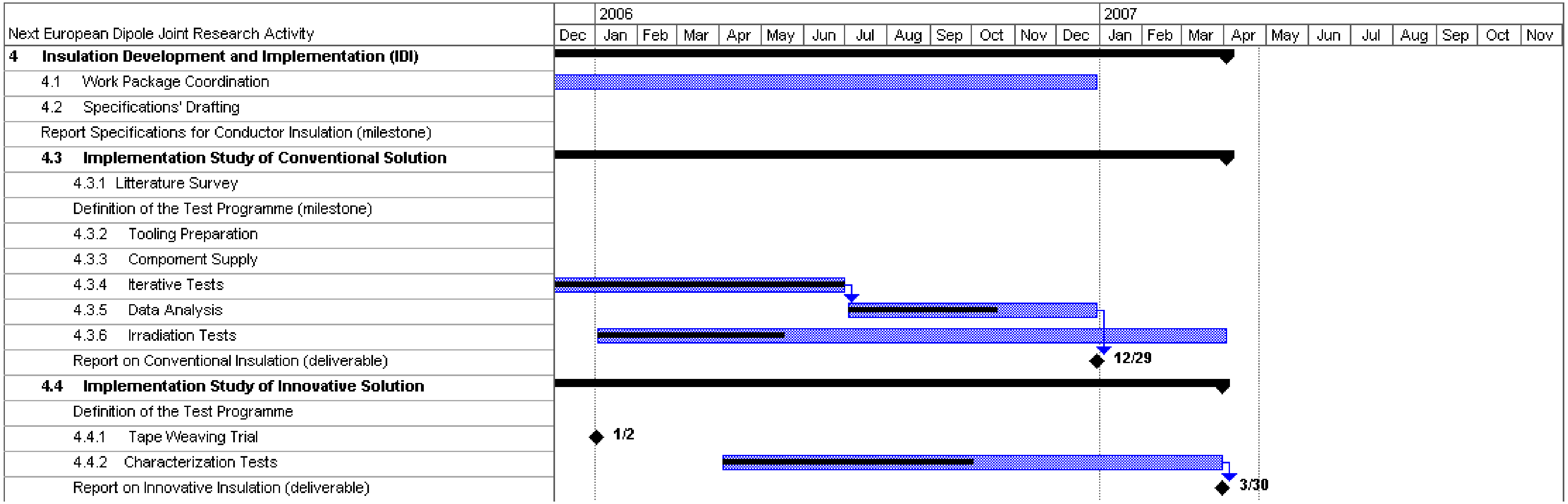
3 Conductor Development (CD)
3.1 Work Package Coordination
3.2 Cable Definition from Field Computations of a 15 T Dipole Magnet
Design of a 15T Dipole Magnet (deliverable)
3.3 Specifications' Drafting
Specifications on Wire and Cable (deliverable)
3.4 Wire Development
3.4.1 Call for tender
3.4.2 Contracts preparation
Contract Signature
3.4.3 Step 1
Progress Report (milestone)
Progress Report (milestone)
12/15
3.4.4 Step 2
3.4.5 Final production
Final Wire Production (deliverable)
6/29
3.5 Wire Characterization
3.5.1 Definition of Measuring Procedures
3.5.2 Wire Ic Measurements
3.5.3 Wire Magnetization Measurements
Interim Report on Wire Characterization (milestone)
3/31
Final Report on Wire Characterization (deliverable)
6/29
3.6 Cable Development
3.6.1 Cabling Trial
3.6.2 Final Production
Final Cable Production (deliverable)
7/31
3.7 Cable Characterization
Report on Cable Performance (deliverable)
7/31



Next European Dipole Joint Research Activity
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Nov
4 Insulation Development and Implementation (IDI)
4.1 Work Package Coordination
4.2 Specifications' Drafting
Report Specifications for Conductor Insulation (milestone)
4.3 Implementation Study of Conventional Solution
4.3.1 Litterature Survey
Definition of the Test Programme (milestone)
4.3.2 Tooling Preparation
4.3.3 Compoment Supply
4.3.4 Iterative Tests
4.3.5 Data Analysis
4.3.6 Irradiation Tests
Report on Conventional Insulation (deliverable)
12/29
4.4 Implementation Study of Innovative Solution
Definition of the Test Programme
1/2
4.4.1 Tape Weaving Trial
4.4.2 Characterization Tests
Report on Innovative Insulation (deliverable)
3/30

Financial information for the duration of the detailed implementation plan (per activity)

N0 Management

Man	Participant (cost model)	Permanent Staff direct cost ONLY (Euros)	Elligible Staff direct cost ONLY (Euros)	Durable Equipment direct cost ONLY (Euros)	Consumables and Prototyping direct cost ONLY (Euros)	Travel including direct cost ONLY (Euros)	All Direct cost	Subcontract	Indirect cost	Expected costs including indirect cost (Euros)	Requested funding (Euros)
1	CEA (FC)	0	233 250	1 500	7 500	11 100	253 350	0	194 250	447 600	90 000
	Grand total	**0**	**233 250**	**1 500**	**7 500**	**11 100**	**253 350**	**0**	**194 250**	**447 600**	**90 000**

N1 Electron Linear Accelerator Network (ELAN)

N1	Participant (cost model)	Permanent Staff direct cost ONLY (Euros)	Elligible Staff direct cost ONLY (Euros)	Durable Equipment direct cost ONLY (Euros)	Consumables and Prototyping direct cost ONLY (Euros)	Travel including direct cost ONLY (Euros)	All Direct cost	Sub contract	Indirect cost	Expected costs including indirect cost (Euros)	Requested funding (Euros)
1	CEA (FC)	0	0	0	0	7 500	7 500	0	0	7 500	7 500
3	CNRS (FCF)	0	0	0	0	20 000	20 000	0	4 000	24 000	14 000
6	DESY (AC)	0	0	0	0	47 800	47 800	0	9 560	57 360	57 360
7	FZJ (FC)	0	0	0	0	2 000	2 000	0	0	2 000	2 000
9	FZR (AC)	0	0	0	0	5 000	5 000	0	1 000	6 000	6 000
10	INFN (AC)	0	0	0	0	22 500	22 500	0	4 500	27 000	27 000
11	TEU (FC)	0	0	0	0	2 200	2 200	0	0	2 200	2 200
12	TUL (AC)	0	0	0	0	3 560	3 560	0	712	4 272	4 272
13	IPJ (AC)	0	0	0	0	3 750	3 750	0	750	4 500	4 500
14	WUT-ISE(AC)	0	0	0	0	750	750	0	150	900	900
16	CSIC (FC)	0	0	0	0	3 400	3 400	0	680	4 080	3 400
17	CERN (AC)	0	0	0	0	37 500	37 500	0	7 500	45 000	45 000
19	PSI (FC)	0	0	0	0	3 000	3 000	0	0	3 000	0
20	STFC (FC)	0	0	0	0	6 000	6 000	0	0	6 000	6 000
21	ICL (AC)	0	0	0	0	3 800,00	3 800	0	760	4 560	4 560
22	UMA (AC)	0	0	0	0	12 200	12 200	0	2 440	14 640	14 600
	Grand total	**0**	**0**	**0**	**0**	**180 960**	**180 960**	**0**	**32 052**	**213 012**	**199 292**

N2 Beam in Europe for Neutrino Experiments (BENE)

N2	Participant (cost model)	Permanent Staff direct cost ONLY (Euros)	Elligible Staff direct cost ONLY (Euros)	Durable Equipment direct cost ONLY (Euros)	Consumables and Prototyping direct cost ONLY (Euros)	Travel including direct cost ONLY (Euros)	All Direct cost	Sub contract	Indirect cost	Expected costs including indirect cost (Euros)	Requested funding (Euros)
1	CEA (FC)	0	0	0	0	14 250	14 250	0	0	14 250	14 250
2	UCLN (AC)	0	0	0	0	2 000	2 000	0	400	2 400	2 400
3	CNRS (FCF)	0	0	0	0	22 000	22 000	0	4 400	26 400	16 400
4	GSI (FC)	0	0	0	0	3 090	3 090	0	0	3 090	3 090
7	FZJ (FC)	0	0	0	0	9 900	9 900	0	0	9 900	9 900
8	TUM (AC)	0	0	0	0	4 500	4 500	0	900	5 400	3 100
10	INFN (AC)	0	0	0	0	23 250	23 250	0	4 650	27 900	27 900
16	CSIC (FC)	0	0	0	0	11 100	11 100	0	0	11 100	11 100
17	CERN (AC)	0	0	0	0	21 700	21 700	0	4 340	26 040	26 000
18	UNI-GE (AC)	0	0	0	0	23 900	23 900	0	4 780	28 680	0
19	PSI (FC)	0	0	0	0	5 220	5 220	0	0	5 220	0
20	STFC (FC)	0	0	0	0	12 000	12 000	0	0	12 000	12 000
21	ICL(AC)	0	0	0	0	17 200,00	17 200	0	3 440	20 640	20 640
	Grand total	**0**	**0**	**0**	**0**	**170 110**	**170 110**	**0**	**22 910**	**193 020**	**146 780**

N3 High-Energy High-Intensity Hadron Beams (HHH)

N3	Participant (cost model)	Permanent Staff direct cost ONLY (Euros)	Elligible Staff direct cost ONLY (Euros)	Durable Equipment direct cost ONLY (Euros)	Consumables and Prototyping direct cost ONLY (Euros)	Travel direct cost ONLY (Euros)	All Direct cost	Sub contract	Indirect cost	Expected costs including indirect cost (Euros)	Requested funding (Euros)
1	CEA (FC)	0	0	0	0	5 250	5 250	0	0	5 250	5 250
4	GSI (FC)	0	0	0	0	4 950	4 950	0	0	4 950	4 950
6	DESY (AC)	0	0	0	0	13 000	13 000	0	2 600	15 600	15 600
10	INFN (AC)	0	0	0	0	12 000	12 000	0	2 400	14 400	14 400
11	TEU (FC)	0	0	0	0	3 000	3 000	0	0	3 000	3 000
15	WUT (AC)	0	0	0	0	2 210	2 210	0	442	2 652	2 000
16	CSIC (FC)	0	0	0	0	1 200	1 200	0	0	1 200	1 200
17	CERN (AC)	0	0	0	0	77 000	77 000	0	15 400	92 400	50 000
19	PSI (FC)	0	0	0	0	0	0	0	0	0	0
20	STFC (FC)	0	0	0	0	0	0	0	0	0	0
	Grand total	**0**	**0**	**0**	**0**	**118 610**	**118 610**	**0**	**20 842**	**139 452**	**96 400**

JRA1 Superconducting Radio-Frequency (SRF)

JRA1	Participant (cost model)	Permanent Staff direct cost ONLY (Euros)	Elligible Staff direct cost ONLY (Euros)	Durable Equipment direct cost ONLY (Euros)	Consumables and Prototyping direct cost ONLY (Euros)	Travel direct cost ONLY (Euros)	All Direct Cost	Sub contract	Indirect cost	Expected costs including indirect cost (Euros)	Requested funding (Euros)
1	CEA (FC)	194 380	115 000	0	66 000	10 000	385 380	0	162 130	547 510	62 100
3	CNRS (FCF)	105 000	45 000	71 500	8 000	16 000	245 500	0	49 100	294 600	13 300
6	DESY (AC)	0	210 000	0	128 000	30 500	368 500	50 000	63 700	432 200	432 200
10	*INFN-LNL*	*0*	*80 000*	*0*	*0*	*5 000*	*85 000*	*0*	*17 000*	102 000	*102 000*
	INFN-LNF	*0*	*50 000*	*0*	*16 670*	*20 000*	*86 670*	*0*	*17 334*	104 004	*104 004*
	INFN-Mi	*0*	*41 580*	*0*	*23 540*	*4 670*	*69 790*	*0*	*13 958*	83 748	*83 748*
	INFN-Ro2	*0*	*45 970*	*3 600*	*16 350*	*6 790*	*72 710*	*0*	*14 542*	87 252	*87 252*
	INFN (AC)	0	217 550	3 600	56 560	36 460	314 170	0	62 834	377 004	377 004
12	TUL (AC)	0	22 660	0	10 500	0	33 160	0	6 632	39 792	39 792
13	IPJ (AC)	24 600	0	3 420	9 480	10 000	47 500	0	9 500	57 000	57 000
14	WUT-ISE(AC)	0	19 235	0	490	250	19 975	0	3 995	23 970	23 970
19	PSI (FC)	30 000	20 000	0	0	3 000	53 000	0	2 800	55 800	0
	Grand total	**353 980**	**649 445**	**78 520**	**279 030**	**106 210**	**1 467 185**	**50 000**	**360 691**	**1 827 876**	**1 005 366**

JRA2 Charge Production with Photo-Injectors (PHIN)

JRA2	Participant (cost model)	Permanent Staff direct cost ONLY (Euros)	Elligible Staff direct cost ONLY (Euros)	Durable Equipment direct cost ONLY (Euros)	Consumables and Prototyping direct cost ONLY (Euros)	Travel direct cost ONLY (Euros)	All Direct Cost	Sub contract	Indirect cost	Expected costs including indirect cost (Euros)	Requested funding (Euros)
3	*CNRS-Orsay*	*291 500*	*0*	*80 000*	*5 000*	*5 000*	*381 500*	*0*	*76 300*	*457 800*	*23 343*
	CNRS-LOA	*64 000*	*0*	*0*	*12 000*	***0***	*76 000*	*0*	*15 200*	*91 200*	*12 000*
	CNRS (FCF)	355 500	0	80 000	17 000	5 000	457 500	0	91 500	549 000	35 343
9	FZR (AC)	0	40 000	0	4 400	5 000	49 400	0	9 880	59 280	59 280
10	*INFN-LNF*	*0*	*80 000*	*0*	*33 000*	*10 000*	*123 000*	*0*	24 600	*147 600*	*123000*
	INFN-Mi	*0*	*80 000*	*0*	*25 000*	*6 600*	*111 600*	*0*	22 320	*133 920*	*111600*
	INFN (AC)	0	160 000	0	58 000	16 600	234 600	0	46 920	281 520	234600
11	TEU (FC)	35 000	0	0	50 000	5 000	90 000	0	30 000	120 000	60 000
17	CERN (AC)	0	22 000	0	186 000	10 000	218 000	0	43 600	261 600	120 000
20	STFC (FC)	0	0	0	0	0	0	0	0	0	0
	Grand total	**390 500**	**222 000**	**80 000**	**315 400**	**41 600**	**1 049 500**	**0**	**221 900**	**1 271 400**	**509 223**

JRA3 High Intensity Pulsed Proton Injectors (HIPPI)

JRA3	Participant (cost model)	Permanent Staff direct cost ONLY (Euros)	Elligible Staff direct cost ONLY (Euros)	Durable Equipment direct cost ONLY (Euros)	Consumables and Prototyping direct cost ONLY (Euros)	Travel direct cost ONLY (Euros)	All Direct Cost	Sub contract	Indirect cost	Expected costs including indirect cost (Euros)	Requested funding (Euros)
1	CEA (FC)	350 000	0	50 000	230 000	5 000	635 000	0	325 000	960 000	160 000
3	*CNRS-IN2P3*	*65 000*	*0*	*1 000*	*45 000*	*7 500*	*118 500*	*0*	*23 700*	142 200	*8 500*
	CNRS-LPSC	*250 000*	*0*	*0*	*0*	*0*	*250 000*	*0*	*50 000*	300 000	*1 800*
	CNRS (FCF)	315 000	0	1 000	45 000	7 500	368 500	0	73 700	442 200	10 300
4	GSI (FC)	0	313 000	0	90	7 800	320 890	0	0	320 890	80 000
5	IAP-FU(AC)	0	70 000	0	300 000	5 000	375 000	0	75 000	450 000	180 000
7	FZJ (FC)	204 000	110 000	0	75 000	9 000	398 000	0	293 088	691 088	194 000
10	INFN (AC)	0	0	0	20 000	5 000	25 000	0	5 000	30 000	15 000
17	CERN (AC)	0	163 700	50 000	50 000	12 000	275 700	0	55 140	330 840	100 000
20	STFC (FC)	208 320	129 234	0	227 270	5 000	569 824	0	384 812	954 636	90 000
	Grand total	**1 077 320**	**785 934**	**101 000**	**947 360**	**56 300**	**2 967 914**	**0**	**1 211 740**	**4 179 654**	**829 300**

JRA4 Next European Dipole (NED)

JRA4	Participant (cost model)	Permanent Staff including indirect cost (Euros)	Elligible Staff including indirect cost (Euros)	Durable Equipment including indirect cost (Euros)	Consumables and Prototyping including indirect cost (Euros)	Travel including indirect cost (Euros)	All direct cost	Sub contract	Indirect cost	Expected costs including indirect cost (Euros)	Requested funding (Euros)
1	CEA (FC)	55 275	0	0	0	5 000	60 275	0	43 680	103 955	20 000
10	INFN (AC)	0	0	0	10 000	0	10 000	0	2 000	12 000	12 000
11	TEU (FC)	0	0	0	0	0	0	0	0	0	0
15	WUT (AC)	0	0	0	0	5 270	5 270	0	1 054	6 324	5 000
17	CERN (AC)	0	0	0	375 000	0	375 000	375 000	0	375 000	160 000
20	STFC (FC)	0	0	0	0	0	0	0	0	0	0
	Grand total	**55 275**	**0**	**0**	**385 000**	**10 270**	**450 545**	**375 000**	**46 734**	**497 279**	**197 000**

Financial information for the duration of the detailed implementation plan (per contractor)

Proposal Number	506395	Proposal Acronym	CARE

Financial information – "Reporting period 4 + first six months of Reporting period 5"														
Partici-pant n°	Organi-sation short name	Cost model used		Estimated eligible costs and requested EC contribution (first 18 months of the project)		Costs and EC contribution per type of activities							Total (8)= (1)+(2)+(3)+(4)+(5)+(6)+(7)	Total receipts
									Other specific activities					
		For transnational Access	For any other activities			RTD activities (1)	Demonstration activities (2)	Consortium Management activities (3)	Coordination/Networking (4)	Transnational access (5)	Connectivity (6)	Other including Specific Service Activities for CND (7)		
1	CEA		FC	Eligible costs	*Direct costs (a)*	1 080 655,00		253 350,00	27 000,00				1 361 005,00	
					of which subcontracting	0,00		0,00	0,00				0,00	
					Indirect costs (b)	530 810,00		194 250,00	0,00				725 060,00	
					Total eligible costs (a)+(b)	1 611 465,00		447 600,00	27 000,00				2 086 065,00	
				Requested EC contribution		242 100,00		90 000,00	27 000,00				**359 100,00**	
2	UCLN		AC	Eligible costs	*Direct costs (a)*	0,00			2 000,00				2 000,00	
					of which subcontracting	0,00			0,00				0,00	
					Indirect costs (b)	0,00			400,00				400,00	
					Total eligible costs (a)+(b)	0,00			2 400,00				2 400,00	
				Requested EC contribution		0,00			2 400,00				**2 400,00**	
3	CNRS		FC	Eligible costs	*Direct costs (a)*	1 071 500,00			42 000,00				1 113 500,00	
					of which subcontracting	0,00			0,00				0,00	
					Indirect costs (b)	214 300,00			8 400,00				222 700,00	
					Total eligible costs (a)+(b)	1 285 800,00			50 400,00				1 336 200,00	
				Requested EC contribution		58 943,00			30 400,00				**89 343,00**	
4	GSI		FC	Eligible costs	*Direct costs (a)*	320 890,00			8 040,00				328 930,00	
					of which subcontracting	0,00			0,00				0,00	
					Indirect costs (b)	0,00			0,00				0,00	
					Total eligible costs (a)+(b)	320 890,00			8 040,00				328 930,00	
				Requested EC contribution		80 000,00			8 040,00				**88 040,00**	
TOTAL				Eligible costs										
				Requested EC contribution										

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Proposal Number	506395	Proposal Acronym	CARE

Financial information – "Reporting period 4 + first six months of Reporting period 5"

Partici-pant n°	Organi-sation short name	Cost model used: For transnational Access	Cost model used: For any other activities	Estimated eligible costs and requested EC contribution (first 18 months of the project)		Costs and EC contribution per type of activities Erreur ! Source du renvoi introuvable.: RTD activities (1)	Demonstration activities (2)	Consortium Management activities (3)	Other specific activities: Coordination/Networking (4)	Transnational access (5)	Connectivity (6)	Other including Specific Service Activities for CND (7)	Total (8)= (1)+(2)+(3)+(4)+(5)+(6)+(7)	Total receipts
5	IAP-FU		FC	Eligible costs	*Direct costs (a)*	375 000,00			0,00				375 000,00	
					of which subcontracting	0,00			0,00				0,00	
					Indirect costs (b)	75 000,00			0,00				75 000,00	
					Total eligible costs (a)+(b)	450 000,00			0,00				450 000,00	
				Requested EC contribution		180 000,00			0,00				**180 000,00**	
6	DESY		AC	Eligible costs	*Direct costs (a)*	368 500,00			60 800,00				429 300,00	
					of which subcontracting	50 000,00			0,00				50 000,00	
					Indirect costs (b)	63 700,00			12 160,00				75 860,00	
					Total eligible costs (a)+(b)	432 200,00			72 960,00				505 160,00	
				Requested EC contribution		432 200,00			72 960,00				**505 160,00**	
7	FZJ		FC	Eligible costs	*Direct costs (a)*	398 000,00			11 900,00				409 900,00	
					of which subcontracting	0,00			0,00				0,00	
					Indirect costs (b)	293 088,00			0,00				293 088,00	
					Total eligible costs (a)+(b)	691 088,00			11 900,00				702 988,00	
				Requested EC contribution		194 000,00			11 900,00				**205 900,00**	
8	TUM		AC	Eligible costs	*Direct costs (a)*	0,00			4 500,00				4 500,00	
					of which subcontracting	0,00			0,00				0,00	
					Indirect costs (b)	0,00			900,00				900,00	
					Total eligible costs (a)+(b)	0,00			5 400,00				5 400,00	
				Requested EC contribution		0,00			3 100,00				**3 100,00**	
TOTAL				Eligible costs										
				Requested EC contribution										

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Proposal Number	506395	Proposal Acronym	CARE

Financial information – "Reporting period 4 + first six months of Reporting period 5"

Partici-pant n°	Organi-sation short name	Cost model used: For transnational Access	Cost model used: For any other activities	Estimated eligible costs and requested EC contribution (first 18 months of the project)		RTD activities (1)	Demonstration activities (2)	Consortium Management activities (3)	Other specific activities: Coordination/Networking (4)	Other specific activities: Transnational access (5)	Other specific activities: Connectivity (6)	Other specific activities: Other including Specific Service Activities for CND (7)	Total (8)= (1)+(2)+(3)+(4)+(5)+(6)+(7)	Total receipts
9	FZR		AC	Eligible costs	*Direct costs (a)*	49 400,00			5 000,00				54 400,00	
					of which subcontracting	0,00			0,00				0,00	
					Indirect costs (b)	9 880,00			1 000,00				10 880,00	
					Total eligible costs (a)+(b)	59 280,00			6 000,00				65 280,00	
				Requested EC contribution		59 280,00			6 000,00				**65 280,00**	
10	INFN		AC	Eligible costs	*Direct costs (a)*	583 770,00			57 750,00				641 520,00	
					of which subcontracting	0,00			0,00				0,00	
					Indirect costs (b)	116 754,00			11 550,00				128 304,00	
					Total eligible costs (a)+(b)	700 524,00			69 300,00				769 824,00	
				Requested EC contribution		638 604,00			69 300,00				**707 904,00**	
11	TEU		FC	Eligible costs	*Direct costs (a)*	90 000,00			5 200,00				95 200,00	
					of which subcontracting	0,00			0,00				0,00	
					Indirect costs (b)	30 000,00			0,00				30 000,00	
					Total eligible costs (a)+(b)	120 000,00			5 200,00				125 200,00	
				Requested EC contribution		60 000,00			5 200,00				**65 200,00**	
12	TUL		AC	Eligible costs	*Direct costs (a)*	33 160,00			3 560,00				36 720,00	
					of which subcontracting	0,00			0,00				0,00	
					Indirect costs (b)	6 632,00			712,00				7 344,00	
					Total eligible costs (a)+(b)	39 792,00			4 272,00				44 064,00	
				Requested EC contribution		39 792,00			4 272,00				**44 064,00**	
TOTAL				Eligible costs										
				Requested EC contribution										

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Proposal Number	506395	Proposal Acronym	CARE

Financial information – "Reporting period 4 + first six months of Reporting period 5"

Partici-pant n°	Organi-sation short name	Cost model used: For transnational Access	Cost model used: For any other activities	Estimated eligible costs and requested EC contribution (first 18 months of the project)		RTD activities (1)	Demonstration activities (2)	Consortium Management activities (3)	Other specific activities: Coordination/Networking (4)	Transnational access (5)	Connectivity (6)	Other including Specific Service Activities for CND (7)	Total (8)= (1)+(2)+(3)+(4)+(5)+(6)+(7)	Total receipts
13	IPJ		AC	Eligible costs	*Direct costs (a)*	47 500,00			3 750,00				51 250,00	
					of which subcontracting	0,00			0,00				0,00	
					Indirect costs (b)	9 500,00			750,00				10 250,00	
					Total eligible costs (a)+(b)	57 000,00			4 500,00				61 500,00	
				Requested EC contribution		57 000,00			4 500,00				**61 500,00**	
14	WUT-ISE		AC	Eligible costs	*Direct costs (a)*	19 975,00			750,00				20 725,00	
					of which subcontracting	0,00			0,00				0,00	
					Indirect costs (b)	3 995,00			150,00				4 145,00	
					Total eligible costs (a)+(b)	23 970,00			900,00				24 870,00	
				Requested EC contribution		23 970,00			900,00				**24 870,00**	
15	WUT		AC	Eligible costs	*Direct costs (a)*	5 270,00			2 210,00				7 480,00	
					of which subcontracting	0,00			0,00				0,00	
					Indirect costs (b)	1 054,00			442,00				1 496,00	
					Total eligible costs (a)+(b)	6 324,00			2 652,00				8 976,00	
				Requested EC contribution		5 000,00			2 000,00				**7 000,00**	
16	CSIC		AC	Eligible costs	*Direct costs (a)*	0,00			15 700,00				15 700,00	
					of which subcontracting	0,00			0,00				0,00	
					Indirect costs (b)	0,00			680,00				680,00	
					Total eligible costs (a)+(b)	0,00			16 380,00				16 380,00	
				Requested EC contribution		0,00			15 700,00				**15 700,00**	
TOTAL				Eligible costs										
				Requested EC contribution										

Please use as many copies of form A3.3 as necessary for the number of participants	***Form A3.3 page***	*4*	***of***	*6*

Proposal Number	506395	Proposal Acronym	CARE

Financial information – "Reporting period 4 + first six months of Reporting period 5"

Partici-pant n°	Organi-sation short name	Cost model used: For transnational Access	Cost model used: For any other activities	Estimated eligible costs and requested EC contribution (first 18 months of the project)		RTD activities (1)	Demonstration activities (2)	Consortium Management activities (3)	Coordination/Networking (4)	Transnational access (5)	Connectivity (6)	Other including Specific Service Activities for CND (7)	Total (8)= (1)+(2)+(3)+(4)+(5)+(6)+(7)	Total receipts
17	CERN		AC	Eligible costs	*Direct costs (a)*	868 700,00			136 200,00				1 004 900,00	
					of which subcontracting	375 000,00			0,00				375 000,00	
					Indirect costs (b)	98 740,00			27 240,00				125 980,00	
					Total eligible costs (a)+(b)	967 440,00			163 440,00				1 130 880,00	
				Requested EC contribution		380 000,00			121 000,00				**501 000,00**	
18	UNI-GE		AC	Eligible costs	*Direct costs (a)*	0,00			23 900,00				23 900,00	
					of which subcontracting	0,00			0,00				0,00	
					Indirect costs (b)	0,00			4 780,00				4 780,00	
					Total eligible costs (a)+(b)	0,00			28 680,00				28 680,00	
				Requested EC contribution		0,00			(28 680)*				**(28 680)***	
19	PSI		AC	Eligible costs	*Direct costs (a)*	53 000,00			8 220,00				61 220,00	
					of which subcontracting	0,00			0,00				0,00	
					Indirect costs (b)	2 800,00			0,00				2 800,00	
					Total eligible costs (a)+(b)	55 800,00			8 220,00				64 020,00	
				Requested EC contribution		(55 800)*			(8 220)*				**(64 020)***	
20	STFC		FC	Eligible costs	*Direct costs (a)*	569 824,00			18 000,00				587 824,00	
					of which subcontracting	0,00			0,00				0,00	
					Indirect costs (b)	384 812,00			0,00				384 812,00	
					Total eligible costs (a)+(b)	954 636,00			18 000,00				972 636,00	
				Requested EC contribution		90 000,00			18 000,00				**108 000,00**	
TOTAL				Eligible costs										
				Requested EC contribution										

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Proposal Number	506395	Proposal Acronym	CARE

Financial information – "Reporting period 4 + first six months of Reporting period 5"

Partici-pant n°	Organi-sation short name	Cost model used: For transnational Access	Cost model used: For any other activities	Estimated eligible costs and requested EC contribution (first 18 months of the project)		RTD activities (1)	Demonstration activities (2)	Consortium Management activities (3)	Other specific activities: Coordination/Networking (4)	Other specific activities: Transnational access (5)	Other specific activities: Connectivity (6)	Other specific activities: Other including Specific Service Activities for CND (7)	Total (8)= (1)+(2)+(3)+(4)+(5)+(6)+(7)	Total receipts
21	ICL		AC	Eligible costs	*Direct costs (a)*	0,00			21 000,00				21 000,00	
					of which subcontracting	0,00			0,00				0,00	
					Indirect costs (b)	0,00			4 200,00				4 200,00	
					Total eligible costs (a)+(b)	0,00			25 200,00				25 200,00	
				Requested EC contribution		0,00			25 200,00				**25 200,00**	
22	UMA		AC	Eligible costs	*Direct costs (a)*	0,00			12 200,00				12 200,00	
					of which subcontracting	0,00			0,00				0,00	
					Indirect costs (b)	0,00			2 440,00				2 440,00	
					Total eligible costs (a)+(b)	0,00			14 640,00				14 640,00	
				Requested EC contribution		0,00			14 600,00				**14 600,00**	
TOTAL				Eligible costs		**7 776 209,00**		**447 600,00**	**545 484,00**				**8 769 293,00**	
				Requested EC contribution		**2 540 889,00 (55 800)***		**90 000,00**	**442 472,00 (36 900)***				**3 073 361,00 (92 700)***	

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**Since the contract with EU has been signed in 2003 and the agreement on Swiss participation in the 6th FP was not yet in force , Swiss Partners should be funded by the Swiss Government)*