SIXTH FRAMEWORK PROGRAMME

Structuring the European Research Area Specific Programme

RESEARCH INFRASTRUCTURES ACTION

Contract for an:

INTEGRATING ACTIVITY

implemented as

INTEGRATED INFRASTRUCTURES INITIATIVE

Annex I - "Description of Work"

Project acronym: CARE

Project full title: Coordinated Accelerator Research in Europe

TABLE OF CONTENTS

1. Project objectives and summary

The main objective of the **CARE** project is to generate **a structured and integrated European area in the field of accelerator research and related R&D**. The program includes the most advanced scientific and technological developments relevant to accelerator research for Particle Physics. It is articulated around 3 Networking Activities and 4 Joint Research Activities.

The aim of the Networking Activities is to foster and strengthen the European knowledge to evaluate and develop efficient and cost effective methods to produce intense and high-energy electron, proton, muon and neutrino beams as recommended by the European Committee for Future Accelerator (ECFA). They will carry comparative studies on the various techniques, establish collaborative and prioritised R&D programs aimed at improving the exiting infrastructures and technical roadmaps toward their longer-term evolution and the construction of new facilities of worldwide interest. The participants will integrate their infrastructures, establishing a European technological platform for accelerator research allowing one to develop joint R&D projects and to foster strong and effective collaborations.

The Joint research activities aim at developing critical and/or beyond the actual state-of-the-art components and systems to upgrade the infrastructures. They include the developments of:

- Superconducting cavity and RF technology
- Photo-injector technology, in particular for two-beam acceleration technique
- Normal and superconducting structures for the acceleration of very high-intensity proton beams as well as challenging beam chopping magnets
- The technology for constructing very high magnetic field and high density currents magnets

Twenty two contracting participants and a large number of associated institutes (including industrial partners and SMEs) participate in this unprecedented integrating effort, including accelerator physicists involved in Nuclear Physics accelerators, Free Electron Lasers and Neutron Spallation sources.

Finally, in order to implement a strong and efficient dissemination plan, a Web-based platform has been developed from the site of the ECFA-European Steering Group for Accelerator R&D (http://esgard.lal.in2p3.fr).

2. Overall description and fundamental objectives of the I3

The CARE project represents an innovative and unique opportunity in Europe as it will involve almost all of the European expertise and know-how in accelerator physics and related technologies and would allow one to address most of the issues relevant to particle accelerators. Thus, it will provide an integrated service to the entire European particle physics community and could provide on the long-term an integrated service for other communities (such as Nuclear Physics, FEL, and Neutron Spallation) as well. The CARE project is considered as very high priority in Particle Physics by European Committee for Future Accelerator (ECFA).

The framework of CARE integrates the subjects, the infrastructures and the expertise.

- **The subjects**
  - On-going and new studies on all types of used and planned accelerator will be integrated, in line with the recommendation and priorities set forward in the ECFA report on the "future of accelerator-based physics in Europe" (ECFA/01/213):
    - Electron linear accelerator and collider
    - Neutrino (muon) beams
    - High-energy/high-intensity proton accelerators
- **The infrastructures**
  - It will include all the relevant infrastructures allowing one to develop an overall efficient R&D program for accelerators and establish the first step toward a European Technological Platform to carry research on accelerator. The proposed activities are articulated around:
    - Large Scale Facilities, including the existing or in construction state-of-the-art accelerators (CERN accelerator complex including LHC, DESY accelerator complex as well as those from LNF, RAL, PSI, GSI),
    - Large-scale accelerator test facilities (CTF at CERN, TTF at DESY)
    - Specialized large and medium size infrastructures allowing one to develop and test specific accelerator concepts and components (LNF, RAL, PSI, CEA/Saclay, CNRS-IN2P3/Orsay).

The following table shows the existing (or in construction) accelerator facilities located at the laboratories participating to the CARE project. The vast majority of these infrastructures are unique in Europe. A large number of them would be improved with the outcome of the CARE research activities.

Laboratory	Accelerator	Description
STFC-RAL	**ISIS**	Accelerator complex for the neutron and muon facility
CERN	**PS, SPS, LHC**	Proton accelerator complex
	CNGS	Neutrino Beam
	CTF3	Two beams electron linear accelerator test facility
DESY	**PETRA, HERA**	Electron and proton accelerator complex
	TTF, X-FEL	Electron superconducting linear accelerator test facility and free electron laser
FZR	**ELBE**	Electron linear accelerator
GSI	**SIS, ESR**	Heavy ion accelerator complex
INFN-LNF	**DAPHNE**	Electron-Positron collider
PSI	**SINQ**	Accelerator complex for the neutron and muon facility

Similarly, the next table shows the existing (or in construction) specialized test facilities relevant for the CARE project

Laboratory	Facility	Description
STFC	**"Unnamed"**	Cryogenic facility for mechanical measurement
CEA	**IPHI**	3 MeV High Intensity Proton Injector
	RF stand	700 MHz RF test stand for pulsed SC cavity testing (1 MW)
	Cryholab	Horizontal Cryogenic test stand
	W7X	Superconducting magnet test facility
	"Unnamed"	Cryogenic facilities for thermal, mechanical and electrical characterization
CERN	**Test Beam**	3 MeV test stand for chopping tests and beam tests
	RF stand	352 MHz RF test stand for cavity testing (120 kW)
	FRESCA	Superconducting wire and cable test facility
CNRS-Orsay	**NEPAL** **"Unnamed"**	Test stand with photo-injector Coupler test laboratory
DESY	**CHECHIA**	Horizontal Cryogenic test stand
	"Unnamed"	Superconducting Magnet Test Facility
	PITZ	Photo-injector test facility
FZJ	**"Unnamed"**	Superconducting cavity test stand
GSI	**"Unnamed"**	Superconducting Magnet Test Facility
	UNILAC	Accelerator for beam tests and diagnostics tests
INFN-Ge	**"Unnamed"**	Superconducting wire test facility
INFN-Mi	**"Unnamed"**	High-Field Superconducting wire test facility

- **The expertise**
  - Most (if not all) European expert involved in the conception, design, development and construction of accelerator for particle physics (and to a large extend for nuclear physics and advanced light sources such as FEL) are participating to the CARE project.

As a consequence, the outcome of the CARE project will

- Considerably strengthen the European expertise and know-how in this field far beyond the sole capacity of the largest research centres (CERN and DESY) to carry forefront accelerator R&D.
- Help many European Institutes and Universities develop their competences in contact with the best experts in Europe, ensuring the long-term sustainability of accelerator R&D. Many of the activities in CARE are at (or beyond) the state-of-the-art technology.
- Further the contact and the involvement of industry in R&D activities (12 companies are participating to the CARE activities).
- Establish the basic development work allowing the future strategic decisions to be made on sound technological basis. CARE will provide the necessary technological inputs to ECFA.
- Identify the common issues relevant to other fields, contact these communities and propose common activities

2.1 The CARE activities and their integration

The ***three Networking Activities (NA)*** aim at fostering and strengthening the European knowledge to generate, evaluate and develop efficient and cost effective methods to produce intense and high-energy electron, proton, muon and neutrino. They will carry comparative studies on the various techniques, establish collaborative and prioritise R&D programs aimed at improving the existing infrastructures and at establishing technical roadmaps toward their longer-term evolution and the construction of new facilities of worldwide interest.

The participants will provide access to unique and indispensable infrastructures establishing the European technological platform for accelerator research allowing one to develop Joint Research Projects and to foster strong and effective collaborations.

The following table shows the different type of particle beams, infrastructures and projects and their relevance for the 3 Networking Activities (N1, N2, N3).

<table>
<tr><th>Networking Activities</th><th>Existing or in construction large scale accelerators</th><th>Test facility or medium size facilities</th><th>Specialized test facilities</th><th>Accelerator Project</th></tr>
<tr><td>N1: Electron Linear accelerator Network</td><td></td><td>TTF(DESY)
CTF(CERN)</td><td rowspan="3">Photo-Injector test facilities (CNRS-Orsay,DESY)
“Cryolabs” (CEA,CERN,DESY,FZJ)
“Super conducting magnet test stations” (STFC,CEA,CERN,DESY,GSI,INFN-Ge,INFN-Mi)</td><td>TESLA, CLIC</td></tr>
<tr><td>N2: Beams for European Neutrino Experiments (superBeam, βBeam, μ-beam)</td><td>CNGS(CERN)</td><td>ISIS(RAL)
SINQ(PSI)
IPHI(CEA)</td><td>SPL, NuFact</td></tr>
<tr><td>N3: High-Energy High-IntensityHadron Beams</td><td>LHC(CERN)
HERA(DESY)
SIS (GSI)</td><td>IPHI(CEA)</td><td>SuperLHC, VLHC</td></tr>
</table>

The ***four Joint Research Activities (JRA)*** aim at developing critical or beyond the state-of-the-art components and systems allowing one to upgrade the infrastructures. They include

- **SRF**: The development of the superconducting cavity technology for the acceleration of electrons with gradient exceeding 35MV/m and the development of the subsequent necessary superconducting RF technology.
- **PHIN**: An R&D program for improving the technology of photo-injectors, in particular to match the severe requirements necessary for demonstrating the 2 beam acceleration concepts.
- **HIPPI**: The integrated developments of normal and superconducting structures for the acceleration of very high-intensity proton beams as well as challenging beam chopping magnets.
- **NED**: The development and mastering of the technology for reaching very high magnetic field (>15T) and high current densities (>1500A/mm^2).

All together **22** participants and a number of associated laboratories or institutes (including **12** industrial companies) will participate in these activities establishing an unprecedented integrating effort in this field.

The Joint Research Activities are relevant and of extreme importance for the networking activities. The following table shows this relation and illustrates the overall integration of the CARE program.

NA / JRA	**N1**: Electron Linear Accelerator Network (**ELAN**)		**N2:** Beams for European Neutrino Experiments (**BENE**)			**N3:** HE/HI Hadron Beams (**HEHIHB**)
Existing projects *Future projects*	TTF *TESLA*	CTF *CLIC*	CNGS *SuperBeams*	 *β–beams*	ISIS, SINQ *μ–beams*	HERA, SIS, LHC *SLHC/VLHC*
SRF	X				X	
PHIN	X	X				
HIPPI			X	X	X	X
NED	X	X			X	X

In fact the R&D projects are not only essential to the improvement of the existing infrastructures and the development of upgrade programs but will also establish the foundation for new ones. Conversely the existing infrastructures are necessary to understand beam dynamics and properties, to validate ideas through dedicated machine developments and to test prototypes. The Research and Development carried in the JRAs will be presented and discussed in the networking activities. The achievements in the JRAs are likely to influence the studies in the Networking Activities, leading to new ideas, which in turn will generate new research directions. General meetings, common workshops and Dissemination Board activities will ensure an effective exchange of information. Furthermore, specialized joint workshops will be organized when several aspects of networking and joint research activities are common (ex. beams diagnostics and instrumentation, high field magnets needs for accelerators, etc...)

Accelerator Research requires access to several types of infrastructure. Since most of the interested parties in Europe are members of CARE, the participants decided that a formal request for transnational access was not necessary at this stage and that an agreement amongst the partners to provide the necessary access allowing one to carry the proposed program was sufficient. At a later stage, the management of CARE might set up a study group to investigate whether a proposal for transnational access to infrastructures for accelerator R&D would be useful.

2.2 Integrated provision of infrastructure related services

2.2.1. Networking activities

The main services provided by the research infrastructures under consideration in CARE are:

- To develop the most advanced accelerators for carrying frontier research in physics
- To provide accelerator beam time for research programs and technical developments
- To develop and provide the most advanced test infrastructures
- To provide a centre of excellence where the smaller institutes and universities can find support for enhancing their own expertise and know-how.

The three networks in their ensemble will integrate a very wide spectrum of research and development activities in accelerator science. They will evaluate and compare different methods to reach higher intensities and energies with several types of probes (electron, proton, muon and neutrino). The CARE networking activities will improve the coordination of those efforts done in many laboratories, institutes and universities in Europe, including industrial companies. Globally, these efforts aim at

i. Increasing the understanding of accelerator science and enlarging the pool of expertise

   In the networks, a lot of exchange of information and knowledge will take place between experts as well as between experts and newcomers in the field. The direct consequences will be an increase of the general level of competence and a high quality training of the individuals starting to work in the field. The encouragement to make and publish thesis works on accelerator topics and the gain of skills about accelerator operation will directly result from the team-works done and from the access to R&D infrastructures. The increase of the pool of experts and the level of expertise (such as for beam dynamics) will lead to the improvement of the operation of the accelerators (better optics and beam controls leading to better beam stability and properties). An additional expected effect of these activities is to attract young people into accelerator physics and technology, and to provide them with the kind of environment, which instigates them to continue in this line of activities. The networks are providing forums for information exchange for the European Industries interested to provide accelerator components as well as, at the other end of the chain, for the High Energy Physics community looking for inputs to plan its activities and define its priorities. To promote even further the former aspect, dedicated Industry Days will be organized.

ii. Establishing centralized technical database and code repositories

   Networking activities will set up databases on test equipments and specific specialized technical information. Convenient and centralized access to this information will make it easier for the users to carry their research and development and eventually access to costly test equipments. Similarly, easily accessible and well documented software for studying beam dynamics and transport will be very useful to the community.

iii. Comparing different options for improving existing facilities and for designing new ones

   A substantial part of the networking activities is aimed at defining the optimal technical choices and the essential R&D efforts to be undertaken. After investigating the technical limitations of present research accelerators, the networks will explore and propose ways to surpass their present performance. Most of the ideas and related improved techniques, which will be addressed, are likely to be used to improve the operation and/or upgrade the accelerators (for example at CERN, DESY, LNF, GSI, and RAL). Furthermore, some of these ideas will be immediately experimented in the accelerator test facilities (such as TTF and CTF), not only for validating them but also for improving these infrastructures, which are indispensable to make progress on accelerator science and making possible the construction of new accelerators.

iv. Stimulating, discussing and evaluating novel acceleration techniques and developing common R&D programs

   The proposed program of activities will also allow the investigation of the lines of accelerator R&D, which are already recognized as important for the future, such as linear collider studies. They will serve to establish and discuss what has to be dealt with and tested before any conceptual and/or technical design could be suggested. These activities will also provide the necessary input for defining and establishing a consistent work-plan aiming at developing novel techniques of acceleration likely to open new ways towards very high accelerating-gradients and consequently beam-collision energies. Indeed for the first time in Europe, a more global and coordinated approach will be carried out, targeted toward novel acceleration techniques. These studies will be imbedded within other approaches. The interaction between the different techniques is likely to be very stimulating and productive. In particular, coordination toward an integrated experiment to demonstrate GeV acceleration in 10cm will be set up, possibly leading to the proposal for a design study of a European test facility. These activities might prepare the long-term evolution of the European infrastructures.

A direct impact can be expected on the services provided by the research infrastructures from the four points above. In summary, it should manifest itself in

- Better operation of the existing infrastructures thanks to a better exchange of expertise and knowledge and by putting in common most advanced beam codes on particle acceleration, and transport. A code maintenance and distribution team will be formed.
- Better reliability and better beam properties leading to improved access
- Altogether more running time and better experimental condition can be expected, i.e. a better service provided by the infrastructure.
- More efficient and coordinated use of the available infrastructure for accelerator R&D
- Higher intensity and/or energy beams leading to improved research opportunities
- Prepare the long-term evolution of the European infrastructures

Finally, the expected additional resources coming from the European Commission will incite more people and more laboratories to work in and contribute to these activities, which will in turn induce an increase of the investments by local authorities on accelerator development and test infrastructures. These resources will also stimulate the participation of EU industrial partners into the projects and the initiatives to lower the costs of basic accelerator components.

2.2.3 Joint research activities

The proposed joint research activities cover the most critical and pressing issues, which need to be addressed as of today for producing better (higher quality, higher intensity, higher energy) beam for particle physics. Mastering the technologies, which are proposed, will lead to maximizing the impact on the related infrastructures. This is best summarized in the preceding table, which shows the relevance of the 4 Joint Research Activities with respect to the infrastructures. It is clear from this table that for each infrastructure several JRAs are useful in contributing to optimise the overall impact.

As an example of how the ensemble of JRAs may maximise the potential of a given infrastructure, we could consider the ensemble of the three JRAs, which have an impact on TTF/TESLA. The importance of JRA1 to TESLA has already been discussed above. JRA2 on photo-injectors is also of direct relevance to TTF/TESLA and TTF-VUV laser. Linear colliders and coherent light sources both require high brightness-low emittance electron beams in order to achieve the *luminosity* (LC) and *brilliance* (FEL) necessary for their exploitation. As a result they both employ photo-injector guns as an electron source, which is the very subject of JRA2. The application of JRA4 to TESLA is the very specific need for strong super-conducting magnetic elements, which find an application in the so-called *final focus* region upstream of the interaction point of collider.

In the very same way, a set of the proposed JRA will maximize the impact for producing intense Neutrino Beams and High-energy/High-Intensity Hadron Beams as they address series of most critical issues relevant to such infrastructures.

In summary, the integrated provision of the infrastructure related services is ensured owing to

- The CARE participants and their commitment (i.e. the vast majority of relevant infrastructures for accelerator research are participant of CARE)
- The CARE management and the coordination of subprojects, which are undertaken by senior staff physicists of the large infrastructures laboratories (CEA, CERN, CNRS-Orsay, DESY, INFN-LNF)
- The Governing Board, in which representatives of the large infrastructures laboratories are present
- The program of the Networking and Joint Research Activities, which integrates and optimises the use of the equipment and technical resources.

2.2.4 Impact on the level of performance of the infrastructures concerned.

The CARE program will directly allow one to raise the level of performance of the infrastructures.

- The program of the Networking and Joint Research Activities, which integrates and optimises the use of the equipment and technical resources.
- Networking Activities will compare and determine the best ways to upgrade the infrastructures both on the medium-term and on the long-term, for example with:
  - An increase of luminosity of LHC by a factor of ten and of its energy by about a factor of two
  - An upgrade of the CERN complex to increase very significantly the neutrino flux
  - An improved access to technical information on the infrastructures through specific technical databases
- Joint Research Activities will design, construct and test prototypes for accelerator components, which will be directly or indirectly used to improve the infrastructures. For example, on could expect
  - A 50% increase of the energy of TTF and better operation of the facility (better stability, efficiency and beam properties)
  - An upgrade of the CTF complex to demonstrate the 2 beam accelerator concept
  - An increase of a factor 2 on the neutrino flux to Gran Sasso,
  - A very significant increase of the proton flux for the fixed target experiment at CERN both for particle physics and nuclear physics with ISOLDE.
  - A more robust operation of the LHC and
  - The possibility to increase its luminosity and, on a longer-term, its energy

In summary, a very significant increase of the performance of the European infrastructures for particle physics and for accelerator research in general is expected.

2.3 Long term sustainability and structuring effect

As shown above, one of the main objectives of the CARE project is to structure the European area on accelerator research. The prospects to achieve such an ambitious goal are rather bright. This optimism is based on the fact that the entire particle physics community adheres to and supports this initiative (even at the worldwide level with non-EU participation and the support of the International Committee for Future Accelerator). Indeed,

1. All parties have a strong interest, motivation and commitment to CARE as it allows them to both strengthen their individual and collective expertise on the long-term.
2. The structure set in place will allow both extensive communication and wide dissemination of knowledge to take place, which is likely to continue after the completion of the CARE program.
3. A European Steering Group for Accelerator R&D (ESGARD), which includes representatives from all major high-energy infrastructure laboratories, has been set up to oversee and monitor the European accelerator R&D activities relevant for particle physics. The foundation of this committee can be considered already as a first step toward ensuring the long-term sustainability of the collaborative effort put in place for CARE. It can be partly attributed to FP6. Discussions are underway to expand it to other fields such as Nuclear Physics, Free Electron Laser. This committee will launch other initiatives such as Design Studies over the next years.
4. Most Joint Research Activities involves trans-field collaboration as well as industrial partnerships. They are the seed for extending or generating future collaborations.
5. CARE offers an ideal framework for establishing specific collaborative arrangements. Examples are already on their way, such as the IPHI project and a joint venture between industrial partners on the development of high performance superconductor cable. It is reasonable to expect that more such initiatives will be triggered, as people will collaborate more closely.
6. Several proposals for common European test platform are to be expected from the networking activities (for example: a Target Test Area and a Collector Test Facility in N2)
7. Most of the Joint Research Activities are likely to lead to collaborative agreements to upgrade existing infrastructure (TTF, CTF, CERN proton injector are good examples).They may even in some cases be the seed for the construction of new infrastructures. Finally, CARE will offer an ideal framework for developing the concept of Global Accelerator Network.

Overall the CARE project is promising to establish a unique and durable interaction

- Amongst European accelerator physicist including connections with non-European partners
- Between accelerator and particle physicists
- Between different research field
- Between researchers and industrial partners

CARE will ensure the emergence of new ideas, new projects and new collaborations in a coordinated way. Hence, it will provide all the ingredients for the long-term sustainability of the collaborative effort in the field of accelerator research, which it has initiated

3. List of Participants

The legal entities of the participants, the associated institutes and the associated industrial partners are listed in the following tables:

Participant number	Organisation (name, city, country)	Short name	Date enter project	Date exit project	Short description (i.e. fields of excellence) and specific roles in the consortium (* indicates work package responsibilities)
1	**Commissariat à l'Energie Atomique, Paris, France**	**CEA**	*start of project*	*end of project*	***Fields of excellence***: High Energy and Nuclear Physics, Research, Development, Construction and operation of Particle Accelerator (Beam dynamics, Superconducting RF Technologies, High Magnetic Field technologies), Computing, remote operation systems ***Specific participation in***: **N1*, N2*, N3, JRA1*, JRA3*, JRA4*** ***Specific Responsibilities***: **General coordinator, coordinator for management of CARE and JRA4**
2	**Uni. Catholique, Louvain la neuve, Belgium**	**UCLN**	*start of project*	*end of project*	***Fields of excellence***: High Energy and Nuclear Physics, Research, Development, Construction and operation of Particle Accelerator (ECR ion sources, cyclotrons, radioactive targets and radioactive beams) ***Specific participation in***: **N2**
3	**Centre National de Recherche Scientifique Paris, France**	**CNRS**	*start of project*	*end of project*	***Fields of excellence***: High Energy and Nuclear Physics Accelerators and Experiments, Construction and operation of Particle Accelerators and electron sources, Superconducting accelerators (cavities, couplers), neutrino horns, computing. Lasers and Plasmas for new techniques of acceleration ***Specific participation*** in: **N1*, N2, JRA1*, JRA2*, JRA3*** Specific Responsibilities: **coordinator for N1 and JRA1**
	CNRS/PNC/LAPP, Laboratoire d'Annecy le Vieux de physique des particules, Annecy leVieux, France	**CNRS-LAPP**	*start of project*	*end of project*	***Fields of excellence***: Active alignment, instrumentation and simulation ***Specific participation*** in: **N1**
	CNRS/PNC/CENBG, Centre d'Etudes Nucléaires de Bordeaux Gradignan, Bordeaux, France	**CNRS-CENBG**	*start of project*	*end of project*	***Fields of excellence***: Neutrino experiments ***Specific participation*** in: **N2**
	CNRS/PNC/LPSC, Laboratoire de Physique Subatomique et de Cosmologie, Grenoble, France	**CNRS-LPSC**	*start of project*	*end of project*	***Fields of excellence***: Ions sources. Accelerator design, construction and operation (GENEPI accelerator, IPHI collaboration). ***Specific participation*** in: **N2, JRA3***

Participant number	Organisation (name, city, country)	Short name	Date enter project	Date exit project	Short description (i.e. fields of excellence) and specific roles in the consortium (* indicates work package responsibilities)
	CNRS/PNC/IPNL, Institut de Physique Nucléaire de Lyon, Lyon, France	**CNRS-IPNL**	*start of project*	*end of project*	***Fields of excellence***: Neutrino Physics and experiments ***Specific participation*** in: **N2**
	CNRS-IN2P3-Orsay Orsay, France	**CNRS-Orsay**	*start of project*	*end of project*	***Fields of excellence***: RF guns, accelerator construction, room temperature and super-conducting cavities, RF power couplers, beam simulations, analytic modelling, and electromagnetic simulations. ***Specific participation*** in: **N1*, JRA1*, JRA2*, JRA3**
	CNRS/SPI/LPGP, Laboratoire de Physique des Gaz et des Plasmas, Orsay, France	**CNRS-LPGP**	*start of project*	*end of project*	***Fields of excellence***: Laser beat-wave, wake-field for accelerating electrons. Beam plasma interaction at high currents. ***Specific participation*** in: **N1***
	CNRS/SCH/LCP, Laboratoire de Chimie Physique d'Orsay, Orsay, France	**CNRS-LCP**	*start of project*	*end of project*	***Fields of excellence***: Photo-cathode production and preparation, lasers, RF source, high-charge and short pulse photo-injector ***Specific participation*** in: **N1**
	CNRS/SPM/CPHT, Centre de Physique Théorique de l'Ecole Polytechnique, Palaiseau, France	**CNRS-CPHT**	*start of project*	*end of project*	***Fields of excellence***: Simulation of laser-plasma interaction ***Specific participation*** in: **N1**
	CNRS/SPM/LOA, Laboratoire d'optique appliquée, Palaiseau, France	**CNRS-LOA**	*start of project*	*end of project*	***Fields of excellence***: lasers, plasmas, plasma-acceleration, charged-particle production ***Specific participation*** in: **N1, JRA2**
	CNRS/SPI/LULI, Laboratoire pour l'Utilisation des Lasers Intenses, Palaiseau, France	**CNRS-LULI**	*start of project*	*end of project*	***Fields of excellence***: Generation of very intense laser beat-wave, wake field. Particle generation and acceleration of electrons. ***Specific participation*** in: **N1**
	CNRS/PNC/LPNHE, Laboratoire Physique Nucléaire et Hautes Energies Paris, France	**CNRS-LPNHE**	*start of project*	*end of project*	***Fields of excellence***: neutrino physics ***Specific participation*** in: **N2**

Participant number	Organisation (name, city, country)	Short name	Date enter project	Date exit project	Short description (i.e. fields of excellence) and specific roles in the consortium (* indicates work package responsibilities)
4	**Gesellschaft fur Schwerionenforschung, Darmstadt, Germany**	**GSI**	*start of project*	*end of project*	***Fields of excellence***: Nuclear, atomic, plasma, and applied physics experiments with heavy ion beams, dynamics of high current beam transport and acceleration, development, design, construction and operation of heavy ion sources, linear and circular accelerators, storage rings, stochastic and electron cooling of stored beams, remote accelerator controls, computing, networking. ***Specific participation*** in: **N2, N3, JRA3***
5	**Institut fuer Angewandte Physik Frankfurt University Frankfurt, Germany**	**IAP-FU**	*start of project*	*end of project*	***Fields of excellence***: Linear Ion Accelerators, Volume Ion Sources, Low Energy Beam Transport, RFQ Development, Room Temperature and Superconducting Drift Tube Linac Development, Beam Optics and Beam Dynamics Computations ***Specific participation*** in: **JRA3**
6	**Deutsches Eletronen Synchrotron Hamburg, Germany**	**DESY**	*start of project*	*end of project*	***Fields of excellence***: Development, construction and operation of Particle Accelerators (linear accelerators, synchrotrons and storage rings for electrons, positrons and protons) for High Energy Physics and Synchrotron radiation sources, Superconducting Cavities, Superconducting Magnets, R&D on Linear colliders and Free Electron Lasers, Accelerator Controls, Computing, Networking, Video Communication Tools, Experience with far remote operations of the Tesla Test Facility and the Fermilab Photo-injector ***Specific participation*** in: **N1*, N3, JRA1*** Specific Responsibilities: **coordinator for JRA1**
7	**Forschungszentrum Jülich Jülich, Germany**	**FZJ**	*start of project*	*end of project*	***Fields of excellence***: Medium energy physics accelerators and experiments, reliability of operation; polarized protons; stochastic cooling, electron cooling; electron beam welding; remote accelerator control and automation, design of superconducting accelerating structures, design of high intensity and high energy accelerators ***Specific participation*** in: **N1, N2, JRA3**
8	**Technical University München, Germany**	**TUM**	*start of project*	*end of project*	***Fields of excellence***: Long term expertise in the field of neutrino *and muon physics* and experiments. It will contribute to the general steering and studies of the PHYSICS potential of future long baseline experiments. The studies aim at guiding the exploration, planning and construction of conceivable set-ups by identifying the capabilities and the crucial components and limitations. ***Specific participation*** in: **N2**

Participant number	Organisation (name, city, country)	Short name	Date enter project	Date exit project	Short description (i.e. fields of excellence) and specific roles in the consortium (* indicates work package responsibilities)
9	**Forschungszentrum Rossendorf, Germany**	**FZR**	*start of project*	*end of project*	***Fields of excellence***: Design and construction of intermediate energy accelerator, photo-injectors, photocathode for SC RF gun, synchrotron radiation source, Free Electron Laser, ELBE accelerator infrastructure. ***Specific participation*** in: **N1, JRA2***
10	**Istituto Nazionale di Fisica Nucleare Frascati, Italy**	**INFN**	*start of project*	*end of project*	***Fields of excellence***: High Energy and Nuclear Physics Accelerators and Experiments, Construction and operation of Particle Accelerators and Colliders, Accelerator Controls, Computing, Networking, Synchrotron Radiation Sources and Experiments, Astroparticle physics. ***Specific participation*** in: **N1*, N2*, N3, JRA1*, JRA2*, JRA3*, JRA4*** Specific Responsibilities: **coordinator for N2 and JRA2**
	INFN Bari Bari, Italy	**INFN-Ba**	*start of project*	*end of project*	***Fields of excellence***: Neutrino physics, hadroproduction data, muon cooling studies ***Specific participation*** in: **N2**
	INFN Frascati, Frascati, Italy	**INFN-LNF**	*start of project*	*end of project*	***Fields of excellence***: High Energy and Nuclear Physics Experiments, Construction and operation of electron and positron Particle Accelerators and Colliders, Beam Dynamics, Accelerator Diagnostics and Controls, Computing, Networking, Synchrotron Radiation Sources, FEL. ***Specific participation*** in: **N1*, N2, N3, JRA1*, JRA2*** Specific Responsibilities: **coordinator for JRA2**
	INFN Genoa, Genoa, Italy	**INFN-Ge**	*start of project*	*end of project*	***Fields of excellence***: Design of superconducting magnets. Finite element analyses. Electrical transport measurements on superconducting wires and cables. AC loss measurements on superconducting devices. ***Specific participation*** in**:** **N2, N3, JRA4**
	INFN Gran Sasso, L'Aquila, Italy	**INFN-GS**	*start of project*	*end of project*	***Fields of excellence***: Neutrino physics, main exploitation laboratory of the CNGS and of future facilities. ***Specific participation*** in: **N2**
	INFN Legnaro, Legnaro, Italy	**INFN-LNL**	*start of project*	*end of project*	***Fields of excellence***: SRF accelerator design and construction (ALPI). Chemistry and Electrochemistry Material surface treatments; Plastic deformation of materials and forming technology; Clean room (HPR and mounting); Thin film technology and PVD machine construction; Non destructive evaluation techniques, in particular flux gate magnetometry. ***Specific participation*** in: **N1, N2, JRA1***

Participant number	**Organisation (name, city, country)**	**Short name**	**Date enter project**	**Date exit project**	**Short description (i.e. fields of excellence) and specific roles in the consortium** (* indicates work package responsibilities)
	INFN Milano, Milano, Italy	**INFN-Mi**	*start of project*	*end of project*	***Fields of excellence***: Design, construction and test of superconducting (SC) cavities for electrons and protons and of SC magnets for accelerators and detectors. High current proton beam dynamics; cryostat and cryomodule design and construction; photocathode and laser for high brightness photoinjector; SC cable and material low temperature characterization; SC magnet protection system design, and test; accelerator remote operation (GAN). Robust electron sources and laser pulse shaping. ***Specific participation*** in: **N1, N2, N3, JRA1*, JRA2, JRA3*, JRA4***
	INFN Napoli, Napoli, Italy	**INFN-Na**	*start of project*	*end of project*	***Fields of excellence***: Neutrino physics and beams, hadroproduction data, cooling studies. Long term expertise in theoretical and experimental accelerator physics. ***Specific participation*** in: **N2, N3** Specific Responsibilities: **coordinator for N3**
	INFN Padova, Padova, Italy	**INFN-Pa**	*start of project*	*end of project*	***Fields of excellence***: Neutrino physics and beams, hadroproduction data, muon cooling studies ***Specific participation*** in: **N2***
	INFN Pisa, Pisa, Italy	**INFN-Pi**	*start of project*	*end of project*	***Fields of excellence***: Neutrino physics, phenomenology and theory ***Specific participation*** in: **N2**
	INFN Roma 2, Roma, Italy	**INFN-Ro2**	*start of project*	*end of project*	***Fields of excellence***: SC Cavity fabrication R&D, accelerator instrumentation and controls, computing and networking. ***Specific participation*** in: **N1, JRA1**
	INFN Roma Tre, Roma, Italy	**INFN-Ro3**	*start of project*	*end of project*	***Fields of excellence***: Neutrino physics, hadroproduction data, muon cooling studies ***Specific participation*** in: **N2**
	University of Salerno, Salerno, Italy	**INFN-Sal**	*start of project*	*end of project*	***Fields of excellence***: Relevant beam dynamics expertise: Impedance estimates in accelerator structures. Single- and multi-bunch beam instabilities. Further developments and application of analytic estimates and simulation codes will be used to characterise the impedance, and to study intensity limitations and ultimate performance of future High-Energy/High-Intensity Proton Accelerators, such as the LHC and its injectors, including beam dynamics with barrier buckets. ***Specific participation*** in: **N3**
	INFN Torino, Torino, Italy	**INFN-To**	*start of project*	*end of project*	***Fields of excellence***: Neutrino physics, phenomenology and theory ***Specific participation*** in: **N2**
	INFN Trieste, Triestre, Italy	**INFN-Tr**	*start of project*	*end of project*	***Fields of excellence***: Neutrino physics, hadroproduction data, muon cooling studies ***Specific participation*** in: **N2**

Participant number	Organisation (name, city, country)	Short name	Date enter project	Date exit project	Short description (i.e. fields of excellence) and specific roles in the consortium (* indicates work package responsibilities)
11	**Twente University Enschede, Netherlands**	**TEU**	*start of project*	*end of project*	***Fields of excellence***: Theoretical and experimental research on superconducting wire and cable, development of superconducting demonstration devices (NbTi, Nb3Sn and HTS), experience on design and manufacture of Nb3Sn dipole magnet models. Development for photo-cathodes and photo-injectors. ***Specific participation*** in: **N1, N3, JRA2, JRA4***
12	**Technical University Lodz, Poland**	**TUL**	*start of project*	*end of project*	***Fields of excellence***: Full-custom design and HDL synthesis of modern ASIC-VLSI circuits, Data acquisition and processing systems, Control systems, power electronics, hardware-software code design of digital systems, software tools for system design and simulation. ***Specific participation*** in: **N1, JRA1**
13	**The Andrzej Soltan Institute for Nuclear Studies Otwock-Swierk, Poland**	**IPJ**	*start of project*	*end of project*	***Fields of excellence***: High Energy and Nuclear Physics, Accelerator Physics and Technology (modelling of beam dynamics, bunching etc., design of accelerator parts, power supplies etc.), Plasma Physics and Technology (plasma diagnostics and techniques for material engineering, e.g. UHV-arc deposition of superconductor layers etc.) ***Specific participation*** in: **N1, JRA1**
14	**Politechnika Warszawska, University of Technology, Institute of Electronic Systems Warsaw, Poland**	**WUT-ISE**	*start of project*	*end of project*	***Fields of excellence***: Analog digital and mixed electronic systems and instrumentation, microwave and optical/photonic circuits and systems, microprocessor and computer and software engineering, distributed large and multichannel measurement systems, multi-gigabit optical links and networks, FPGA/DSP systems design, Internet engineering, image processing systems, neural networks and fuzzy systems ***Specific participation*** in: **N1, JRA1**
15	**University of Technology Wroclaw, Poland**	**WUT**	*start of project*	*end of project*	***Fields of excellence***: Mechanical Engineering, Refrigeration and Cryogenics, Research, Development, Construction and Commissioning of Cryogenic Systems (modeling of cooling systems and refrigerators, heat transfer and material thermal properties, flow calculations, modeling of magnet resistive transition thermo hydraulics etc.) ***Specific participation*** in: **N3, JRA4**
16	**Consejo Superior de Investigaciones Cientificas, Madrid, Spain**	**CSIC**	*start of project*	*end of project*	***Fields of excellence***: High energy experiments, accelerator studies, superconducting magnets, power supplies ***Specific participation*** in: **N1, N2, N3**
	Univ. of Barcelona, Barcelona, Spain	**UBa**	*start of project*	*end of project*	***Fields of excellence***: Experimental neutrino physics ***Specific participation*** in: **N2**

Participant number	Organisation (name, city, country)	Short name	Date enter project	Date exit project	Short description (i.e. fields of excellence) and specific roles in the consortium (* indicates work package responsibilities)
	CIEMAT, Madrid, Spain	**CIEMAT**	*start of project*	*end of project*	***Fields of excellence***: Design and fabrication of superconducting magnets ***Specific participation*** in: **N1, N3**
	Universidad Autonoma de Madrid Madrid, Spain	**UAM**	*start of project*	*end of project*	***Fields of excellence***: Recognized leadership in the field of theory and phenomenology of neutrinos. ***Specific participation*** in: **N2**
	Lab. of Industr. Electron. & Instrum. Uni. Valencia, Valencia, Spain	**LEII**	*start of project*	*end of project*	***Fields of excellence***: Design of power supplies ***Specific participation*** in: **N1**
	University of Valencia Valencia, Spain	**IFIC**	*start of project*	*end of project*	***Fields of excellence***: Design optics, modelling of machine imperfections and beam based measurements ***Specific participation*** in: **N1, N2, N3**
17	**European Organization for Nuclear Research Geneva, Switzerland**	**CERN**	*start of project*	*end of project*	***Fields of excellence***: High energy Physics Accelerators and Experiments, Nuclear Physics accelerators including heavy ions and antiproton decelerator, Superconducting Cavities, Superconducting Magnets, Accelerator Controls, Computing, Networking, Video Communication Tools, Linear colliders, Photocathodes, Neutrino Factories, High Intensity Proton Machines, Ion Sources ***Specific participation*** in: **N1*, N2*, N3*, JRA2, JRA3, JRA4*** Specific Responsibilities: **coordinator for N3, JRA3**
18	**Université de Genève, Genève, Switzerland**	**UNI-GE**	*start of project*	*end of project*	***Fields of excellence***: A consortium of physicists from Swiss Universities contributing long-term expertise in the field of neutrino physics, experiments & beams (design, detailed simulation, operation and analysis of their data), expertise in horn technology and in the field of intense low energy muon beams and leadership in the experimental studies of muon ionisation cooling. It will contribute to the general steering and to the PHYSICS, TARGET, HORN, COOLING WPs. ***Specific participation*** in: **N2**
19	**Paul Scherrer Institute Villingen, Switzerland**	**PSI**	*start of project*	*end of project*	***Fields of excellence***: Development, construction and operation of electron and proton accelerators (linear accelerators, synchrotrons, storage rings and cyclotrons) for synchrotron radiation, nuclear, atomic and applied physics experiments. Development and operation of (digital) feedback systems for particle beam stabilization and RF-control. Research and development of accelerator instrumentation and data processing electronics. ***Specific participation*** in: **N1, N2, N3, JRA1**

Participant number	Organisation (name, city, country)	Short name	Date enter project	Date exit project	Short description (i.e. fields of excellence) and specific roles in the consortium (* indicates work package responsibilities)
20	**Council for the Central Laboratory of the Research Councils Oxfordshire & Daresbury,United Kingdom**	**STFC**	*start of project*	*end of project*	***Fields of excellence***: High Energy Physics Accelerators and Experiments, proton accelerators, beam dynamics, targets for proton beams, synchrotron radiation sources and experiments, photo-injectors, free electron lasers, accelerator controls, superconducting magnets, computing. ***Specific participation*** in: **N1*, N2*, N3, JRA2*, JRA3, JRA4***
	Daresbury Laboratory Daresbury, UK	**STFC-DL**	*start of project*	*end of project*	***Fields of excellence***: RF design. Small emittance electron sources. Laser acceleration. SC cavity design. RF coupler design. Machine simulation. Laser-plasma acceleration. Design and construction of linear accelerator components. High brightness gun design. Beam diagnostics and instrumentation (DL provides the coordinator for WP4). General coordination of many UK network activities. ***Specific participation*** in: **N1***
	Rutherford Appleton Laboratory Oxfordshire, UK	**STFC-RAL**	*start of project*	*end of project*	***Fields of excellence***: High Energy Physics Accelerators and Experiments, accelerator physics and technology, lasers for photoinjectors, high brightness gun design, beam diagnostics using laser devices. laser-plasma acceleration, instrumentation, pulsed proton accelerators, high power target , ion sources, RFQs, chopper development, beam dynamics, superconducting magnets. ***Specific participation*** in: **N1, N2*, N3, JRA2*, JRA3, JRA4***
21	**Imperial College London, United Kingdom**	**ICL**	*start of project*	*end of project*	***Fields of excellence***: Particle Physics experimentation, machine-experiment interface in experiments, electronics, muon cooling design, high gradient electron and ion acceleration techniques using laser-produced plasmas, diagnostic techniques, theoretical modelling of laser-plasma interactions. ***Specific participation*** in: **N1, N2, N3**
22	**Manchester University Manchester, United Kingdom**	**UMA**	*start of project*	*end of project*	***Fields of excellence***: Particle Physics experimentation, simulation of beam delivery systems at linear colliders, beam diagnostics. ***Specific participation*** in: **N1**

Participant number	Organisation (name, city, country)	Short name	Short description (i.e. fields of excellence) and specific roles in the consortium (* indicates work package responsibilities)	Associated to
Associated Institutes				
1	**Helsinki Institute of Physics, Helsinki, Finland**	**HIP**	***Fields of excellence***: Beam diagnostics tools and instrumentation. HEPH is assisted by a consortium of Finnish institutes and industry with expertise in RF measurements, automation and vacuum related mechanics and welding. ***Specific participation*** in: **N1**	CERN
2	**European Synchrotron Radiation Facility, Grenoble, France**	**ESRF**	***Fields of excellence***: Beam dynamics and beam instrumentation expertise ***Specific participation*** in: **N3**	CERN
3	**RWTH, Aachen, Germany**	**RWTH**	***Fields of excellence***: High energy experiments, beam instrumentation ***Specific participation*** in: **N1**	DESY
4	**Max Born Inst Berlin, Germany**	**MBI**	***Fields of excellence***: Laser, RF gun ***Specific participation*** in: **N1**	DESY
5	**Technical Univ. Berlin Berlin, Germany**	**TUBE**	***Fields of excellence***: High frequency planar RF cavities, beam position monitors, wake field calculations ***Specific participation*** in: **N1, N3**	CERN
6	**TEMF/ Tech. Univ. Darmstadt, Darmstadt, Germany**	**TEMF**	***Fields of excellence***: Simulation code for machine modelling, RF gun ***Specific participation*** in: **N1, N3**	DESY
7	**Institiut für Theoretische Physik Düsseldorf, Germany**	**UDUSS**	***Fields of excellence***: Novel methods of acceleration, simulation of particle acceleration in plasma using PIC (particle in cell) codes ***Specific participation*** in: **N1**	CERN
8	**Max-Planck-Institut für Quantumnoptik, Garching, Germany**	**MPQ**	***Fields of excellence***: High intensity laser technology, relativistic plasma and electron generation and acceleration with laser-produced plasma, associated diagnostics ***Specific participation*** in: **N1**	CERN
9	**Forschungszentrum, Karlsruhe, Karlsruhe, Germany**	**FZK**	***Fields of excellence***: SMES, modulator, pulsed power sources ***Specific participation*** in: **N1, N3**	DESY
10	**University of Rostock, Rostock, Germany**	**UROS**	***Fields of excellence***: Space charge simulation, code development, HOMs ***Specific participation*** in: **N1**	DESY
11	**University of Wuppertal, Wuppertal, Germany**	**UWUP**	***Fields of excellence***: High gradient cavities, field emission control ***Specific participation*** in: **N1**	DESY

Participant number	Organisation (name, city, country)	Short name	Short description (i.e. fields of excellence) and specific roles in the consortium (* indicates work package responsibilities)	Associated to
Associated Institutes				
12	**Ente per le Nuove Tecnologie l'Energia e l'Ambiente Roma, Italy**	**ENEA**	***Fields of excellence***: Long experience in using tools capable to determine the nuclear responses in different components of magnetic fusion reactors. Those has been used (Monte Carlo methods mainly) to optimise the shields necessary to protect from the nuclear radiation the Superconducting Coils used to sustain the plasma in magnetic fusion reactors. Relevant work and contracts for ITER (International Thermonuclear Experimental Reactor). ***Specific participation*** in: **N3**	CERN
13	**University of Osaka, Osaka, Japan**	**UnO**	***Fields of excellence***: Neutrino and muon physics, accelerators, experiments, theory. Leading institution in the NuFACTJ Collaboration ***Specific participation*** in: **N2**	CERN
14	**KEK, High Energy Accelerator Research Organization Tsukuba, Japan**	**KEK**	***Fields of excellence***: Expertise in Sc magnets for Accelerators and detectors and SC accelerator integration. Development of design and constructing techniques for super conducting magnets, development of special conductors. Experience in the operation of storage rings with electron cloud effects and development of electron cloud simulation tools, design studies on linear colliders, development of klystrons, modulators and normal conducting RF cavities. ***Specific participation*** in: **N3**	CERN
15	**Institute of Physics, University of Latvia, Latvia,**	**IPUL**	***Fields of excellence***: IPUL has many years of expertise in designing and operating liquid metal loops and in developing necessary equipment and technologies. ***Specific participation*** in: **N2**	FZJ
16	**NRG Petten Netherlands**	**NRG**	***Fields of excellence***: NRG is experienced in fluid dynamics, structural mechanics and thermal hydraulics calculations and in developing suitable computer software. ***Specific participation*** in: **N2**	FZJ
17	**Eindhoven University of Technology Eindhoven, Eindhoven, Netherlands**	**TUE**	***Fields of excellence***: Photo--injectors and photo-guns. High brightness electron beams for FEL, colliders and laser wakefield accelerators ***Specific participation*** in: **N1**	CERN
18	**Group of Lasers & Plasmas of the Inst Sup Tecnico Lisboa, Lisboa, Portugal**	**GOLP**	***Fields of excellence***: Simulation and experiments on laser-plasma interactions and accelerators ***Specific participation*** in: **N1**	CERN
19	**Joint Institute of Nuclear Research, Dubna, Russia**	**JINR**	***Fields of excellence*****:** Expertise in accelerator magnets and integration. Design capability and studies on synchrotron radiation effect. Very special expertise in fast cycled magnets at low temperature. FEM produced power pulses and cavity-cell heating-tests. ***Specific participation*** in: **N3**	CERN

Participant number	Organisation (name, city, country)	Short name	Short description (i.e. fields of excellence) and specific roles in the consortium (* indicates work package responsibilities)	Associated to
Associated Institutes				
20	**Institute for High Energy Physics, Moscow, Russia**	**IHEP**	***Fields of excellence*** Radiation and shower calculations ***Specific participation*** in: **N3**	CERN
21	**University of Uppsala, Uppsala, Sweden**	**UPSA**	***Fields of excellence***: CTF3 commissioning. Tests of optics, modelling, and development of beam monitoring equipment. ***Specific participation*** in: **N1**	CERN
22	**Université Bern, Bern, Switzerland**	**UNI-Bern**	***Fields of excellence*****:** Experimental neutrino physics. ***Specific participation*** in: **N2**	UNI-GE
23	**Université de Neuchâtel, Neutchâtel, Switzerland**	**UNI-Neuchatel**	***Fields of excellence*****:** Experimental neutrino physics. ***Specific participation*** in: **N2**	UNI-GE
24	**Ecole Polytechnique Fédérale de Lausanne Centre de Recherches en Physique des Plasma Lausanne, Switzerland**	**CRPP**	***Fields of excellence***: Design and characterization of high current carrying superconductors (both low and high Tc). Experiments and analyses in the field of ac losses, quench and stability. Fusion magnets. World largest test facility for low temperature, short length superconductors (SULTAN). ***Specific participation*** in: **N3**	CERN
25	**Eidgenossiche Technische Hochscule, Zurich, Switzerland**	**ETHZ**	***Fields of excellence***: Very high frequency oscillators with applications to CTF3, fast optics, short pulse and survey and detector alignment ***Specific participation*** in: **N1, N3**	CERN
26	**Physik-Institut Universitat Zurich Zurick, Switzerland**	**PIUZ**	***Fields of excellence***: Muon beams and muon experiments. High power beams and targets. ***Specific participation*** in: **N2**	UNI-GE
27	**University of Bath, Bath, U.K.**	**BAT**	***Fields of excellence***: Electromagnetic levitation. ***Specific participation*** in: **N2**	ICL
28	**Brunel University, Uxbridge, U.K.**	**BRU**	***Fields of excellence***: Particle Physics experiments, computing and software, ionisation cooling studies. ***Specific participation*** in: **N2**	ICL
29	**University of Cambridge, Cambridge, U.K.**	**CAM**	***Fields of excellence***: Particle Physics experiments, neutrino physics studies. ***Specific participation*** in: **N2**	ICL

Participant number	**Organisation (name, city, country)**	**Short name**	**Short description (i.e. fields of excellence) and specific roles in the consortium** (* indicates work package responsibilities)	**Associated to**
Associated Institutes				
30	**University of Abertay, Dundee, U.K.**	**UAD**	***Fields of excellence***: Ultra short electron bunch measurements with ultra fast lasers for LC ***Specific participation*** in: **N1**	UMA
31	**University of Durham, Durham, UK**	**DUR**	***Fields of excellence***: Neutrino physics studies ***Specific participation*** in: **N2**	ICL
32	**University of Edinburgh, Edinburgh, U.K.**	**EDIN**	***Fields of excellence*****:** Particle Physics experiments, computing and software, ionisation-cooling studies. ***Specific participation*** in: **N2**	ICL
33	**University of Glasgow, Glasgow, U.K.**	**GLA**	***Fields of excellence***: Particle Physics experiments, computing and software, ionisation cooling studies ***Specific participation*** in: **N2**	ICL
34	**University of Lancaster, Lancaster, UK**	**LANC**	***Fields of excellence***: RF component design and simulation. ***Specific participation*** in: **N1**	UMA
35	**Queen Mary, Univ. of London, London, U.K.**	**QMUL**	***Fields of excellence***: Luminosity optimisation, simulation of beam transportation, prototype for fast feedback, neutrino physics studies. ***Specific participation*** in: **N1, N2**	UMA
36	**Royal Holloway, Univ. of London, London, U.K.**	**RHUL**	***Fields of excellence***: Geant4 simulation of beam line, laserwire R&D, collimation, luminosity spectrum ***Specific participation*** in: **N1**	UMA
37	**University College London, London, U.K.**	**UCL**	***Fields of excellence***: Laserwire R&D, Shintake monitor, luminosity spectrum ***Specific participation*** in: **N1**	UMA
38	**University of Liverpool, Liverpool, U.K.**	**ULI**	***Fields of excellence***: Simulation of beam delivery spectrum, positron undulator source, neutrino physics studies, ionisation muon cooling studies. ***Specific participation*** in: **N1, N2**	UMA
39	**University of Oxford Oxford, U.K.**	**UOX**	***Fields of excellence***: Particle Physics experimentation, neutrino physics studies, ionisation cooling studies, instrumentation for beam alignment, diagnostics, beam profile, beam delivery. Plasma for novel acceleration**.** RF power supply technology. ***Specific participation*** in: **N1, N2**	ICL
40	**University of Sheffield, Sheffield, U.K.**	**SHEF**	***Fields of excellence***: Particle physics experimentation, neutrino physics studies, mechanical aspects of targetry, ionisation muon cooling studies. ***Specific participation*** in: **N2**	ICL

Participant number	Organisation (name, city, country)	Short name	Short description (i.e. fields of excellence) and specific roles in the consortium (* indicates work package responsibilities)	Associated to
Associated Institutes				
41	**University of Southampton, Southampton, U.K.**	**SOTON**	***Fields of excellence***: Neutrino physics studies ***Specific participation*** in: **N2**	ICL
42	**Univ. of Strathclyde Glasgow, U.K.**	**USTRAT**	***Fields of excellence***: Laser plasma interactions and FEL, RF engineering for accelerators. ***Specific participation*** in: **N1**	UMA
43	**University of Sussex, Sussex, U.K.**	**SUSS**	***Fields of excellence***: Particle Physics experimentation, neutrino physics studies. ***Specific participation*** in: **N2**	ICL
44	**Fermi National Accelerator Laboratory Batavia, U.S.A.**	**FNAL**	***Fields of excellence***: Expertise in SC hadron collider integration and operation. Design and construction of accelerator magnets, test of magnets. Specific experience in high field A15 accelerator magnets R&D, design of innovative solution of VLHC (like the handling of synchrotron radiation). Radiation shielding calculations. Design work on linear colliders of SC and NC technology ***Specific participation*** in: **N3**	CERN
45	**Lawrence Berkeley National Laboratory, Berkeley, U.S.A.**	**LBNL**	***Fields of excellence*****:** Expertise in SC magnets for accelerators and wide experience in very high field design and construction technique. Test of SC magnets. Reference centre for cabling of Rutherford cable and of A15 and HTS development and test for accelerators ***Specific participation*** in **N3**	CERN
46	**Brookhaven National Laboratory U.S.A.**	**BNL**	***Fields of excellence***: Expertise in SC hadron collider integration and operation, Accelerator Magnets design and construction, cable design, and test; recent development for cycling SC magnets and HTS special designed magnets ***Specific participation*** in: **N3**	CERN
Associated industrial partners				
47	**Alsthom MSA Belford, France**	**ALS**	***Fields of excellence***: Design and manufacture of superconducting wire and cable, design and manufacture of superconducting magnet. ***Specific participation*** in: **JRA4**	CERN
48	**ACCEL Instruments GmbH, Bergisch-Gladbach Germany**	**ACCEL**	***Fields of excellence***: Design and fabrication of complete accelerating systems (normal- and superconducting), design and fabrication of superconducting cavities, infrastructure for chemistry and clean-room work, EB welding facility ***Specific participation*** in: **N1, JRA1**	DESY
49	**WSK Messtechnik GmbH, Hanau, Germany**	**WSK**	***Fields of excellence***: Design and fabrication of analytic equipment for material analysis, development of a SQUID scanner for examination of sputter targets ***Specific participation*** in: **N1, JRA1**	DESY

Participant number	Organisation (name, city, country)	Short name	Short description (i.e. fields of excellence) and specific roles in the consortium (* indicates work package responsibilities)	Associated to
Associated industrial partners				
50	**European Advanced Superconductors GmbH, Hanau, Germany**	**EAS**	***Fields of excellence***: Design and manufacture of superconducting wires. ***Specific participation*** in: **JRA4**	CERN
51	**Henkel Lohnpoliertechnik GmbH Neustadt-Glewe, Germany**	**HLT**	***Fields of excellence***: chemical and electrochemical surface treatment of steel and special alloys for pharma, biotech. and semiconductor industry ***Specific participation*** in: **JRA1**	DESY
52	**E. Zanon S.P.A., Schio, Italy**	**ZANON**	***Fields of excellence***: Design and fabrication of Nb cavities, infrastructure for chemistry, EB welding facility ***Specific participation*** in: **N1**, **JRA1**	DESY
53	**ShapeMetal Innovation BV, Enschede, Netherlands**	**SMI**	***Fields of excellence***: Design and manufacture of Nb3Sn wires by the powder-in-tube technique. ***Specific participation*** in: **JRA4**	CERN
54	**Kriosystem Ltd. Poland**	**KRIO**	***Fields of excellence***: Design and manufacture of helium cryostats. ***Specific participation*** in: **JRA4**	WUT
55	**e2v Technologies Ltd, Chelmsford, UK**	**E2V**	***Fields of excellence***: Design and manufacture of RF, microwave and switching devices, sensors, power supplies, etc. ***Specific participation*** in: **N1**	STFC
56	**TMD Technologies Ltd, Hayes, UK**	**TMD**	***Fields of excellence***: Design and manufacture of microwave tubes, high voltage power supplies, transmitters and receivers. ***Specific participation*** in: **N1**	STFC
57	**Oxford Danfysik Ltd, Oxford, UK**	**DAN**	***Fields of excellence***: Design, production and installation of synchrotron beam lines. ***Specific participation*** in: **N1**	STFC
58	**Technical Systems Ltd, Reading, UK**	**TECUK**	***Fields of excellence***: Design and manufacture of electron beam linear accelerators for industrial and scientific uses. ***Specific participation*** in: **N1**	STFC

4. List of Activities

The participants to the contract will perform the activities summarised in these tables:

Activity Number	Descriptive Title	Short description and specific objectives of the activity
Networking activities		
N1 **ELAN**	Electron Linear Accelerator Network	The project N1 aims at coordinating the European R&D on electron accelerators and colliders and at defining a strategy to optimise the cost and reliability of present technologies, in particular supra conductive linacs using TTF at DESY. For the longer term, the aim is to define a roadmap for multi-TeV colliders, using CTF at CERN. Generating new ideas in instrumentation and evaluating the most advanced acceleration techniques using lasers and plasmas will also be part of the mission.
N2 **BENE**	Beams for European Neutrino Experiments	The project N2 aims at co-ordinating and integrating the activities of the accelerator and particle physics communities that are giving or promise contributions to the realization of upgraded and/or new European neutrino facilities of unprecedented performance. The final objectives are 1) recommend the optimal road map from the present infrastructure to the most rewarding future facilities, including conventional neutrino Superbeams, Neutrino Factories and Betabeams 2) assemble a coherent community capable to sustain the long term program of R&D, technical realization and scientific exploitation.
N3 **HEHIHB**	High-Energy High-Intensity Hadron Beams	The project N3 aims at identifying the main obstacles for pushing the beam intensity and energy in a collider storage ring beyond those of the LHC. The N3 activities address in this context machine operation aspects as well as technical challenges for the accelerator hardware. Over a period of 5 years the project aims at defining a roadmap for cost efficient solutions for a future high energy and high intensity hadron collider. The project is organized in 3 working groups each specialising on one challenge for achieving high intensity and high energy proton beams: 1) Advancements in accelerator magnet technologies (AMT), novel methods for accelerator beam instrumentation (ABI) and accelerator physics and optics design (APD).

Activity Number	Descriptive Title	Short description and specific objectives of the activity
Research activities		
JRA1 **SRF**	Super-conducting Radio Frequency	R&D on superconducting cavity technology in order to upgrade the quality of the existing SRF accelerator test facility TTF and to develop the basis of improved SRF systems for superconducting accelerators. The activity will include the following studies and developments of prototypes: • implementation of electro-polishing for better surface quality (roughness $<1\mu m$), • exploration of new fabrication methods such as vacuum arc coating, • improving the methods for quality control (sensitivity), • developing improved input couplers, • developing new cold tuner systems, • improving the reliability of RF components and developing low-cost prototypes, • performing integrated tests of the cavities, couplers, tuners…. under development.
JRA2 **PHIN**	Charge production with Photo-Injectors	Research and Development on charge-production by interaction of a laser pulse with material within an RF field. Coordination of the efforts done in various Institutes on the photo-injectors devoted to improve or extend the existing infrastructures like CTF. The activities include the study, design, realization and test of: • Photocathodes with high quantum efficiency and lifetime • Laser systems to produce long train of high charge electron bunches • 3 GHz RF gun with innovative photo-cathode with high charge and high average current or low emittance • Superconducting RF gun • Alternative electron source using laser-driven plasma
JRA3 **HIPPI**	High Intensity Proton Pulsed Injector	Integrated development of the technology required for the upgrade or construction of high intensity proton pulsed linear injectors (linacs) with beam energies below 200 MeV. This includes the studies and prototyping of • Normal conducting Accelerating Structures • Superconducting accelerating structures • Beam chopping • Beam Dynamics
JRA4 **NED**	Next European Dipole (High Magnetic Field Tech.)	The Joint Research Activities aim at integrating and coordinating superconducting accelerator magnet technology in Europe. The project has 3 main objectives: • To address coil cooling issues, • To promote high performance Nb_3Sn wire development in collaboration with European industry • To improve Nb_3Sn conductor insulation

5. Financial information for the whole duration of the project

Financial information – whole duration of the project

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 (whole duration 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
1	CEA		FC	Eligible costs	*Direct costs (a)*	4 526 491		844 500	90 000				5 460 991	
					of which subcontracting	0		0	0				0	
					Indirect costs (b)	2 576 509		647 500	0				3 224 009	
					Total eligible costs (a)+(b)	7 103 000		1 492 000	90 000				8 685 000	
				Requested EC contribution		1 645 000		624 200	90 000				**2 359 200**	
2	UCLN		AC	Eligible costs	*Direct costs (a)*	0			5 167				5 167	
					of which subcontracting	0			0				0	
					Indirect costs (b)	0			1 033				1 033	
					Total eligible costs (a)+(b)	0			6 200				6 200	
				Requested EC contribution		0			6 200				**6 200**	
3	CNRS		FCF	Eligible costs	*Direct costs (a)*	5 431 667			132 500				5 564 167	
					of which subcontracting	0			0				0	
					Indirect costs (b)	1 086 333			26 500				1 112 833	
					Total eligible costs (a)+(b)	6 518 000			159 000				6 677 000	
				Requested EC contribution		2 055 000			159 000				**2 214 000**	
4	GSI		FC	Eligible costs	*Direct costs (a)*	1 476 000			26 800				1 502 800	
					of which subcontracting	0			0				0	
					Indirect costs (b)	205 000			0				205 000	
					Total eligible costs (a)+(b)	1 681 000			26 800				1 707 800	
				Requested EC contribution		363 000			26 800				**389 800**	
TOTAL				Eligible costs										
				Requested EC contribution										

Financial information – whole duration of the project

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 (whole duration of the project)		Costs and EC contribution per type of activities: 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		AC	Eligible costs	*Direct costs (a)*	836 667			0				836 667	
					of which subcontracting	0			0				0	
					Indirect costs (b)	167 333			0				167 333	
					Total eligible costs (a)+(b)	1 004 000			0				1 004 000	
				Requested EC contribution		420 000			0				**420 000**	
6	DESY		AC	Eligible costs	*Direct costs (a)*	1 365 833			177 500				1 543 333	
					of which subcontracting	290 000			0				290 000	
					Indirect costs (b)	215 167			35 500				250 667	
					Total eligible costs (a)+(b)	1 581 000			213 000				1 794 000	
				Requested EC contribution		1 581 000			213 000				**1 794 000**	
7	FZJ		FC	Eligible costs	*Direct costs (a)*	1 421 000			39 000				1 460 000	
					of which subcontracting	0			0				0	
					Indirect costs (b)	854 000			0				854 000	
					Total eligible costs (a)+(b)	2 275 000			39 000				2 314 000	
				Requested EC contribution		527 000			39 000				**566 000**	
8	TUM		FC	Eligible costs	*Direct costs (a)*	0			8 583				8 583	
					of which subcontracting	0			0				0	
					Indirect costs (b)	0			1 717				1 717	
					Total eligible costs (a)+(b)	0			10 300				10 300	
				Requested EC contribution		0			10 300				**10 300**	
TOTAL				Eligible costs										
				Requested EC contribution										

Financial information – whole duration of the project

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 (whole duration 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)*	341 667			18 333				360 000	
					of which subcontracting	0			0				0	
					Indirect costs (b)	68 333			3 667				72 000	
					Total eligible costs (a)+(b)	410 000			22 000				432 000	
				Requested EC contribution		380 000			22 000				**402 000**	
10	INFN		AC	Eligible costs	*Direct costs (a)*	1 731 667			167 000				1 898 667	
					of which subcontracting	0			0				0	
					Indirect costs (b)	346 333			33 400				379 733	
					Total eligible costs (a)+(b)	2 078 000			200 400				2 278 400	
				Requested EC contribution		1 934 000			200 400				**2 134 400**	
11	TEU		FC	Eligible costs	*Direct costs (a)*	346 000			18 500				364 500	
					of which subcontracting	0			0				0	
					Indirect costs (b)	274 000			0				274 000	
					Total eligible costs (a)+(b)	620 000			18 500				638 500	
				Requested EC contribution		282 000			18 500				**300 500**	
12	TUL		AC	Eligible costs	*Direct costs (a)*	210 833			8 333				219 166	
					of which subcontracting	0			0				0	
					Indirect costs (b)	42 167			1 667				43 834	
					Total eligible costs (a)+(b)	253 000			10 000				263 000	
				Requested EC contribution		253 000			10 000				**263 000**	
TOTAL				Eligible costs										
				Requested EC contribution										

Financial information – whole duration of the project

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 (whole duration 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
13	IPJ		AC	Eligible costs	*Direct costs (a)*	333 333			8 333				341 666	
					of which subcontracting	0			0				0	
					Indirect costs (b)	66 667			1 667				68 334	
					Total eligible costs (a)+(b)	400 000			10 000				410 000	
				Requested EC contribution		235 000			10 000				**245 000**	
14	WUT-ISE		AC	Eligible costs	*Direct costs (a)*	308 333			6 667				315 000	
					of which subcontracting	0			0				0	
					Indirect costs (b)	61 667			1 333				63 000	
					Total eligible costs (a)+(b)	370 000			8 000				378 000	
				Requested EC contribution		370 000			8 000				**378 000**	
15	WUT		AC	Eligible costs	*Direct costs (a)*	54 667			4 167				58 834	
					of which subcontracting	48 000			0				48 000	
					Indirect costs (b)	1 333			833				2 166	
					Total eligible costs (a)+(b)	56 000			5 000				61 000	
				Requested EC contribution		56 000			5 000				**61 000**	
16	CSIC		FC	Eligible costs	*Direct costs (a)*	0			41 833				41 833	
					of which subcontracting	0			0				0	
					Indirect costs (b)	0			8 367				8 367	
					Total eligible costs (a)+(b)	0			50 200				50 200	
				Requested EC contribution		0			50 200				**50 200**	
TOTAL				Eligible costs										
				Requested EC contribution										

Financial information – whole duration of the project

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 (whole duration 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
17	CERN		AC	Eligible costs	*Direct costs (a)*	2 937 500			312 750				3 250 250	
					of which subcontracting	600 000			0				600 000	
					Indirect costs (b)	467 500			62 550				530 050	
					Total eligible costs (a)+(b)	3 405 000			375 300				3 780 300	
				Requested EC contribution		2 413 000			342 300				**2 755 300**	
18	UNI-GE		AC	Eligible costs	*Direct costs (a)*	0			77 500				77 500	
					of which subcontracting	0			0				0	
					Indirect costs (b)	0			15 500				15 500	
					Total eligible costs (a)+(b)	0			93 000				93 000	
				Requested EC contribution		0			(93 000)*				**(93 000)***	
19	PSI		FC	Eligible costs	*Direct costs (a)*	325 000			53 400				378 400	
					of which subcontracting	0			0				0	
					Indirect costs (b)	35 000			0				35 000	
					Total eligible costs (a)+(b)	360 000			53 400				413 400	
				Requested EC contribution		(360 000)*			(53 400)*				**(413 400)***	
20	STFC		FC	Eligible costs	*Direct costs (a)*	2 024 000			82 800				2 106 800	
					of which subcontracting	0			0				0	
					Indirect costs (b)	1 910 000			0				1 910 000	
					Total eligible costs (a)+(b)	3 934 000			82 800				4 016 800	
				Requested EC contribution		640 000			82 800				**722 800**	
TOTAL				Eligible costs										
				Requested EC contribution										

Financial information – whole duration of the project

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 (whole duration 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			74 417				74 417	
					of which subcontracting	0			0				0	
					Indirect costs (b)	0			14 883				14 883	
					Total eligible costs (a)+(b)	0			89 300				89 300	
				Requested EC contribution		0			89 300				**89 300**	
22	UMA		AC	Eligible costs	*Direct costs (a)*	0			32 500				32 500	
					of which subcontracting	0			0				0	
					Indirect costs (b)	0			6 500				6 500	
					Total eligible costs (a)+(b)	0			39 000				39 000	
				Requested EC contribution		0			39 000				**39 000**	
TOTAL				Eligible costs		32 048 000		1 492 000	1 601 200				35 141 200	
				Requested EC contribution		**13 154 000 (+360000)***		**624 200**	**1 421 800 (+146400)***				**15 200 000 (+506400)***	

**Since the contract with EU is expected to be signed in 2003 and the agreement on Swiss participation in the 6th FP will not yet be in force , Swiss Partners should be funded by the Swiss Government*

6. Estimated breakdown of the EC contribution per reporting period

Estimated breakdown of the EC contribution per reporting period			
Reporting Periods	Month x – Month y	Estimated Grant to the Budget	
		Total	In which first six months
Reporting Period 1	M1-12	3 500 000	
Reporting Period 2	M13-M24	4 700 000	2 350 000
Reporting Period 3	M25-M36	3 900 000	1 950 000
Reporting Period 4	M37-M48	2 500 000	1 250 000
Reporting Period 5	M49-M60	600 000	300 000

7. Management of the I3

The Management of CARE

The CARE consortium is composed of 22 legal entities (public research entities operating research infrastructures and universities) representing a scientific staff of more than 600 people. The management structure of the consortium will, at the same time, ensure a wide participation of this entire scientific community and keep an efficient decision-making process.

The management organizational structure is summarized in the attached diagram. Its key bodies include the Governing Board, the coordinator assisted by the management team, the steering committee, the Dissemination Board and the CARE Council. They are detailed below.

- The **GOVERNING BOARD (GB)** is the arbitration and strategic decision-making body. It is composed of 1 representative per Contractor, i.e. 22 members. The CARE coordinator and the ECFA chairman are non-voting members of the Governing Board. Meetings will take place once a year. The Governing Board is competent to decide, upon the Steering Committee proposals, on political and strategic orientation of the Project, significant modification of the work to be done (i.e. decision to abandon a research program), approval of the Consortium budget and of the financial allocation of the European funds, rescheduling of an activity, exclusion of a defaulting participant…
- **THE CARE COORDINATOR (CC)** is from the Commissariat à l'Energie Atomique (CEA) working in the DSM/DAPNIA Department. He will be responsible for the overall management of the CARE Project and for the day-to-day operation, both for scientific actions and for administrative, financial and legal management. He will also be the intermediary between the Consortium and the Commission and fulfil its duties in accordance with the EC Contract. The Coordinator chairs the Steering Committee, is member of the CARE Collaboration Council and of the Dissemination Board and is a non-voting member of the Governing Board.
- **A MANAGEMENT TEAM (MT)** will assist the CARE Coordinator. It includes:
  - A Technical/Administrative Deputy Coordinator assisted by accounting staff
  - A legal advisor (part time) from the CEA Legal Department
  - A Deputy coordinator for Dissemination matters, who will chair the Dissemination Board and be the link between the Coordinator and the Dissemination Board. He will supervise the reports and deliverables for the Commission.
  - A web master specialist
- **The SUBPROJECTS and their Management**

The CARE Project includes 7 SUBPROJECTS:

- 3 for carrying out Networking Activities (NA)
- 4 for carrying out Joint Research Activities (JRA)

A Subproject Coordinator(s) who is assisted by a Deputy leads each Subproject. The Subproject Coordinator manages and coordinates the work within the Subproject on a day-to-day basis. Each Subproject is structured by Work Packages (**WP**), having their own and defined tasks, under the supervision of a Work Package Leader.

- **Subproject Steering Committee (SSC)**

  Following the same model than the CARE Steering Committee (see below), each subproject has his own **Subproject Steering Committee** composed of the Subproject Coordinator, his deputy and the Work Package leaders. Each Subproject Steering

Committee will meet at least four times a year to review and manage the activities conducted within the Subproject. In case of a deadlock situation, it will refer to the CARE Steering Committee for arbitration.

- **External Scientific Advisory Committee (ESAC)**
An External Scientific Advisory Committee, which will meet once per year, is set up for each subproject. Composed of renowned experts, it will review the Subproject activities, establish a link with other field for which these activities are relevant and with similar activities being carried out outside of Europe.

- The **STEERING COMMITTEE (SC)** is composed of 11 members: the Coordinator, who will chair the meetings, the technical/administrative Deputy Coordinator, the 8 Subproject Coordinators (JRA1 has two subproject coordinators) and the Heads of the Dissemination Board. Each member has one vote; the decisions are taken upon a simple majority.

  The Steering Committee is the central management body of the Consortium in charge of managing the whole Project. It meets at least three times a year. It oversees and reviews the work progress and decides on overall technical matters, submit proposals to the Governing Board, prepare the Consortium budget and the allocation of funding to be submitted to the Governing Board, consolidate the reports received from the Subprojects and prepare the reports and deliverables to be submitted to the Governing Board for approval and then sent to the Commission. The Steering Committee has also an arbitration role in case of deadlock situation within a Subproject or between a Subproject and a Work package.

- The **DISSEMINATION BOARD (DB)** is composed of 9 members: the chair elected by the CARE Council, the 7 Subprojects Deputies and the Coordinator. Meetings will take place at least 3 times a year. The Dissemination Board is responsible for the dissemination of the Knowledge, for ensuring the quality of publication and is the arbitration body for intellectual property issues arising from the Project. It is also in charge to ensure an appropriate protection of the Knowledge. The participation of deputies' coordinators from the Subproject allows efficient and complete information of the Dissemination Board.

- Once a year, all representatives of the community of researchers and scientists involved in the Project, including subcontractors and associated partners, will meet at the **CARE COLLABORATION COUNCIL**. This consultative and advisory body on organizational and scientific matters advises both the Steering Committee and the Governing Board on Project orientation, the operation of the Consortium and its outcomes. This annual meeting is a place of communication and exchange for the whole scientific community.

- A very important element in the operation of the CARE consortium will be the

Yearly CARE general meetings

These meetings will be organized in the large infrastructure laboratories. A different place will be chosen every year and the dates and the location of the meeting will be announced 6 months in advance.

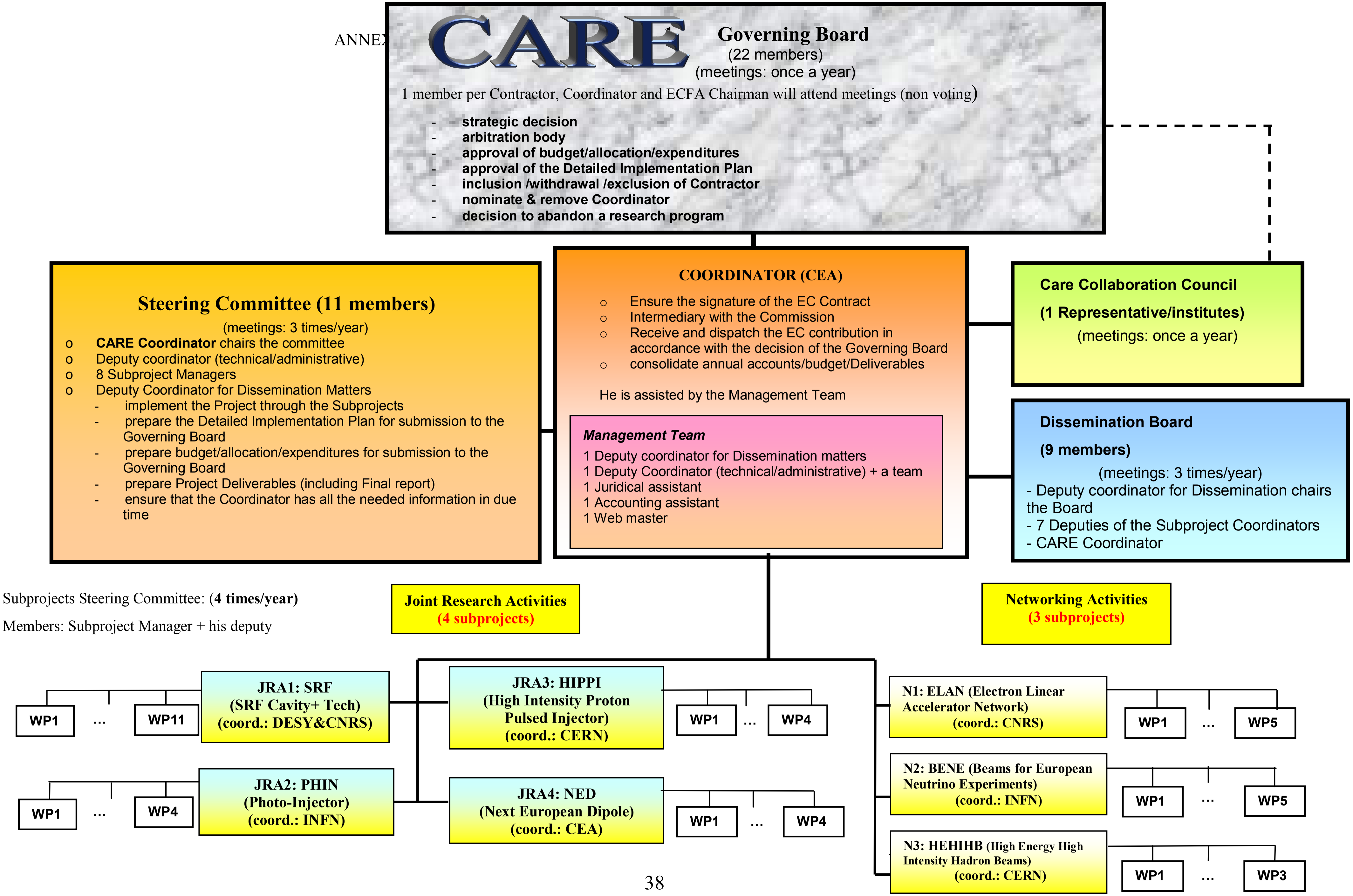
These meetings are essential events for the CARE project and will contribute

- To enhance the exchange of information and stimulate lively scientific discussions
- To disseminate the achievements of CARE amongst the participants but also to the international community
- To review all organizational and scientific matters

This meeting integrates one of the yearly-scheduled Networking meetings and therefore 5 days are normally needed. Indeed, during the first 3 days, the networking activities will hold parallel sessions, possibly with joint sessions on specific topics. During the networking session, specific discussions with the Joint Research Activities will be set up. The 2 last days will be devoted to plenary sessions, where all activities will make a status report, as well as general discussion sessions.

The participants plan to hold at a **kick-off meeting** financed by the participating institutes at the end of 2003 at CERN.

ANNEX


CARE
Governing Board
(22 members)
(meetings: once a year)
1 member per Contractor, Coordinator and ECFA Chairman will attend meetings (non voting)
- strategic decision
- arbitration body
- approval of budget/allocation/expenditures
- approval of the Detailed Implementation Plan
- inclusion /withdrawal /exclusion of Contractor
- nominate & remove Coordinator
- decision to abandon a research program
Steering Committee (11 members)
(meetings: 3 times/year)
o CARE Coordinator chairs the committee
o Deputy coordinator (technical/administrative)
o 8 Subproject Managers
o Deputy Coordinator for Dissemination Matters
- implement the Project through the Subprojects
- prepare the Detailed Implementation Plan for submission to the Governing Board
- prepare budget/allocation/expenditures for submission to the Governing Board
- prepare Project Deliverables (including Final report)
- ensure that the Coordinator has all the needed information in due time
COORDINATOR (CEA)
o Ensure the signature of the EC Contract
o Intermediary with the Commission
o Receive and dispatch the EC contribution in accordance with the decision of the Governing Board
o consolidate annual accounts/budget/Deliverables
He is assisted by the Management Team
Management Team
1 Deputy coordinator for Dissemination matters
1 Deputy Coordinator (technical/administrative) + a team
1 Juridical assistant
1 Accounting assistant
1 Web master
Care Collaboration Council
(1 Representative/institutes)
(meetings: once a year)
Dissemination Board
(9 members)
(meetings: 3 times/year)
- Deputy coordinator for Dissemination chairs the Board
- 7 Deputies of the Subproject Coordinators
- CARE Coordinator
Subprojects Steering Committee: (4 times/year)
Members: Subproject Manager + his deputy
Joint Research Activities
(4 subprojects)
Networking Activities
(3 subprojects)
JRA1: SRF
(SRF Cavity+ Tech)
(coord.: DESY&CNRS)
WP1 ... WP11
JRA2: PHIN
(Photo-Injector)
(coord.: INFN)
WP1 ... WP4
JRA3: HIPPI
(High Intensity Proton Pulsed Injector)
(coord.: CERN)
WP1 ... WP4
JRA4: NED
(Next European Dipole)
(coord.: CEA)
WP1 ... WP4
N1: ELAN (Electron Linear Accelerator Network)
(coord.: CNRS)
WP1 ... WP5
N2: BENE (Beams for European Neutrino Experiments)
(coord.: INFN)
WP1 ... WP5
N3: HEHIHB (High Energy High Intensity Hadron Beams)
(coord.: CERN)
WP1 ... WP3

Plan for using and disseminating knowledge

Particular attention will be devoted to the dissemination of the knowledge acquired in the CARE activities. It includes the monitoring of the worldwide activities relevant to the work being carried out in CARE, thanks to the participation of non-EU partners in the networking activities and to the External Scientific Advisory Committees in each Joint Research Activity. The plan for the dissemination of the knowledge is articulated around 5 main axes

1. Written CARE documentations
2. Web based activities
3. Creation and maintenance of specific database
4. Promotion of conference/workshop talks and contributions
5. Identification of Spin-offs and development of Outreach Activities

In general, the detailed definition and the reviewing of the Plan for Use and Dissemination of the knowledge issued in the CARE project will be the task of the Dissemination Board (DB). The plan will be submitted to approval to the Governing Board. The DB will then assist the CARE Steering Committee in its implementation. The initial DB membership (which may be extended at a later stage as appropriate) includes 9 persons:

- A Chairperson, elected by the CARE Collaboration Council
- The deputies of the 3 NA and 4 JRA coordinators
- And the CARE Coordinator, as an ex-officio member

Although the first task of the DB will be to define the detail of the dissemination plan, it is expected that it will include the following goals and means:

1. Ensuring the quality and the distribution of the publications in scientific review, contributions to and proceeding of conferences and workshops, CARE general meetings and workshops, CARE-notes and reports, books… To this end, the DB will be in charge of
   - Drafting the publication policy to be submitted for approval to the Governing Board
   - Defining and regularly updating the list of eligible authors for scientific documents as appropriate
   - Organizing the internal reviewing of the publications and rehearsal of speakers
2. Developing Web based activities: a web site (http://esgard.lal.in2p3.fr) has already been created and has been used intensively in preparing the CARE projectl. It includes already much information relative to the CARE activities. Recently, a centralized archiving Web-based mailing system has been set up, allowing one to subscribe to the different CARE activities and thus be up to date on all development. This site will be developed further by including in particular
   - Information related to the Project in the web,
   - Postdoctoral and thesis opportunities
   - Indicators of the impact of the Activities. For example the number of publications, preprints, reports and their citations in other publications, presentations at the conferences, number of thesis, number of access to the CARE web site…
3. Providing centralized repositories, directories and databases such as
   - Database of electronic addresses of the CARE members
   - CARE-note and Report repository with search engine
   - Scientific and technical specific databases
4. Promoting actively talk and contribution at conferences and workshops, including the reporting activities at a higher level (ECFA, ICFA, EPS…).
5. Identifying the possible spin-off from the intellectual and technical developments and set up a team for developing outreach activities.

To achieve its objectives, the DB may set up, as appropriate, ad-hoc task or review committees with specific and limited in time tasks (for example a committee to review a paper to be submitted for publication, or to organize a rehearsal of a presentation at a conference…)

It will also carry specific communication actions in the name of the Consortium and, in case of any problem, refer it to the Steering Committee for arbitration. For example several Industry days will be organised during the 5 years of the project.

The Dissemination Board will submit an annual report to the Steering Committee and to the Governing Board.

8. Description of each activity of the I3 (including its outline implementation plan)

8. N1 Activity N1: Electron Linear Accelerator Network *(ELAN)*

8. N1.1 Description and objectives of the activity

Major accelerator centres in the world, CERN and DESY in Europe, SLAC and FNAL in the USA, KEK in Japan, have been active during the last 10 years on R&D in view of building a 500 GeV - 1TeV electron-positron Linear Collider (LC). A timely construction of a worldwide LC, overlapping with LHC operation, is recognized as the highest scientific priority in particle physics after LHC in Asia (ACFA), Europe (ECFA) and North America (HEPAP) and at the political level by OECD.

While in the USA there is a structure which allows one to coordinate accelerator activities by providing centrally manpower and financing, this is not the case in Europe. CARE provides an excellent opportunity to strengthen the structure of European activity for the next 5 years.

- The first objective of the ELAN network is to coordinate the R&D on electron accelerators at the European level, and to foster the participation of new groups in the various European countries to the worldwide effort.

At present TESLA, the project based on superconductivity (SC), is acknowledged as the most advanced, cost effective and ready to be built to reach 500 GeV with very high luminosity. The development of this technology being validated at the TESLA Test Facility (TTF) at DESY aims at low cost, reliability and increase in gradients to reach 800 GeV.

For the longer term, a new approach replacing the discrete power sources (klystrons) by an auxiliary accelerator (two-beam scheme) is under development at CERN in the CTF3 facility. The goal is to achieve a very high accelerating field, 150 MV/m. The major challenges will be to generate the required RF power and to transport the beam through the cavities operating at very high RF frequency.

- The second objective of the ELAN network is to evaluate the various technologies for improving the present test facilities, to set the priorities, and to define a roadmap for future electron accelerators and colliders.

An international panel chaired by G. Loew has issued a report (ILC-TRC report) ranking for the various projects the remaining necessary R&D studies in the proposed technologies. It will serve as a reference to this network.

Although there are different technologies being considered, there is a large overlap between the various schemes studied. Moreover, many accelerator physics issues are equally important for linear colliders and linac-based radiation sources like the free-electron lasers (FEL) operating in the X-ray range. We think that optimal efficiency can be reached by combining these efforts, by creating the appropriate tools to collect informations and by evaluating the accelerator simulation software tools.

- The third objective is to enhance the present synergy and avoid the duplication of work.

Beyond consolidating and improving existing technologies, a large part of the activity will be to evaluate and promote innovative concepts, in contact with groups specialized in complementary techniques such as laser-plasma acceleration.

The network will also investigate potential applications for the the Superconducting RF (SRF) and Photon-Injector (PHIN) Joint Research Activities, as well as synergies with linac-based FEL and synchrotron light sources.

8. N1.2 Participants in the activity

The 16 contracting participants and the 26 associated institutes of this network are listed in Tables 8.N1.2a and 8.N1.2b, with their involvement in the work packages described below. They represent 11 countries plus the international laboratory CERN, including large institutes such as STFC, CEA, DESYor INFN and small universities, fulfilling the goal assigned in FP6: dissemination of knowledge and expertise from large to medium size laboratories and institutes.

Table 8.N1.2a: List of contracting participants

Number	Participant	LTECNC	LTECSC	BDYN	INSTR	ANAD
1	**CEA**		X	X	X	
3	**CNRS**	X	X	X	X	X
	CNRS-Orsay	*X*	*X*	*X*		
	CNRS-CPHT					*X*
	CNRS-LULI					*X*
	CNRS-LAPP	*X*			*X*	
	CNRS-LOA	*X*			*X*	*X*
	CNRS-LPGP					*X*
	CNRS-LCP	*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*			
	IFIC			*X*		
	LEII		*X*			
17	**CERN**	X		X	X	
19	**PSI**				X	
20	**STFC**	X	X	X	X	X
21	**ICL**			X	X	X
22	**UMA**			X	X	

Table 8.N1.2b: List of associated institutes

Number	Institutes	LTECNC	LTECSC	BDYN	INSTR	ANAD	Associated to
1	**HEPH**				X		CERN
3	**RWTH**				X		DESY
4	**TUBE**	X			X		CERN
5	**MBI**	X					DESY
6	**TEMF**			X			DESY
7	**UDUSS**					X	CERN
8	**MPQ**					X	CERN
9	**FZK**		X				DESY
10	**UROS**			X			DESY
11	**UWUP**		X				DESY
17	**TUEI**					X	CERN
18	**GOLP**					X	CERN
21	**UPSA**	X					CERN
25	**ETHZ**	X					CERN
30	**UAD**				X		UMA
34	**LANC**	X	X				UMA
35	**QMUL**			X	X		UMA
36	**RHUL**			X	X		UMA
37	**UCL**				X		UMA
38	**ULI**			X	X		UMA
39	**UOX**				X	X	ICL
42	**USTRAT**					X	UMA
55	**E2V**	X	X				STFC
56	**TMD**	X	X				STFC
57	**DAN**	X	X				STFC
58	**TECUK**	X	X				STFC

8. N1.3 Outline of the implementation plan for the full duration of the activity (including milestones and deliverables)

The objectives of ELAN will be achieved by:

- a series of general and specialized meetings and workshops in conjunction with the JRA activities whenever possible
- the development of a Web site
- the development of databases and code repositories

The activity of ELAN has been shared in 5 work packages. In most cases the first objective is to collect all available information to establish the 'state of the art' in the field and to identify the present limitations.

- **WP1: Normal Conducting Linac Technology (LTECNC)**
  - LTECNC1: Study of high gradient accelerating structures
  - LTECNC2: Power transfer structures
  - LTECNC3: RF power sources
  - LTECNC4: R&D on drive beam generation in CTF
  - LTECNC5: Study on precision alignment
  - LTECNC6: Electron source (in collaboration with JRA on photo injector)
- **WP2: Super conducting Linac Technology (LTECSC)**
  - LTECSC1: Cavities
  - LTECSC2: Magnets
  - LTECSC3: Material research and fabrication methods
- **WP3: Beam dynamics (BDYN)**
  - BDYN1: Emittance preservation
  - BDYN2: Luminosity stabilization
  - BDYN3: Tuning algorithms
  - BDYN4: Orbit control
  - BDYN5: Simulation code development
- **WP4: Instrumentation and diagnostics (INSTR)**
  - INSTR1: Beam position monitors
  - INSTR2: Beam size and bunch length monitors
  - INSTR3: Feedback systems
- **WP5: Advanced and Novel Accelerator Development (ANAD)**
  - ANAD1: Ultra-short pulse electron injectors
  - ANAD2: Ultra-high gradient extended plasma wave
  - ANAD3: Beam diagnostics and delivery for plasma based accelerators
  - ANAD4: Integrated experiment

These work packages are dealing with tightly connected issues, such as beam emittance preservation, which will be coordinated by WP3. Another important issue will be to ensure that the R&D work benefits to both proposed LC technologies. Luminosity stabilization will also require a tight connection between WP3 and WP4. Feedback systems for alignments of the linacs are common items for WP1 and WP2.

8. N1.3.1 Deliverables

The Main Deliverables (**MD**) of ELAN are:

1. **MD**: Development of a **Web site** to centralize and disseminate the information relevant to the fields covered by ELAN.
2. **MD**: Development of **databases** and code repositories.
3. **MD**: The **final report** of the ELAN activity including:
    - Priorities of R&D with eventually proposals of JRA or DS needed in the fields covered by ELAN ;
    - The status of the state-of-the-art at the time of the final report, on LTECNC, LTECSC, BDYN, INSTR and ANAD.
    - Possible synergies between different techniques of acceleration.

Intermediate Deliverables (ID) will also be provided by:

- The proceedings of the workshops
- Progress reports on the various activities
- The annual report of the ELAN network

8. N1.3.2 Milestones

The milestones (**MS**) will be constituted by the yearly ELAN general meetings, the specialized work package meetings or workshops, and courses (dissemination of knowledge) held during the 5 year period of the CARE project. They will also include the deployment of Web sites and code repositories with continuous updating.

The following tables summarize the ELAN deliverables and milestones.

WP	Task		Year 1	Year 2	Year 3	Year 4	Year 5
All	Review of all ELAN activities Dissemination of knowledge	Period	←—	———	———	———	—→
		MS	Annual meeting	Annual meeting	Annual meeting	Annual meeting	Annual meeting
		ID/**MD**	**Web Site**	Annual Report	Annual Report	Annual Report	**Final Report**
LTECNC	*Understanding the two-beam technique as a solution for producing RF power at frequencies beyond those at which high-power klystrons are presently available. Understand the gradient limits of NC structures associated with dark current, RF break-down, surface field and structure geometry. Gain experience on NC structure engineering. Improvement of the present test facility used for beam manipulation, structure prototype powering, and equipment tests, and suggestions of other applications. Identify the points, which are common to all NC and LC linear colliders gathering the efforts on these topics.*						
	Periodic review of the test facility (CTF3) results at the yearly Collaboration Meetings (CM)	Period	←—	———	———	———	—→
		MS	CM	CM	CM	CM	CM
		ID	Proceedings	Proceedings	Proceedings	Proceedings	Proceedings
	Monitoring of WP activity and suggestions	Period		←—	———	—→	
		MS		Workshop	Workshop	Workshop	Workshop
		ID		Report	Report	Report	Report
	Identification of topics to be addressed and of the topics common to WP1 and WP2. Review of the available data and results on these topics	Period	←→				
		MS	Coordination				
		ID	Report				
	Identification of possible benchmarks. Define the work plan and documentation (data base)	Period	←→				
		MD		**Data Base**			
		ID	Work plan	Documentation			
	Review of results obtained with structure prototypes (including US labs).	Period			←—	—→	
		MS				Review	
		ID				Report	
	Proposals for possible complementary JRA and DS.	Period	←—	—→			
		MS		Proposals JRA			
		ID		Report			
	Benchmarks are reviewed and work plan revisited.	Period		←—	———	—→	
		MS			Review		
		ID				Report	
	Review on sources including the outcome of photo-injector R&D for the drive-beam	Period		←—	—→		
		MS		Review			
		ID			Report		

WP	Task		Year 1	Year 2	Year 3	Year 4	Year 5
LTECSC	*The work package is aimed at improving existing technology to its limits and to evaluate new materials for application in accelerators. The coordination in this work-package will allow well-defined R&D programs to share the workload between different institutes. Additionally, a comparison between the standard technology available today and possible alternatives is needed. This would allow one to increase either the performance and the reliability of the technology, or a more cost efficient approach. In this way each subsystem from the accelerating structure to the power source will be reviewed and can be optimised in this framework. The coordination will avoid duplication of developments. A database on SRF related documents will serve to ease distribution of the information. The work package will also serve to include industry into the R&D effort by introducing training courses thus allowing one to transfer knowledge from institutes to the industry. Also, new developments in technology will be reviewed for industrial manufacturability*						
	Coordination of R&D	Period	←	—	—	—	→
		MS	Workshop	Workshop	Workshop	Workshop	Workshop
		ID	Proceedings	Proceedings	Proceedings	Proceedings	Proceedings
	Dissemination of knowledge Courses on SC technology	Period		←	→		
		MS		Course			
		ID			Proceedings		
	Data base on SRF	Period	←	—	→		
		MD		**Data Base**			
		ID			Documentation		
	Strategy for R&D						
	Cavity Reliability Roadmap for coupler R&D Manufacturability of modules Machine protection	Period	←	→			
		MS		Workshop			
		ID		Reports			
	Surface treatments for cavities Reliable klystrons	Period	←	—	→		
		MS			Workshop		
		ID			Report		
	Material research on Nb sheets						
	Evaluation of quality control	Period	←	—	→		
		MS		Workshop			
		ID			Report		
	Evaluation of cleaning methods	Period	←	—	—	—	→
		MS		Workshop		Workshop	
		ID			Report		Report

LTECSC	**Roadmap to fabrication**						
	Evaluation of standard methods versus alternative ones	Period	↔	↔	↔	↔	
		MS	Workshop		Workshop		
		ID		Report		Report	
	Evaluate thin film methods	Period	↔	↔	↔	↔	↔
		MS		Workshop		Workshop	
		ID			Report		Report
	Comparison of power sources, Cost efficiency	Period	↔	↔	↔		
		MS		Workshop			
		ID			Report		
	Alternative cavities, feasibility study	Period	↔	↔			
		MS		Workshop			
		ID		Report			

WP	Task		Year 1	Year 2	Year 3	Year 4	Year 5
BDYN	*Form a working group, which helps to review, prioritise and coordinate the beam dynamics studies in the different institutes. As an example, the full understanding the performance of tuning, also in the presence of dynamic imperfections, was one of the urgent R&D items identified in the International Linear Collider Technical Review Committee. The working group should also help identifying the required performance of the instrumentation. Provide a common code repository and coordinate integration of the codes into one common framework. Agree on standards for the necessary interfaces. This will make integrated simulations of the accelerators simpler, reduce redundant effort and allow in particular universities to more easily contribute to beam dynamics studies. Coordinate verification of the codes by comparisons with other codes and experiments and provide centralised documentation of these. This will foster the reliability of codes. Coordinate extension of the codes to cover the relevant beam physics effects and the implementation of feedback systems and tuning procedures. This will also reduce redundant effort and help to achieve better coverage of all relevant beam physics. Contribute to the luminosity and background database for the physics studies. A part of this effort will take place in a worldwide international collaboration.*						
	Start identifying beam studies, catalogue existing codes and agree on program repository	Period	↔ (first half of Year 1)				
		MD	**Data Base**				
		ID	Documentation				
	Establish list of priorities, start collection of codes. Identify interfaces, benchmarks, code extensions	Period	↔ (Year 1)				
		MS	Workshop				
		ID	Report				
	First results. Priority of tasks established	Period	↔ (Year 1 – mid Year 2)				
		MS		Workshop			
		ID		Report			
	Documentation on interfaces. Results on high priority benchmarks documented. New milestones defined	Period	↔ (Year 1 – mid Year 4)				
		MS		Workshop	Workshop		
		ID		Proceeding	Proceeding	Report	
	Final report summarising status of beam studies with an intermediate progress report	Period	↔ (Year 1 – Year 5)				
		MS		Workshop		Workshop	
		ID			Report		Report

WP	Task		Year 1	Year 2	Year 3	Year 4	Year 5
INSTR	*Form a working group, which helps to review, prioritise and coordinate the development and testing of diagnostics and instrumentation by different institutes. Improving the availability of information on test facilities will allow effective use and development of such facilities. The creation of a database of diagnostic performance will provide valuable information to groups developing such diagnostic and improve the accuracy of such data used with the important area of accelerator simulations. The coordination and clarification of R&D goals will ensure a more effective use of resources and reduce duplication of effort. Organising the cross checking of instrument performance will increase the confidence in the measured performance of state of the art devices. Encouraging and organising communications with industrial companies will help to ensure industry will be able to provide support for the future industrial production of these advanced devices.*						
	Dissemination of knowledge Create a web site	Period	⟷				
		MD	**Web Site**				
		ID	Report				
	Data base of test facilities	Period	⟷				
		MD	**Data Base**				
		ID	Documentation				
	Data base of diagnostics performance	Period	⟷	⟷	⟷		
		MD			**Data Base**		
		ID			Documentation		
	Coordination of R&D goals. Define key diagnostic requirements, identify high risk instruments for LC, and roadmap for key instruments	Period	⟷	⟷			
		MS		Workshop			
		ID	Reports				
	Coordinated prototype R&D programme. Cross checking of instrument performance and benchmarking in existing facilities	Period	⟷	⟷	⟷	⟷	⟷
		MS		Proposals	Workshop	Workshop	Workshop
		ID		Reports	Report	Report	Report
	Promote industrial, European and International collaborations	Period	⟷	⟷	⟷		
		MS		Workshop			
		ID		Report	Proposal		
	Industry day	Period		⟷	⟷		
		MS		Industry day			
		ID			Report		
	Satellite meetings with international Instrumentation conferences	Period	⟷	⟷	⟷	⟷	
		MS	Conferences	Conferences	Conferences		
		ID		Proceedings	Proceedings	Proceedings	

WP	Task		Year 1	Year 2	Year 3	Year 4	Year 5
ANAD	*Form a working group to identify the most efficient technical solutions for controlled acceleration of electrons in the GeV range in a plasma-based accelerator. Foster collaboration in a community of plasma physicists scattered in different institutes or universities in Europe, using various types of laser facilities and simulation tools. Define a strategy to achieve a joint proof-of-principle experiment in European maintain European competitiveness in this research area. Initiate collaborations between plasma physicists and accelerator physicists in order to achieve transfer of knowledge and define common prospective studies.*						
	Coordination of R&D	Period	◄	—	—	—	►
		MD				**Data Base**	
	Ultra-short pulse injectors Compare all-optical and RF injector	Period	◄	—	—	►	
		MS	Workshop		Workshop		
		ID		Proceedings		Report	
	Extended plasma wave excitation Compare laser guiding techniques	Period	◄	—	►		
		MS		Workshop			
		ID			Report		
	Identify diagnostics needed for plasma based accelerators	Period	◄	—	►		
		MS	Workshop		Workshop		
		ID			Report		
	Electron beam focusing and propagation in a guided plasma wave	Period	◄	—	►		
		MS	Workshop		Workshop		
		ID	Proceedings		Report		
	Prepare an integrated experiment (DS) to demonstrate GeV acceleration in 10cm	Period	◄	—	—	►	
		MS		Workshop		Workshop	
		ID		Proceedings		Report	
	Prospective ideas for a design study in collaboration with BDYN.	Period	◄	—	—	—	►
		MS	Workshop		Workshop		Workshop
		ID	Proceedings		Proceedings		Report

8. N1.4 Expected outcome

The first outcome of ELAN will be participation to the gathering of a community and launching of a Design Study in view of a TeV Linear Collider in the next months.

Generally speaking ELAN should have the following impacts:

- Better coordination of R&D efforts on electron accelerators (integrating effect), at the European level but also within countries (promoting new centres of competencies)
- Additional resources from the European Community will mobilize new laboratories, new people and will encourage increased investments from local authorities
- Raising the level of competence in electron accelerators: training by experts, participation to research infrastructures, exchanges
- Stimulating effect on European industry
- Lowering the cost of basic accelerator components which will allow one to develop these instruments in a wider environment (e.g. XFEL)
- Coordination of efforts between accelerator experts and laser plasma specialists working on new sources and new schemes of acceleration
- Improved instrumentation in accelerator physics

Another expected important output will be proposals for new JRA needed for ther Linac R&D and possibly a Design Study to test new ideas on acceleration techniques.

8. N1.4.1 Measuring the impact of the network activity

A measure of the success and impact of the network activity will be given by the number of:

- documents on new ideas proposed for operating and improving infrastructures
- new initiatives for R&D to solve the problems encountered
- publications and the frequency of quotation of these publications
- proposed Ph/D theses arising from the network
- new collaborations among the participants
- proposed design studies arising from the network

8. N2 Activity N2: Beams in Europe for Neutrino Experiments *(BENE)*

8. N2.1 Description and objectives of the activity

The recent discovery of neutrino (ν) transitions is one of the most important results in physics in the last ten years and has generated considerable interest worldwide. Much remains to be discovered about neutrino oscillations and this will require dedicated neutrino beams

The present European experimental programme (CNGS, CERN Neutrino beam to Gran Sasso) aims at validating the existing results and will begin data taking in 2006. To go beyond and fully exploit the physics potential of neutrino oscillations requires the realization of one or more new neutrino facilities, with higher beam power, better defined spectrum and flavour composition, allowing experiments with higher statistics and reduced systematic errors, in optimal conditions of beam energy and distance from the source.

- The first objective of the BENE network is to establish a roadmap to upgrade the current CNGS facility and for the design and the construction of new ones.

In the short term, the improvement of the performances of the approved program CNGS facility will be vigorously investigated. For the longer term, since 1998 contacts have been established between laboratories and universities around Europe with the goal of preparing and carrying out the R&D and the studies necessary to propose the next major neutrino facility by the time of the start-up of LHC. The three facilities presently considered are:

i) a conventional but very intense muon-neutrino beam (Superbeam) of the CNGS type, using a new high power proton accelerator;
ii) a Neutrino Factory, in which the neutrinos are produced by the decay of muons in a storage ring;
iii) a Beta Beam, in which electron-neutrinos are produced by the decay of radioactive nuclei in a storage ring.

- The second objective is to assemble a community capable of sustaining the technical realisation and the scientific exploitation of these facilities.

To compare the physics reach of these approaches and to monitor the rapid evolution of the field, it is important to coordinate and integrate accelerator and particle physics studies, leading to a comparison of the technologies, costs, risks, and physics results.

- The third objective is to foster a sequence of prioritized and coordinated initiatives capable to establish and propose the necessary R&D activities.

By achieving these objectives, BENE will create a strong network of accelerator and particle physicists working together to build a coherent programme to study the physics of neutrino oscillations in Europe. The network will also investigate synergies of each approach with other domains of particle and nuclear physics as well as potential applications for the High-Intensity Pulsed Proton Injector (HIPPI), the Superconducting RF (SRF) and the Next European Dipole (NED) Joint Research Activities.

8. N2.2. Participants in the activity

The 13 contracting participants and the 21 associated institutes of this network are listed in Tables 8.N2.2a and 8.N2.2b, with their involvement in the work packages described below. They represent 11 countries plus the international laboratory CERN including large institutes such as STFC, CEA or INFN and small universities, fulfilling the goal assigned in FP6: dissemination of knowledge and expertise from large to medium size laboratories and institutes.

Table 8.N2.2a: List of contracting participants

Participant number	Participant	PHYSICS	DRIVER	TARGET	COLLECTOR	NOVEL NEUTRINO BEAMS
1	**CEA**	X	X	X	X	X
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					*X*
4	**GSI**					X
7	**FZJ**		X	X		
8	**TUM**	X				X
10	**INFN**	X	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	*X*				*X*
	INFN-Pi	*X*				
	INFN-Tr	*X*				*X*
	INFN-Ro3	*X*				*X*
	INFN-To	*X*				
16	**CSIC**	X				
	UBa	*X*				
	IFIC	*X*				
	UAM	*X*				
17	**CERN**	X	X	X	X	X
18	**UNI-GE**	X		X	X	X
19	**PSI**			X		
20	**CCLCR**	X	X	X	X	X
21	**ICL**	X		X		X

Table 8.N2.2b: List of associated institutes

Participant number	Participant	PHYSICS	DRIVER	TARGET	COLLECTOR	NOVEL NEUTRINO BEAMS	Associated to
13	UnO	X	X	X	X	X	CERN
15	IPUL			X			FZJ
16	NRG			X			FZJ
22	UNI-Bern	X					UNI-GE
23	UNI-Neuchatel	X					UNI-GE
26	PIUZ	X				X	UNI-GE
27	BAT	X		X			ICL
28	BRU	X				X	ICL
29	CAM	X					ICL
31	DUR	X					ICL
32	EDIN	X					ICL
33	GLA	X				X	ICL
35	QMUL	X					ICL
38	ULI	X				X	ICL
39	UOX	X		X		X	ICL
40	SHEF	X		X		X	ICL
41	SOTON	X					ICL
43	SUSS	X					ICL
44	FNAL	X	X	X	X	X	CERN
45	LBL	X				X	CERN
46	BNL	X	X	X	X	X	CERN

8. N2.3 Outline of the implementation plan for the full duration of the activity (including milestones and deliverables)

The objectives of the BENE network will be achieved by

- regular general and specialized meetings and Workshops
- the development of a Web site
- the development of common databases and code repositories

The work has been organized in five work packages covering the subsequent topics:

- **WP1: Physics demands on ν accelerator facilities (PHYSICS**).
  - PHY1: establish the widest consensus on general neutrino physics requirements
  - PHY2: define the ultimate scientific reach of the present and future upgrades of CNGS
  - PHY3: “ “ of conventional Superbeams
  - PHY4: “ “ of Neutrino Factories
  - PHY5: “ “ of Beta beams
  - PHY6: provide recommendations for each option on beam energy, baseline, beam structure, composition, flux and monitoring in view of minimizing the systematic errors
  - PHY7: formulate a strategy of measurement of all oscillation parameters based on the four options PHY2-3-4-5 and synergic combinations among them.
- **WP2: High Power proton drivers (DRIVER).**
  - DRI1: compare the merits of Superconducting Proton Linacs and Rapid Cycling Synchrotrons
  - DRI2: evaluate the impact of both on the performance of the CNGS and of future Superbeams
  - DRI3: propose a choice, based also on the HARP data presently being analysed
  - DRI4: evaluate approaches to intense H- ion sources, high power injectors
  - DRI5: assess HIPPI results on Fast beam choppers and Normal & Super Conducting Accelerating Structures
  - DRI6: provide a recommendation on technologies for all driver components.
- **WP3: High power targets (TARGET**).
  - TAR1: examine the various solutions (molten metal jet, multiple helium cooled granular targets and rotating metal bands) being proposed for a multi-MW target
  - TAR2: study pulsed heating, high radiation levels and mechanical stress from thermal shock waves
  - TAR3: integrate designs with those of the surrounding pieces of equipment, including the collector and the beam dump
  - TAR4: address safety, radioactive disposal, remote handling and maintenance issues
  - TAR5: select one or a few viable solutions.
- **WP4: High power collection systems (COLLECTOR**).
  - COL1: assess the unprecedented challenges of thermo-mechanical stresses and fatigue
  - COL2: “ “ of radiation damage
  - COL3: study implementation of high repetition rate of electrical discharge
  - COL4: define optimal integrated target & collection for Superbeams (horns)
  - COL5: “ “ Neutrino Factories (solenoids)
- **WP5: Novel Neutrino Beams (NOVEL NEUTRINO BEAMS**).
  - NNB1: collect and disseminate knowledge.
  - NNB2: promote further initiatives and funding prospects in these novel sectors

- NNB3: focus specifically on the front stage of a Neutrino Factory (the muon beam, produced from the solenoidal pion decay channel) examining specific muon ionization cooling schemes
- NNB4: focus in detail on options for the end stage of Neutrino Factories for muon acceleration (Recirculating Linac and Fixed Field Alternating Gradient accelerators) and storage
- NNB5: produce a road-map for both a high and a low energy Beta-beam facility in Europe, assessing results from several technical tests planned at existing facilities.

8. N2.3.1 Deliverables

The Main Deliverables (**MD**) of the BENE network are:

1. **MD:** Development of a **Web site** to centralize and disseminate the information relevant to BENE and its Work Packages
2. **MD:** The **final report** of the BENE activity, including
   - The worldwide studies relevant for improving performance of the CNGS and achieving superior neutrino facilities beyond it
   - The status of the state-of-the-art at the time of the final report, on PHYSICS, DRIVER, TARGET, COLLECTOR and NOVEL NEUTRINO BEAMS.
   - A priority list of the required R&D and a roadmap for carrying them over
   - A global road map specifying the optimum neutrino oscillation programme for Europe and the path to design and construction of the superior neutrino facilities required

In addition, a series of Interim Deliverables (ID) will be provided. They will be constituted by

- Proceedings or Summaries of the topical meeting and workshops
- Proposals for Design Studies and R&D
- the 18 month Interim Report
- the annual report of the BENE network

8. N2.3.2 Milestones

The milestones (**MS**) will be constituted by the various general BENE meetings, and the specialized meeting or workshops held during the 5 year period of the CARE project. Europe will host the International NuFact Workshop in 2005 and 2008. These dates are considered also to be milestones for the BENE programme. So will be important steps in the deployment of the Web sites.

The following table shows an outline of the BENE deliverables and milestones.

WP	Task		Year 1	Year 2	Year 3	Year 4	Year 5
All	*These activities will be carried out by the ensemble of the Work Packages*						
	Review and promote all BENE activities. Organize BENE events and international events. Dissemination of knowledge	Period	←→ (Year 1 – Year 5)				
		MS	Two BENE meetings and one CARE/BENE meeting yearly				
		ID		Organization of NuFact05 International Workshop. Proceedings			Organization of NuFact08 International Workshop. Proceedings
		MD	**Web Site**				**Final Report**
	Define Parameters and Road Map to Conceptual Design	Period	←→ (Year 1 – Year 2)				
		MS	Spring BENE Meeting	Summer BENE Meeting			
		ID	Design Studies and R&D Proposals (DS/R&DP)	Interim Report (IR)			
	Assess Status of Physics Studies and Conceptual Designs: road Map to Technical Design	Period		←→ (Year 2 – Year 5)			
		MS			Summer BENE Meeting	Summer BENE Meeting	
		ID			Updates to IR and DS/R&DP	Updates to IR and DS/R&DP	

WP	Task		Year 1	Year 2	Year 3	Year 4	Year 5
PHYSICS	*During the first 18 months the PHYSICS group will define the parameters of optimized neutrino facilities of both conventional and novel nature. A strategy towards the measurement of oscillation parameters will be proposed for careful technical assessment. The experimental strategy will be refined in the following years and a road map will be proposed in the end, properly revised with updated knowledge of technical achievements and projections in the accelerator sector.*						
	Monitor the development of the physics of neutrinoand of their transmutation in flight (neutrino oscillation). Establish Website. Steer accelerator and detector R&D.	Period	←→ (Year 1 to Year 5)				
		MD	**Web Site** (early 2004)				
		ID	Neutrino Unbound WebSite				
	Plan strategy of unambiguous measurement of all oscillation parameters using complementarity and sinergies between optimized 1) conventional Superbeam 2) NuFact 3) BetaBeam. Assess their optimal physics potentials with uniform comparison criteria of different beam baseline detector configurations	Period	←→ (Year 1 to Year 2)				
		MS	Topical Workshop (Dec)	Summer BENE meeting			
		ID		Workshop Proceedings Physics Section of Interim Report			
	Revise periodically IR strategy weighing detector masses, resolutions, backgrounds vs beam flux, energy, composition. Define requirements on ancillary experiments and on beam monitoring for control of systematic errors.	Period		←→ (Year 2 to Year 5)			
		MS				Topical Workshop (Sep)	
		ID					Workshop Proceedings

WP	Task		Year 1	Year 2	Year 3	Year 4	Year 5
DRIVER	*During the first 18 months the DRIVER group will launch working group activities towards the Interim Report. A preliminary report with a recommendation for the choice of the energy of the DRIVER will be the main goal. The following 12 months will bring a recommendation for the choice of the technology (SPL vs RCS). Three Topical Workshops will be finally held during the last Summer BENE meeting sto review and assess progress versus final design. Necessary attention will be given to each individual components. The final report will conclude this third andinal phase.*						
	Assess preliminary HARP results. Define criteria of SPL vs RCS comparison and perform it preliminarly Review HIPPI JRA annual report Identify R&D plans beyond HIPPI. Produce interim report.	Period	↔	↔			
		MS	Spring BENE meeting	Summer BENE meeting			
		ID	DS/R&DP in the Driver Sector	Driver Section of IR			
	Assess final HARP results. Review HIPPI JRA annual report. Perform final SPL vs RCS comparison. Hold first topical workshop and produce report and recommendation on the choice of the technology.	Period		↔	↔		
		MS			Topical Workshop		
		ID			Workshop Proceedings		
	Assemble results of studies for various DRIVER components. Revise R&D plans. Produce final report on the status of studies towards driver design	Period			↔	↔	↔
		MS				Topical Workshop	Topical Workshop
		ID				Workshop Proceedings	Workshop Proceedings

WP	Task		Year 1	Year 2	Year 3	Year 4	Year 5
TARGET	*It will work in close connection with WP4. During the first 18 months the TARGET group will launch working group activities towards the Interim Report. A consensual view of the merits of the different target schemes and of the area will be its Interim goal. Assessment of R&D and specific recommendations for both Superbeam and Neutrino Factory will be its task in the following 32 months and the focus of the final report.*						
	Prepare Web Pages. Review present status of high power target studies in & out of the neutrino sector. Identify nature, location and first list of experiments at a TargetTestArea (TTA) and propose it. Attack safety issues. Hold International Workshop on Target & Collectors and assess merits of different schemes. Produce IR.	Period	⟷	⟷			
		MS	Spring BENE meeting	International Workshop on Target & Collectors			
		ID	DS/R&DP in the Target Sector (TTA)	Proceedings of Workshop Target Section of IR			
	Revise periodically IR. Revise Design Study and R&D progress at TTA and formulate new plans. Study specific Superbeam and Neutrino Factory options in the target sector. Hold International Workshop on Target & Collectors and prepare specific final recommendations for both options above. Produce FR.	Period		⟷	⟷	⟷	⟷
		MS				International Workshop on Target & Collectors	
		ID				Workshop Proceedings	

WP	Task		Year 1	Year 2	Year 3	Year 4	Year 5
COLLECTOR	*It will work in close connection with WP3. During the first 18 months the COLLECTOR group will launch working group activities towards the Interim Report. A consensual view of the merits of the different target schemes and of the area will be its Interim goal. Assessment of R&D and specific recommendations for both Superbeam and Neutrino Factory will be its task in the following 32 months and the focus of the final report.*						
	Evaluate progress on power supply design, on studies of properties of irradiated materials and of mechanical and thermal stresses. Identify nature, location and first list of experiments at a CollectorTest Area (CTA) and propose it. Attack safety issues. Hold International Workshop on Target & Collectors and assess merits of different schemes. Produce IR.	Period	←———	———→			
		MS	Spring BENE meeting	Int. Workshop on Target & Collectors			
		ID	DS/R&DP in the Collector Sector (CTA)	Proceedings of Workshop Collector Section of IR			
	Revise periodically IR. Revise Design Study and R&D progress at CTF and formulate new plans. Study specific Superbeam and Neutrino Factory options in the collector sector. Hold International Workshop on Target & Collectors and prepare specific final recommendations for both options above.	Period		←———	———	———	———→
		MS				Int.Workshop on Target & Collectors	
		ID				Workshop Proceedings	

WP	Task		Year 1	Year 2	Year 3	Year 4	Year 5
NOVEL NEUTRINO BEAMS	*During the first 18 months the NOVEL NEUTRINO BEAMS group will set the basis of its own work, will propose Design Studies and R&D Proposal and assess the prospecs in the interim reprt. Assessment of R&D and specific recommendations for both Neutrino Factory and Beta beam will be its task in the following 32 months and the focus of the final report. This will include again both evaluation of the state of the art and recommendation for additional R&D.*						
	Definition of expanded WP membership and implement dissemination mechanisms. Review of existing designs for NuFact (both front and back end) and Betabeams, beyond target and collection. Hold specific Betabeam Workshops in synergy with other adjacent physics communities. Identify Design Studies and R&D experiments needed and propose them. Assess and influence MICE measurement plans. Produce IR.	Period	←→	←→			
		MS	Spring BENE meeting Betabeam Workshop	Summer BENE meeting Betabeam Workshop	Betabeam Workshop	Betabeam Workshop	
		ID	DS/R&DP in the Novel Beams Sector Betabeam Workshop Summary	Novel Neutrino Beams Section of IR Betabeam Workshop Summary	Betabeam Workshop Summary	Betabeam Workshop Summary	
	Revise periodically IR. Revise Design Study and R&D progress. Assess MICE results. Hold a number of informal Workshops dedicated to this purpose. Assemble status of knowledge and maximize dissemination.	Period		←→	←→	←→	←→
		MS		Workshop on Front & Back End of a Neutrino Factory			Summer BENE meeting
		ID		Workshop Summary			

8. N2.4 Expected outcome

Such a coherent and coordinated European program on neutrino beams will involve the large majority of the European experts in the field.

- It will bring an unprecedented collaboration between accelerator and particle physicists.
- It will provide the critical mass necessary to develop an attractive and ambitious program allowing in due course to design and construct cutting-edge infrastructures.
- It will thus strengthen the European role in this sector.
- The expertise and skills of each participant will be enhanced by the contact with worldwide experts and improved communication.
- Dissemination of knowledge will be one of BENE's main concerns. We plan to apply for a Marie Curie fellowship for a postdoc who, in addition to participating to the BENE studies, would strengthen our effort in:
  - the centralization, maintenance, upgrade and distribution of common simulation software
  - the development of the BENE Website,
  - including the management of the BENE documentation.

The knowledge will be shared through active participation to international worldwide conferences and workshops. Very limited resources are presently available in Europe for neutrino initiatives, due to the difficulties of LHC funding. The EC support requested here will add a decisive value in view of the strategic goal of producing a timely European initiative and leadership in the fundamental area of neutrino science.

8.N2.4.1 Measuring the impact of the network activity

Appropriate ways and parameters to monitor the impact of BENE will be the number of

1) participants to Muon Weeks and BENE Workshops
2) documents and tools produced
3) new collaborations among participants
4) novel ideas proposed to improve operation and performance of existing infrastructures and of R&D
5) design study proposals generated by BENE. The approval of each proposal by a host laboratory will require the favourable assessments of a peer review panel and will provide direct evidence of the network impact.
6) quotations of BENE documents.

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8. N3 Activity N3: High-Energy High-Intensity Hadron Beams *(HEHIHB)*

8. N3.1 Description and objectives of the activity

In 2007, the large hadron collider (LHC), currently under construction at CERN, will push the frontier for high-energy particle physics to unprecedented limits. It will provide particle collisions with centre of mass energies (14 TeV) and beam intensities approximately one order of magnitude above those at existing hadron colliders. This increase in performance required a total development time of more than 20 years from the first conceptual design until its final completion. At the time of the first design proposals, the required technologies for constructing and operating the LHC machine and its pre-injectors were not yet available and had to be developed after most of the machine parameters had been determined. Such a design and construction process is only possible:

- if the technical limits are well understood,
- if the experience from the construction and operation of existing machines indicate how the remaining obstacles can be overcome.

Planning for hadron colliders with specifications well above those of the LHC requires the identification of the main issues and carrying the related necessary R&D.

- The first objective of the HEHIHB network is to set the framework, and develop a coordinated program for accelerator R&D and experimental studies in existing machines relevant for achieving High Energy and High Intensity Hadron Beams

The construction of the LHC is done in an international collaboration involving a large number of major international laboratories like CERN and CEA in Europe, FNAL, BNL and LBNL in the USA and KEK in Japan. Preparing the roadmap for future high-energy and high-intensity hadron beams requires a similar or larger collaboration of international laboratories. The major High-Energy Physics laboratories in the USA are currently setting up a program for inter-laboratory collaborations towards a future high-energy hadron collider with applications for funding by the DOE (US-LARP = US LHC Accelerator Research Program).

CARE provides an excellent opportunity for generating a similar structure within Europe that can facilitate the collaboration between US and European laboratories over the next 5 years.

- The second objective is to integrate and coordinate the relevant studies on High Energy and High Intensity Hadron Beams done at the major laboratories as well as the smaller laboratories and universities.

These studies can help deciding which technologies provide viable options for such a project. The HEHIHB network work will also investigate potential applications for the Next European Dipole (NED Joint Research Activity) and High-Intensity Pulsed Proton Injector (HIPPI Joint Research Activity).

Finally after achieving the previous objectives,

- The third objective is to establish a road map towards the improvement of the performance of existing hadron beam facilities in Europe and the realization of High-Energy High-Intensity Hadron colliders.

It is worthwhile noting that studies towards high-energy high intensity hadron beams can also have a wide range of applications and hence the network will contribute actively to the dissemination of the gathered information.

8. N3.2. Participants in the activity

The 10 contracting participants and the 13 associated institutes to this network are listed in Tables 6.N3.2a and 6.N3.2b. They represent 13 countries plus the international laboratory CERN including large laboratories such as STFC, CEA, DESY or INFN, and small universities, fulfilling the goal assigned in FP6: dissemination of knowledge from large to medium size laboratories and institutes.

Table 8.N3.2a: List of contracting participants

Participant number	Participant	AMT	ABI	APD
1	**CEA**	X		
4	**GSI**	X	X	X
5	**DESY**		X	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*		
	IFIC			*X*
17	**CERN**	X	X	X
19	**PSI**		X	
20	**STFC**	X		

Table 8.N3.2b: List of associated institutes

Participant	Participant	AMT	ABI	APD	Associated to
2	**ESRF**		X		CERN
4	**TUBE**			X	CERN
6	**TEMF**			X	DESY
9	**FZK**	X			DESY
12	**ENEA**	X			CERN
14	**KEK**	X			CERN
19	**JINR**	X			CERN
20	**IHEP**			X	CERN
21	**UPSA**		X		CERN
24	**CRPP**	X			CERN
44	**FNAL**	X	X	X	CERN
45	**LBNL**	X	X	X	CERN
46	**BNL**	X	X	X	CERN

8. N3.3 Outline of the implementation plan for the full duration of the activity (including milestones and deliverables)

The objectives of the HEHIHB network will be achieved by

- a series of general and specialized meetings and workshops
- the development of the a Web site
- the development of common database and code repositories

The work has been organized in three work packages covering the subsequent topics:

- **WP1: Advancements in accelerator magnet technologies (AMT**).
    - AMT1: Study the Stability and Quench Limit of LHC-ultimate and LHC-upgrade
    - AMT2: Definition of magnet specification for an SPS upgrade
    - AMT3: Definition of magnet specification for a booster ring in the LHC tunnel
    - AMT4: Comparison of High-Field Magnet Designs and their applications
    - AMT5: Optimisation of the overall cost of the magnets system for a high-energy hadron collider
- **WP2: Novel Methods for Accelerator Beam Instrumentation (ABI**).
    - ABI1: Studying tools and diagnostic systems for luminosity monitoring and steering
    - ABI2: Studies on the applicability of a wire compensation for long range beam-beam interactions
    - ABI3: Studies on advanced transverse beam diagnostics
    - ABI4: Implementation of fast feedback loops for orbit, coupling and chromaticity control
    - ABI5: Studies on advanced beam halo diagnostics
    - ABI6: Studies leading to remote diagnostics and maintenance of instrumentation devices
- **WP3: Accelerator Physics and Synchrotron Design (APD**).
    - APD1: Interaction Region design for an LHC luminosity upgrade
    - APD2: Optics design for booster synchrotrons in the SPS or LHC tunnel
    - APD3: Impedance calculations for new experimental beam pipes and booster systems
    - APD4: Generation of a structured list of intensity limits for the LHC operation
    - APD5: Studies on electron cloud effects for very high-intensity bunches
    - APD6: Studies on measurement procedures for non-linear machine parameters
    - APD7: Advanced theoretical studies on halo formation and loss mechanisms

8. N3.3.1 Deliverables

The Main Deliverables (**MD**) of the HEHIHB network are:

1. **MD:** Development of **Web site** to centralize and disseminate the information relevant to HEHIHB
2. **MD:** Development of centralized **database** and **code repositories**.
3. **MD:** A **final report** including
    - The worldwide studies relevant for achieving High Energy High Intensity hadron beams beyond those provided by the LHC
    - The status of the state-of-the-art at the time of the final report on AMT, ABI and APD.
    - A priority list of the required R&D and a roadmap for carrying them over
    - A road map towards the realization of High-Energy High-Intensity Hadron colliders

In addition, a series of Interim Deliverables (ID) will be provided. They will be constituted by

- the proceedings of the topical meeting and workshops
- the annual report of the HEHIHB network

8. N3.3.2 Milestones

The milestones (**MS**) will be constituted by the various general HEHIHB meetings, and the specialized meeting or workshops held during the 5 year period of the CARE project. It will also include important steps in the deployment of the Web sites, databases and code repositories.

The following table shows an outline of the HEHIHB deliverables and milestones.

WP	Task		Year 1	Year 2	Year 3	Year 4	Year 5
All	Review of all HEHIHB activities. Dissemination of knowledge	Period	←→ (Years 1–5)				
		MS	Annual meeting	Annual meeting	Annual meeting	Annual meeting	Final meeting
		ID	Annual Report	Annual Report	Annual Report	Annual Report	
		MD	**Web Site**				**Final Report**
AMT	*During the first year the AMT group will discuss and define a priority list with issues requiring a stronger interaction and coordination (e.g. high-field magnet design issues, low field magnet design issues, synchrotron radiation issues etc…). An integrated work plan will be set and a list of 3 topical workshops will be established to address them and workshop dates will be decided for the different topics, in addition to the annual meetings.*						
	Establish list of priorities. The priority list will determine topics and their sequence for the dedicated workshops, (e.g. Sc cable, high field magnet and low field magnet design issues and future collider project).	Period	←→				
		MS					
		ID	Report				
	Identification of the main issues of progress needed on material and cabling and definition of a roadmap of the required studies and experimental tests	Period	←→ (Year 1 – Year 2)				
		MS	1st Topical AMT Workshop				
		ID	Proceedings of 1st Topical Workshop				
	Identification of the main obstacles for the generation of High field and/or pulsed field and generation of a road map for the required studies	Period		←→ (Year 2 – Year 4)			
		MS		2nd Topical AMT Workshop			
		ID		Proceedings of 2nd Topical Workshop			
	Identification of the main obstacles for the future colliders and the key merit parameters to compare different design and generation of a road map for the required studies	Period				←→ (Year 4 – Year 5)	
		MS				3rd Topical AMT Workshop	
		ID				Proceedings of 3rd Topical Workshop	
	Generation of internet based databases for SC Magnets and Cables, and on the ongoing activities related to super conducting magnet developments.	Period	←→ (Year 1 – Year 3)				
		MS	Running database skeleton (mid-3rd year)				
		MD	**Completion of databases (end-3rd year)**				

WP	Task		Year 1	Year 2	Year 3	Year 4	Year 5
ABI	*During its first meeting the ABI WP will review and discuss the ongoing R&D program in the institutes. It will define a priority list with issues requiring a stronger interaction and coordination. An integrated work plan will be set and a list of 5 topical workshops in addition to the annual meetings will be established to address them. Workshop dates will be decided for the different topics (T1-T5).*						
	Discussion and definitions of priority list:	Period	↔				
		MS					
		ID	Report				
	T1: a) Identification of the main obstacles b) Definition of a road map for the required studies	Period	↔				
		MS	1st Top. workshop				
		ID	Proceedings of 1st Topical Workshop				
	T2: a) Identification of the main obstacles b) Definition of a road map for the required studies	Period		↔			
		MS		2nd Top workshop			
		ID		Proceedings of 2nd TopicalWorkshop			
	T3: a) Identification of the main obstacles b) Definition of a road map for the required studies	Period			↔		
		MS			3rd Top. workshop		
		ID			Proceedings of 3rd TopicalWorkshop		
	T4: a) Identification of the main obstacles b) Definition of a road map for the required studies	Period				↔	
		MS				4th Top.workshop	
		ID				Proceedings of 4th TopicalWorkshop	
	T5: a) Identification of the main obstacles b) Definition of a road map for the required studies	Period					↔
		MS					5th Top.workshop
		ID					Proceedings of 5th TopicalWorkshop

WP	Task		Year 1	Year 2	Year 3	Year 4	Year 5
APD	*During the first year the APD group will discuss and define a priority list with issues requiring a stronger interaction and coordination, e.g. on IR design, collective effects and/or booster synchrotron design. An integrated work plan will be set and a list of 2 or 3 topical workshops will be established to address them and workshop dates will be decided for the different topics, in addition to the annual meetings.*						
	Creation of the web site to document APD studies. Catalogue of existing simulation codes	Period	↔				
		MD	**Web site**				
		ID	Report				
	Definition of the list of priorities and agreement on a code repository. Proposal for code benchmarks and extensions.	Period	↔				
		ID	Report				
	First results. Priority of tasks established. Creation of web based code repository.	Period		↔			
		MD		**Code Repository**			
		ID		Report			
	Documentation of results on high-priority benchmarks. Definition of optics design options for IR layout and booster synchrotrons.First structured list of intensity limits. Definition of possible new milestones.	Period		↔	↔		
		ID		Report			

WP	**Task**		**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
APD	*Series of 2 or 3 Workshops. The aim of these workshops is first to document the current beam intensity and luminosity limits imposed by the current hardware capabilities for the optics design and the collective effects of the beam dynamics*						
	Workshop on 1st selected topic	Period	⟷	⟷			
		MS	1st Topical Workshop				
		ID	Workshop Proceedings				
	Workshop on 2nd selected topic	Period		⟷	⟷		
		MS		2nd Topical Workshop			
		ID		Workshop Proceedings			
	Possible Workshop on 3rd selected topic	Period				⟷	
		MS				3rd Top. Workshop	
		ID				Proceedings	

8. N3.4 Expected outcome

One of the main expected outcomes is that the community will be ready to launch a Design Study on the LHC Luminosity and Energy upgrade in due time.

The proposed network will have:

- Identified the most efficient solutions for future high-energy high-intensity proton beams.
- Set the priorities
- Set the organizational framework for these studies
- Created the appropriate tools to collect information and evaluate the various software codes

Furthermore, the network will help in spreading the knowledge and expertise available at the laboratories with operating accelerators to smaller institutes and Universities that can't maintain their own accelerators.

The HEHIHB network will help in bringing together different communities such as high-energy physics (HEP) and fusion physics and facilitate the exchange of technical expertise between them (e.g. shared research on high-field superconducting magnets).

Finally, coordinating the research studies related to high-energy and high-intensity hadron beams and integrating laboratories on a European-wide scale in Europe will also lead to the following outcomes:

- Expose small laboratories and institutes to the frontiers of high-energy accelerator research
- Offer new training and job opportunities for young people in particular within Universities and small laboratories raising the European level of competence and its sustainability
- Provide improved techniques and competence for the operation of existing accelerator facilities and thus a more efficient use of the existing infrastructure
- Set a framework similar to the one being set up by the US laboratories, enhance the synergies and facilitate the collaboration between European and US laboratories
- Stimulate the exchange of knowledge and expertise between research laboratories and industry and thus provide a stimulating effect on the European industry
- Open the door for very high-energy physics after the LHC, contributing to ensure the future of High Energy Physics in Europe and in the World

8. N3.4.1 Measuring the impact of the network activity

A measure of the success and impact of the network activity will be given by the number of:

- Documents describing the current expertise in high-energy high-intensity hadron beams.
- Documents describing the identified limitations for pushing beam intensities and energies above those currently at hand in existing machines.
- Documents describing new ideas for operating and improving the existing infrastructure.
- Documents describing new initiatives for R&D work for solving the identified limitations for the beam intensities and energies.
- New collaborations among the participants and inter laboratory sharing of existing facilities.
- Design studies for future machines and equipment that can increase the achievable intensities and energies in hadron beams.
- Proposed new Ph.D theses arising from the network.

8. R1 Activity JRA1: Superconducting Radio Frequency *(SRF)*

8. R1.1 Description and objectives of the activity

Superconducting accelerating systems have been in use successfully for electron and heavy ion accelerators. Although the SRF (Superconducting Radio Frequency) technology has reached a state of maturity, substantial improvements are required to exploit the intrinsic potential of the superconducting material. Great effort was started within the framework of the international collaboration TESLA. The superconducting test accelerator TTF and all necessary infrastructures for the preparation of superconducting resonators were set up and have been in operation for several years. A remarkable increase of the accelerating gradient was achieved. Further improvements up or near to the maximum intrinsic properties of the superconducting Niobium material are expected by consequent continuation of the R&D effort. In SRF, a joined European R&D activity is proposed for the development of novel cavity fabrication and preparation techniques and for the development of cheaper, more reliable ancillary RF components (tuners, couplers etc….). This will result in prototype components to be tested under realistic operating conditions in the TTF linac and it will result in the improvement of the performance of this infrastructure. New SRF accelerator projects like TESLA and the superconducting X-ray FEL will directly benefit from these expected improvements.

The basic objectives of the proposed 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 and
- to achieve a cost reduction of the SRF cavities and their associated components. .

The main steps towards these goals are

- ✓ implementation of electro-polishing for better surface quality (roughness <1µm),
- ✓ exploration of new fabrication methods such as vacuum arc coating,
- ✓ improving the methods for quality control (sensitivity),
- ✓ developing improved input couplers,
- ✓ developing new cold tuner systems,
- ✓ improving the reliability of RF components and developing low-cost prototypes,
- ✓ performing integrated tests of cavities, couplers, tuners, under development

The objectives mentioned above are treated within 10 work packages, which are described in more detail in the section on the implementation plan. An eleventh work package will cover the management of SRF.

Work Package	Full name	Short name
WP1	Management and Communication	M&C
WP2	Improved Standard Cavity Fabrication	ISCF
WP3	Seamless Cavity Production	SCF
WP4	Thin Film Cavity Production	TFCP
WP5	Surface Preparation	SP
WP6	Material Analysis	MA
WP7	Power Couplers	COUP
WP8	Cavity Tuners	TUN
WP9	Low Level RF	LLRF
WP10	Cryostat Integration Tests	CIT
WP11	Beam Diagnostics	BD

Work packages, full names and short names in JRA1

8. R1.2 Participants in the activity

Table 8.R1.2a lists the participants and their involvement in the eleven work packages.

Table 8.R1.2b shows the detailed involvement of each participant, together with an estimate of their total contribution to the activity in person months for the duration of the project.

Table 8.R1.2a: List of participants and their involvement in the different work packages.

Participant 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
1	**CEA**					X			X		X	X
3	**CNRS**	X						X	X		X	
6	**DESY**	X	X	X		X	X			X		
10	**INFN**		X	X	X	X	X		X			X
	INFN-LNF											*X*
	INFN-LNL		*X*	*X*		*X*	*X*					
	INFN-MI		*X*						*X*			
	INFN-RO2				*X*							*X*
12	**TUL**								X	X		
13	**IPJ**		X		X							
14	**WUT-ISE**									X		
19	**PSI**									X		

Table 8.R1.2b: Involvement of each participant in person-months

Participant number	Participant	WP/Topic	Roles	Person month
1	CEA	WP5/SP	EP on single cells	85
		WP8/TUN	Design and fabrication of new piezo-electric tuners	16
		WP10/CIT	Preparation of cryogenic test facilities. Tests of prototypes in	66
		WP11/BD	Design and fabrication of novel BPM.	58
		TOTAL	*Permanent staff 141, temporary staff 84 person month*	**225**
3	CNRS-Orsay	WP1/M&C	M&C	8
		WP7/COUP	Coulpler development	258
		WP8/TUN	Test of tuners	24
		WP10/CIT	Cryostat integration test	36
		TOTAL	*Permanent staff 278, temporary staff 48 person month*	**326**
6	DESY	WP1/M&C	M&C	112
		WP2/ISCF	EB welding	80
		WP2/ISCF	Reliability analysis	39
		WP3/SCF	SCP by hydroforming	45
		WP5/SP	EP on multicells	96
		WP5/SP	Dry ice cleaning	90
		WP5/SP	DC FE studies on Nb samples	40
		WP6/MA	SQUID scanning	96
		WP9/LLRF	Detector of single bunch transient	62
		WP9/LLRF	Design of reliable, cost optimal LLRF system	44
		TOTAL	*Permanent staff 602, temporary staff 102 person month*	**704**
10	INFN	**TOTAL**	*Permanent staff 494, temporary staff 291 person month*	**785**
	INFN-LNF	WP11/BD	R&D of a novel non-intercepting diagnostic for emittance	163
		TOTAL	*Permanent staff 115, temporary staff 48 person month*	**163**
	INFN-LNL	WP2/ISCF	EB welding	20
		WP3/SCF	SCP by spinning	80
		WP5/SP	Alternative EP	90
		WP6/MA	Flux gate magnetometry	40
		TOTAL	*Permanent staff 158 , temporary staff 72 person month*	**230**
	INFN-Mi	WP2/ISCF	Reliability analysis	50
		WP2/ISCF	Improved component design	48
		WP8/TUN	R&D on pieco electric actautors	48
		TOTAL	*Permanent staff 75 , temporary staff 71 person month*	**146**
	INFN-Ro2	WP4/TFCP	Development of planar arc cathode	156
		WP11/BD	R&D on a novel non-intercepting diagnostic for emittance	90
		TOTAL	*Permanent staff 146 temporary staff 100 person month*	**246**
12	TUL	WP8/TUN	R&D on magneto-strictive tuner	15
		WP9/LLRF	Data management for DOOCS operating system.	24
		WP9/LLRF	Radiation damage studies on electronics	16
		WP9/LLRF	Development of Finite State Machine	41
		TOTAL	*Permanent staff 48, temporary staff 48 person month*	**96**
13	IPJ	WP2/ISCF	EB welding	30
		WP4/TFCP	R&D on linear arc cathode	200
		TOTAL	*Permanent staff 210 , temporary staff 20 person month*	**230**
14	WUT-ISE	WP9/LLRF	Highly stable frequency distribution network	48
		WP9/LLRF	RF control using FPGA's.	48
		WP9/LLRF	Performance optimisation for different gradients	36
		WP9/LLRF	Multichannel downconverter.	36
		TOTAL	*Permanent staff 120, temporary staff 48person month*	**168**
19	PSI	WP9/LLRF	Design of exception handling routines	36
		WP9/LLRF	RF gun control system	36
		TOTAL	*Permanent staff 36, temporary staff 36 person month*	**72**

8.R1.3 Outline implementation plan for the full duration of the activity (including milestones and deliverables)

SRF is articulated around 11 work packages:

- one work package dedicated to management and communication (M&C)
- the ten others targeting the main objectives as described below

All tasks aim at an improvement of the quality of the accelerator test facility TTF. Deliverables will be in form of scientific reports, proposals for design or treatment changes, approved new fabrication methods and construction of prototypes.

Work package 1: Management and Communication (M&C) oversees and coordinates the work of all work packages, organizes Steering Committee meetings, ensures proper reviewing and reporting as well as dissemination of knowledge within the JRA SRF and the CARE project.

Work package 2: Improved Standard Cavity Fabrication (ISCF) aims at improving the present cavity fabrication technology. It is based on the operating experience with superconducting cavities in the test linac TTF. There is an obvious need to modify at least partially the cavity design and the preparation procedures to improve the performance and reliability of the SRF accelerating system.

Work package 3: Seamless Cavity Production (SCP) follows the idea to fabricate the actual cavity (excluding the end groups with auxiliary components like input coupler ports, higher order mode dampers…) by a method that avoids welding. This would eliminate possible performance degradation by a low quality weld. There are two methods of seamless production: spinning and hydro-forming. Very encouraging results are obtained with single cell cavities. This technology will be extended to multi-cell cavities.

Work package 4: Thin Film Cavity Production (TFCP) works on a new method of thin film coating by vacuum arc technology. Instead of fabrication of a cavity from bulk Niobium, a Copper cavity will be coated at the inside by a thin (several μm thick) superconducting Niobium layer. As compared to the sputter coating method (as being developed by CERN) the novel method of vacuum arc coating promises superior superconducting film properties. First results on samples support this expectation. Two different methods using a planar or a linear source will be investigated.

Work package 5: Surface Preparation (SP) investigates new methods of surface cleaning. There are two different topics: electro-polishing and dry ice cleaning. Electro-polishing will produce smoother surfaces as compared to the widely used chemical polishing method. There are very encouraging results on single-cell and nine-cell cavities (in collaboration with KEK, Japan), which can be excited to considerable higher RF fields. In this work package, the optimum EP parameters will be investigated first with single cells. As a next step, this technology will be adapted to the geometry of multi-cell cavities. In parallel, a new method of EP with self-stabilising parameters will be further developed for single cell and multicell cavities. Dry ice (CO_2) cleaning is expected to clean surfaces from dust or residual contaminations much more effectively than the presently used technique of high pressure water. It is under use in the semiconductor industry but was never applied to SRF cavities.

Work package 6: Material Analysis (MA) extends the methods of quality control of Niobium material and cavity surfaces. At present, an eddy current scanning technique is implemented in the acceptance procedure of Niobium sheet from industry. It is a quantitative measure of the purity that can be used to detect inclusions beneath the surface of the sheet material. This scanning technique can be improved further in sensitivity by implementation of a superconducting Squid sensor. A second way is to develop a simpler flux gate magnetometer for use at the industrial plant.

DC field emission scanning is a very sensitive method for detection of small surface contaminations. This technology will be further developed for a systematic evaluation of the surfaces of samples, which travel together with the cavity during the different steps of preparation. It is envisaged to install a nearly in-situ quality control of the preparation steps by this method.

Work package 7: Couplers

The aims of this WP include new input coupler designs as well as construction of prototypes. Results from the tests of prototypes will also be delivered, the tests being carried out on a dedicated high power tests stand recently built at Orsay. Among the delivered hardware will be a titanium-nitride coating bench designed to allow coating of several coupler ceramic windows simultaneously. RF "conditioning" studies will also be provided. The TTF couplers were specified for 210 kW peak power in normal operation with higher powers (~ 1 MW) at short pulse lengths for cavity conditioning. We aim to develop couplers that will comfortably handle 1 MW peak powers for pulse lengths of 1.3 milliseconds at 5 Hz repetition rate. Such couplers are necessary to match the progress aimed for in the cavity fields. In addition it is hoped that the conditioning studies will lead to a procedure allowing faster conditioning times than at present (typically of the order of one week).

Work package 8: Tuners

The development of active tuner systems is imperative for operation of SC cavities at high gradient. Four of the participating laboratories are investigating innovative tuner systems as well as developing the electronic drive circuitry necessary for them. These tuners are the deliverables of this WP. Especially innovative will be the development of tuners based on piezo-electric and magneto-strictive effects. Tuners are required to counteract the so-called Lorentz de-tuning effect when the cavities are pulsed at high field so as to maintain the phase and amplitude constant during the RF pulse, whilst minimising additional RF power needed for field control. We aim to develop tuners capable of correcting 1 kHz of de-tune so allowing the cavities to operate stably at 35 MV/m. This should be compared with existing tuners on TTF which correct for fields of ~ 15 – 20 MV/m. Long life-time is also a major issue and we aim to develop tuners allowing for 20 years of operation.

Work package 9: Low level RF

This WP is comprised of a large number of sub-tasks all of which are aimed at improving the performance, reliability and ease of operability of the LLRF system, both hardware electronics and software, while at the same time allowing significant cost reductions. These sub-tasks will result in the following deliverables:

- design and construction of a detector of single bunch transients,
- automation of the LLRF,
- development of an optimal controller,
- development of exception handling routines,
- high performance optimisation routines for operation at different cavity fields,
- cost optimisation and reliability studies,
- studies of radiation damage to electronic hardware,
- development of a low cost, compact, high performance multi-channel down-converter,
- development of digital RF feedback control system,
- development of a highly stable frequency distribution system,
- development of a data management system,
- RF gun control.

It is important to note that all of these tasks are independent of the others and that each contributes individually to the improvement of the RF system.

Work package 10: Horizontal Cryostat Integration Tests

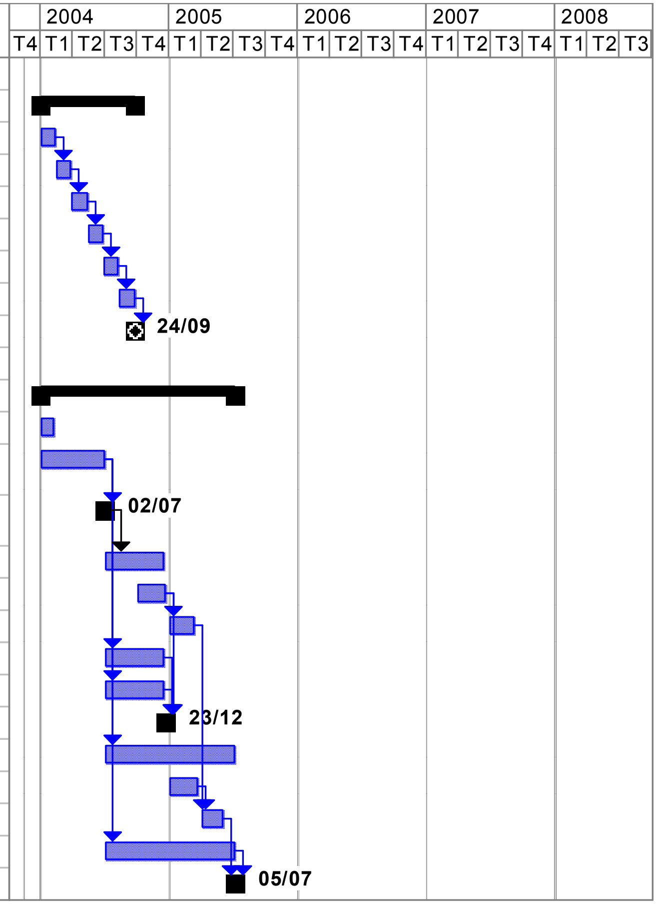
The deliverables of this WP concern the results of tests performed on SC cavities in CRYHOLAB (shown as test 1, test 2 etc..., in Gantt chart), a test infra-structure built by an IN2P3-CEA collaboration at Saclay. This facility will allow integrated tests of cavities equipped with improved components resulting from developments in other WP's within the JRA (tuners and couplers). Novel thermometric calibration techniques will be developed for use during these tests.

Work package 11: Beam Diagnostics

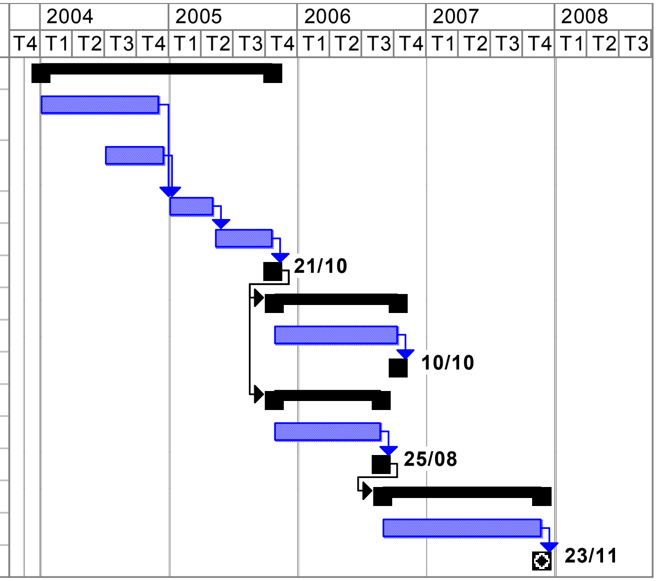
Two different diagnostics will be designed and constructed within this work package. The first will be an RF cavity based beam position monitor (BPM). This device will have a resolution five times better than existing devices while maintaining high temporal resolution. The second will be a non intercepting emittance monitor based on millimetre wave radiation emitted by diffraction effects as the beam traverses a slotted aperture. These diagnostics, both of which will be tested on TTF, constitute the deliverables of this WP.

The following Gantt chart presents the implementation plan for the whole duration of the SRF-JRA for each of the workpackages. Milestones and main deliverables are included.

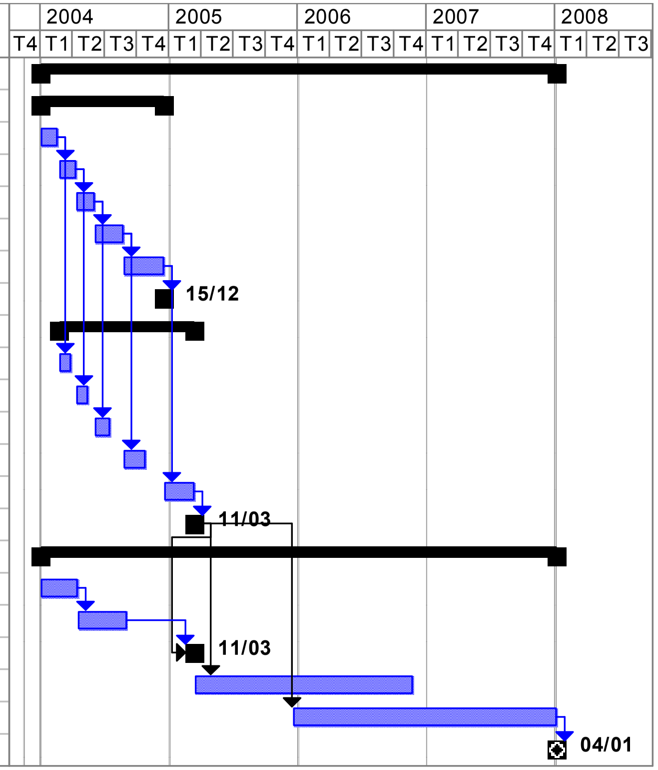
Task Name	Milestones	Main Deliverables
WP2 Improved standard cavity fabrication		
2.1 Reliability Analysis		
2.1.1 Review of data bank: cavity fabrication		
2.1.2 Review of data bank :cavity treatment		
2.1.3 Review of data bank: cavity VT performance		
2.1.4 Review of data bank: string assembly		
2.1.5 Review of data bank: string performance		
2.1.6 Establish correlations		
2.1.7 Final report on reliability issue		**Final Report**
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	**Summary Report**	
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	**Design Report**	
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	**Report**	



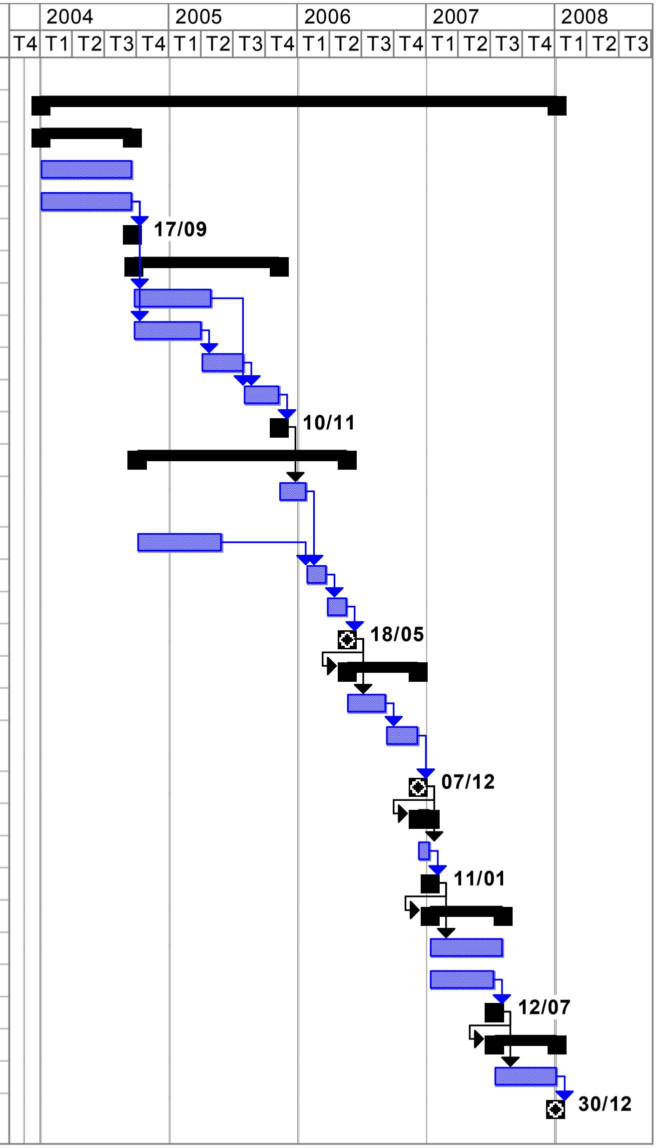
Task Name	Milestones	Main Deliverables
2.2.2 Review of criticality in welding procedures		
2.2.2.1 Review of available parameters on vendor welding machine		
2.2.2.2 Definition of prototype requirements for tests		
2.2.2.3 Welding test on specimens		
2.2.2.4 Analysis of the results		
2.2.2.5 Report about welding parameters	**Report**	
2.2.3 Finalize new component design		
2.2.3.1 Do drawings		
2.2.3.2 New components design finished	**Design report**	
2.2.4 Finalize new cavity design		
2.2.4.1 make drawings		
2.2.4.2 New cavity design finished	**Design report**	
2.2.5 Fabrication of new cavity		
2.2.5.1 Fabrication		
2.2.5.2 New cavity finished		**Cavity Prototype**



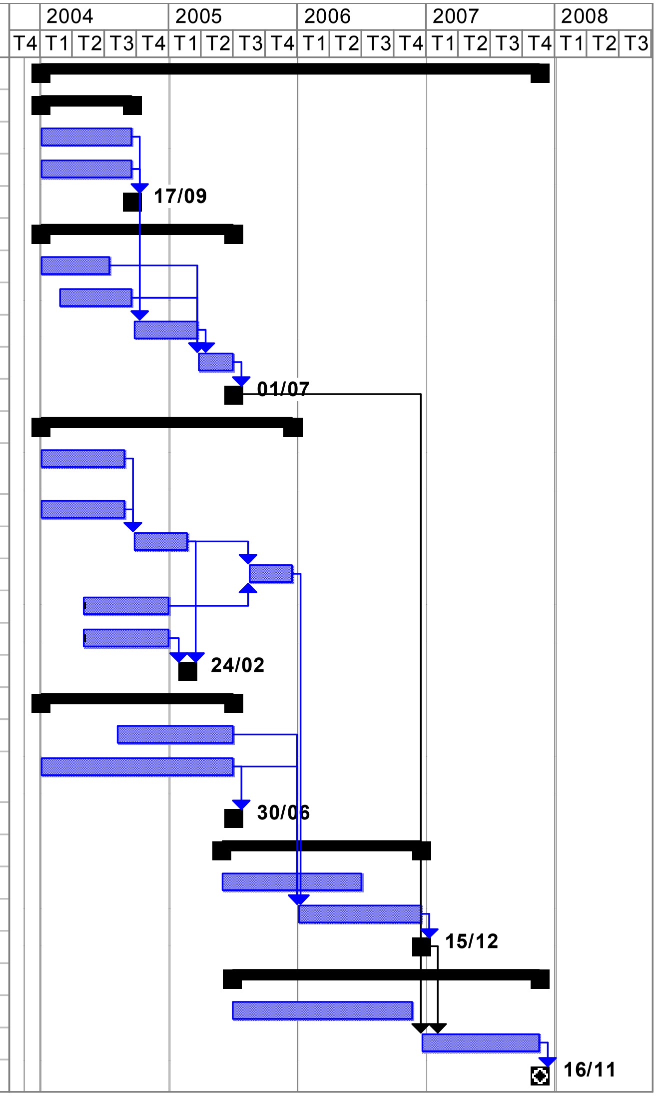
Task Name	Milestones	Main Deliverables
2.3 EB welding		
2.3.1 Design tooling		
2.3.1.1 Tools for flange welding		
2.3.1.2 Tools for pipe welding		
2.3.1.3 Tolls for stiffening rings		
2.3.1.4 Tools for single cell welding		
2.3.1.5 tools for 9-cells		
2.3.1.6 Tools design finished	**Design report**	
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	**Tools Ready**	
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	**Commissioning**	
2.3.3.4 Single cell welding		
2.3.3.5 Multicell welding		
2.3.3.6 Welding of prototypes of components finished		**Prototypes**



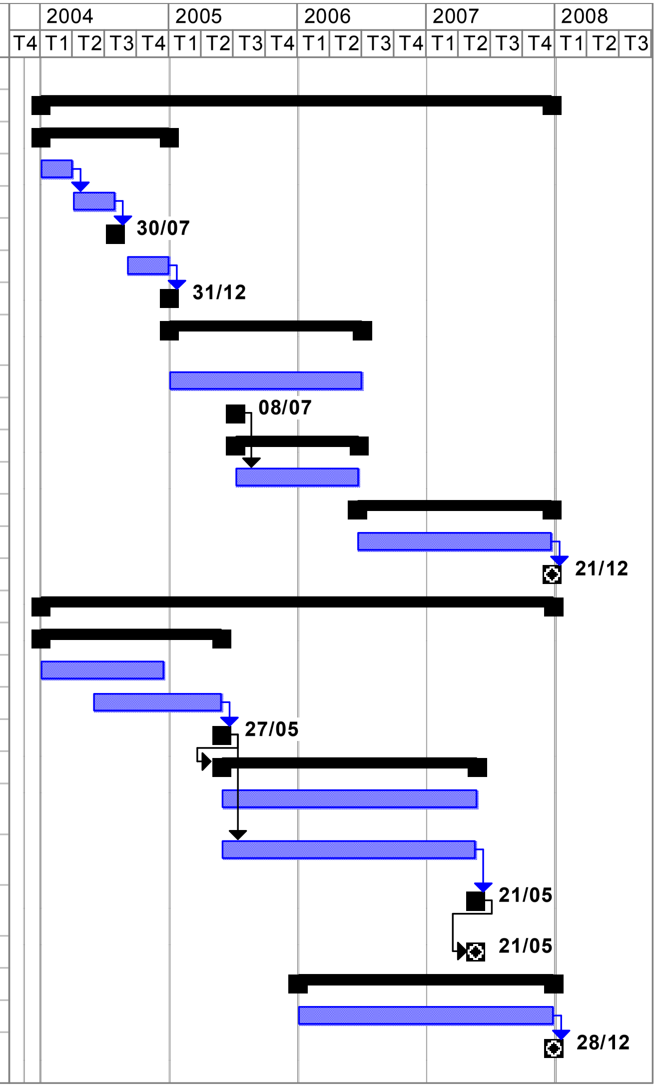
Task Name	Milestones	Main Deliverables
WP3 Seamless cavity production		
3.1 Seamless by spinning		
3.1.1 Design spinning machine		
3.1.1.1 Drawings of the matrices		
3.1.1.2 Drawings of the support system		
3.1.1.3 Drawings of spinning machine finished	**Design report**	
3.1.2 Fabrication of spinning machine		
3.1.2.1 Hydraulic for machine		
3.1.2.2 Software for the machine		
3.1.2.3 Machine fabrication		
3.1.2.4 Commissioning of the machine		
3.1.2.5 Spinning machine ready	**Commissioning**	
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		**Design Report**
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		**Design Report**
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	**Start spinning**	
3.1.6 Spinning of multi-cell cavities cavities		
3.1.6.1 Computer simulation of the hydro forming		
3.1.6.2 Hydro forming of bulk Nb 9-cell cavities		
3.1.6.3 Parameters of multi-cell spinning defined	**Design report**	
3.1.7 series production of multi-cell cavities		
3.1.7.1 Spinning		
3.1.7.2 Multi-cell cavities finished		**Final report, Cavity Prototypes**



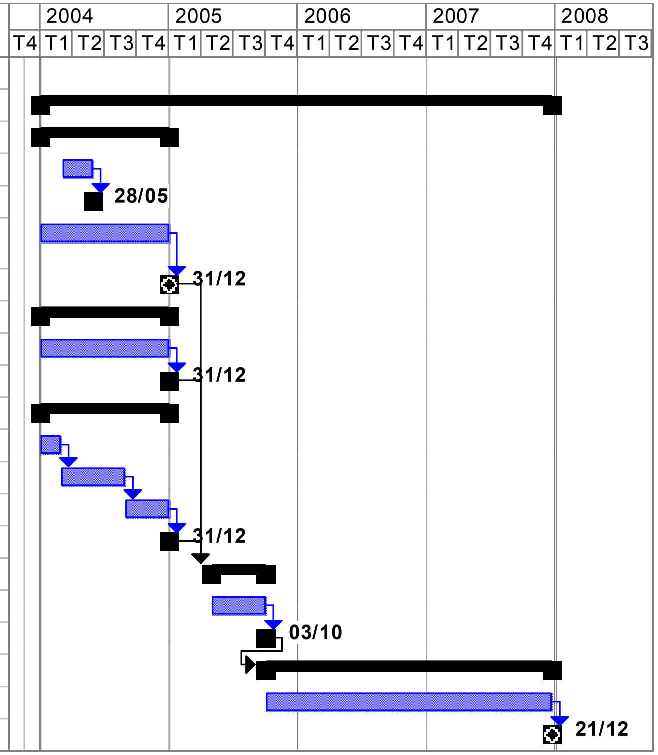
Task Name	Milestones	Main Deliverables
3.2 Seamless by hydro forming		
3.2.1 Design hydro forming machine		
3.2.1.1 Drawings of the matrices		
3.2.1.2 Drawings of the support system		
3.2.1.3 Drawings matrix & support finished	**Design report**	
3.2.2 Construction of hydro forming machine		
3.2.2.1 Hydraulic 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	**Commissioning**	
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 Commissioning of the machine		
3.2.3.5 MS necking machine ready		
3.2.3.6 Software for the tube necking machine		
3.2.3.7 Construction tube necking machine finished	**Design report**	
3.2.4 Development of seamless tubes for 9-cell cavities		
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	**Design report**	
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	**Commissioning**	
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		**Cavity Prototypes**



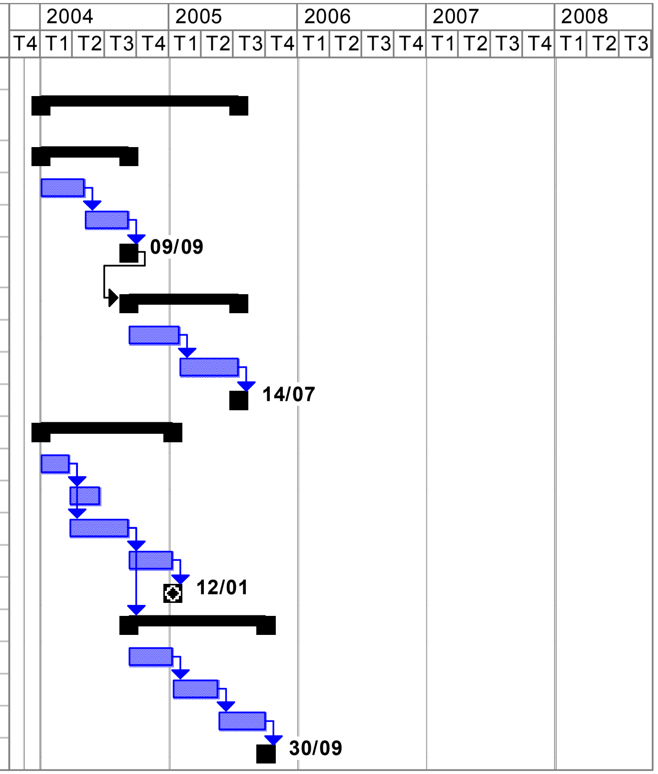
Task Name	Milestones	Main Deliverables
WP4. Thin film cavity production		
4.1 Linear-arc cathode coating		
4.1.1 Installation & commissioning of coating apparatus		
4.1.1.1 Modification of a prototype facility for single cells		
4.1.1.2 Optimization of a triggering system		
4.1.1.3 Prototype facility ready	**Commissioning**	
4.1.1.4 Study of arc current reduction and stabilization		
4.1.1.5 Coating apparatus operational	**Apparatus ready**	
4.1.2 Coating of single cells without micro droplet filtering		
4.1.2.1 Coating		
4.1.3 Droplet filter ready	**Hardware ready**	
4.1.4 Coating of single cell with micro droplet filtering		
4.1.4.1 Coating		
4.1.5 Design and commissioning multi-cell coating		
4.1.5.1 design &commissioning		
4.1.5.2 First Multicell coating		**Cavity Prototype**
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	**Status Report**	
4.2.2 Routine Operation of planar arc system		
4.2.2.1 Characterization of samples coated at different conditions		
4.2.2.2 Quantitative investigation of the micro droplet problem		
4.2.2.3 Summary report on quality of planar arc coating	**Status Report**	
4.2.2.4 First multicell coating		**Cavity Prototype**
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		**Final Report**



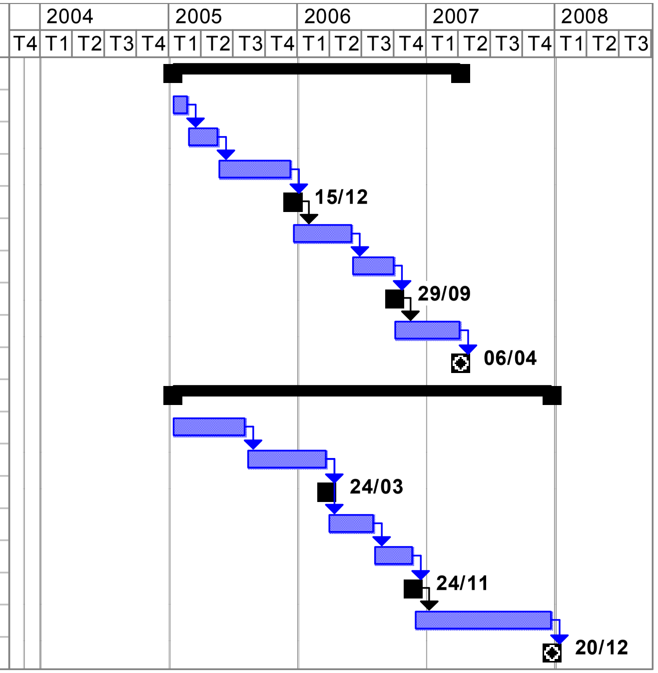
Task Name	Milestones	Main Deliverables
WP5. Surface preparation		
5.1 EP on single cells		
5.1.1 EP on samples		
5.1.1.1 Establishing method of surface characterization		
5.1.1.2 Surface characterization fixed	**Design Report**	
5.1.1.3 Series of EP with samples for surface investigations		
5.1.1.4 Best EP parameters		**Final Report**
5.1.2 Single cell cavities		
5.1.2.1 Order Nb and fabricate 3 cavities		
5.1.2.2 3 cavities fabricated	**Cavities ready**	
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	**Commissioning**	
5.1.4 Operation of single cell EP		
5.1.4.1 Continuous single cell operation		
5.1.4.2 Define working parameters for single cells	**Design Report**	
5.1.5 Continuous operation, search for best parameters		
5.1.5.1 Parameterising EP procedure		
5.1.5.2 EP parameters fixed		**Final report**



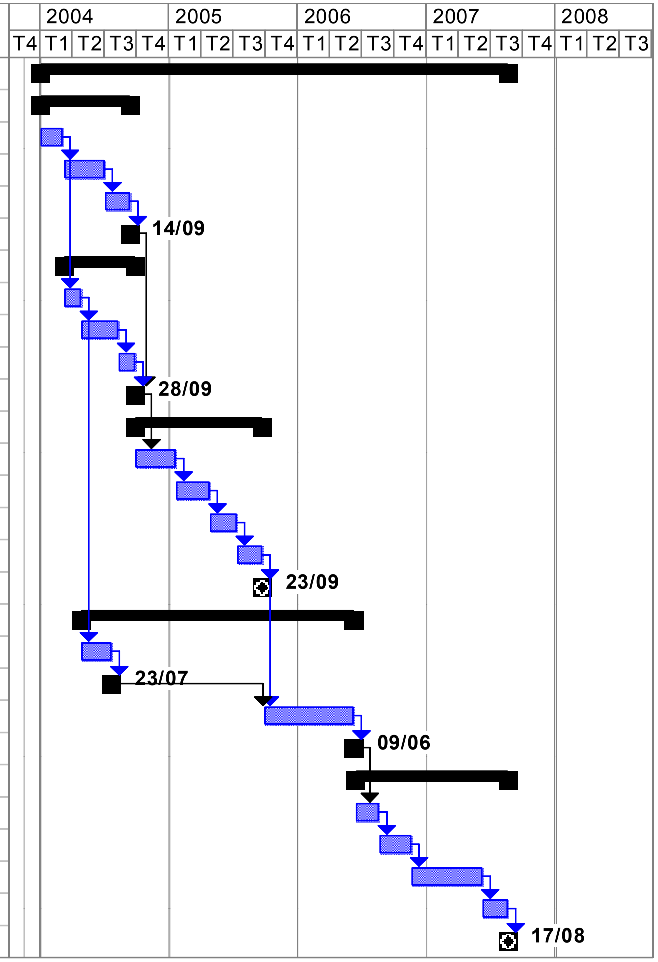
Task Name	Milestones	Main Deliverables
5.2 EP on multi-cells		
5.2.1 Transfer of parameters from 1 cell to multi cell equipment		
5.2.1.1 Finish EP setup nine-cells at DESY		
5.2.1.1.1 Improved gas cleaning system		
5.2.1.1.2 Design for hot water rinsing		
5.2.1.1.3 Proof-of-Principle experiment hot water rinsing	**Status Report**	
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	**Design report**	
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		**Final report**
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	**Equipment ready**	



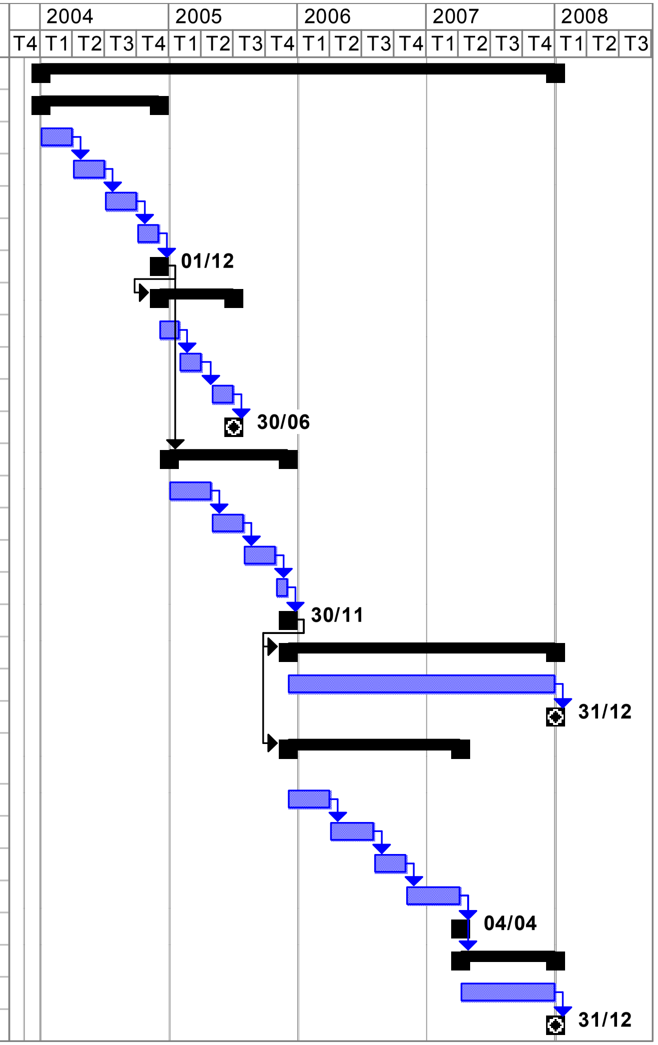
Task Name	Milestones	Main Deliverables
5.2.3 Oxipolishing as final chemical cleaning		
5.2.3.1 Laboratory studies		
5.2.3.2 Design of OP system		
5.2.3.3 Setup one-cell system		
5.2.3.4 Proof-of-Principle experiment Oxipolishing	**Status Report**	
5.2.3.5 Design OP for nine-cells		
5.2.3.6 Build OP for 9-cells		
5.2.3.7 OP for 9-cells ready	**Commissioning**	
5.2.3.8 Study op with 9-cell cavities		
5.2.3.9 Evaluate experiments		**Status Report**
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	**Report**	
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	**Commissioning**	
5.2.4.7 Operate EP multi-cell industrial prototype		
5.2.4.8 Final report on industrial EP		**Final report**



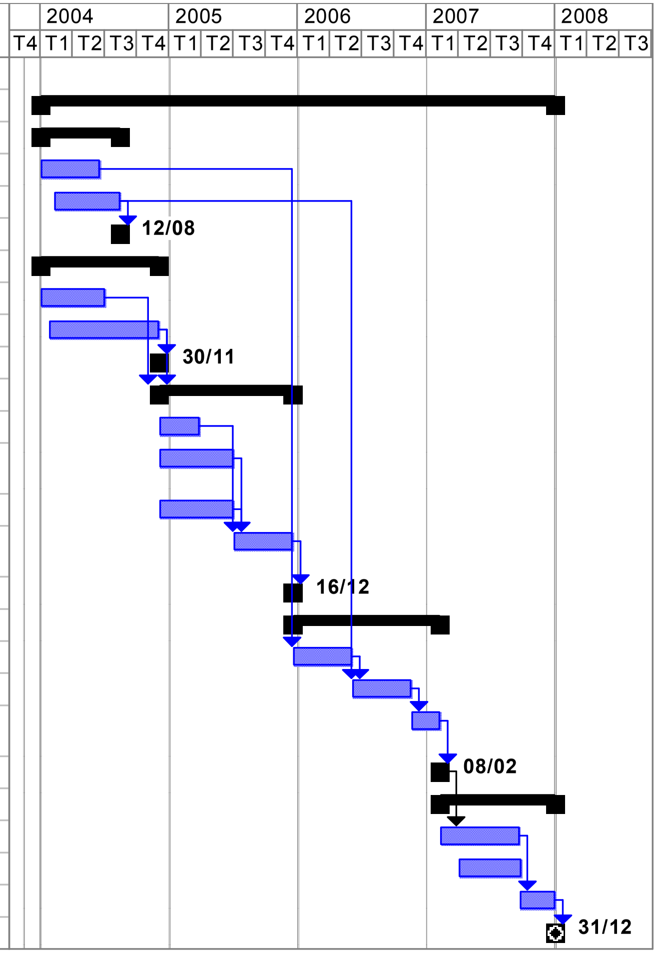
Task Name	Milestones	Main Deliverables
5.3 Automated EP (AEP)		
5.3.1 prototype EP installation		
5.3.1.1 Design installation		
5.3.1.2 Fabricate/ order components		
5.3.1.3 Assemble EP installation		
5.3.1.4 First operation of automated EP	**Commissioning**	
5.3.2 EP computer control		
5.3.2.1 Design control architecture		
5.3.2.2 Developed software		
5.3.2.3 Test of software		
5.3.2.4 Software ready	**Status Report**	
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		
5.3.3.5 Design report on AEP		
5.3.3.4 Automated EP is defined		**Final Report**
5.3.4. Alternative electrolytes		
5.3.4.1 Review of EP chemistry		
5.3.4.2 Proposal for alternative electrolytes	**Report**	
5.3.4.3 Experiments with alternative electrolytes		
5.3.4.4 Conclude experimental results	**Status Report**	
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		**Final Report**



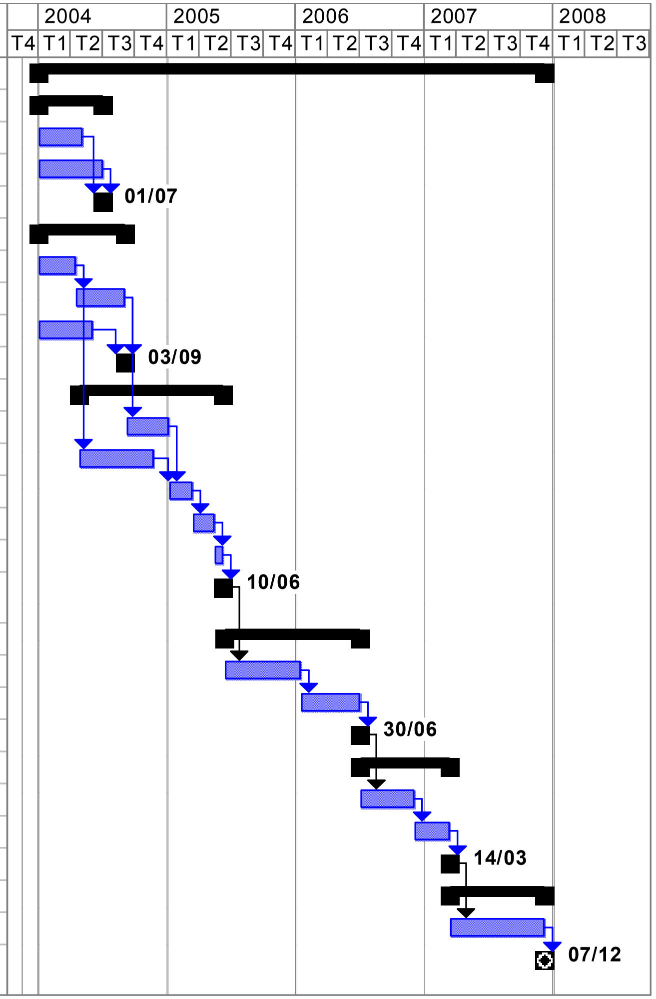
Task Name	Milestones	Main Deliverables
5.4 Dry ice cleaning		
5.4.1 Installation of full system for 1-3 cell cavities		
5.4.1.1 Installation of CO2 piping		
5.4.1.2 Installation of motion system		
5.4.1.3 Installation of control system		
5.4.1.4 Commissioning		
5.4.1.5 Installation finished	**Commissioning**	
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		**Final Report**
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	**Commissioning**	
5.4.4 VT Cleaning of 9-cell cavities		
5.4.4.1 Continuous cleaning		
5.4.4.2 Evaluation of experimental results		**Final Report**
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		
5.5.5.5 Start H 9-cell cleaning	**Commissionning**	
5.4.6 Cleaning of horizontal nine-cell cavity		
5.4.6.1 Continuous cleaning		
5.4.6.2 Evaluation of experimental results		**Final Report**



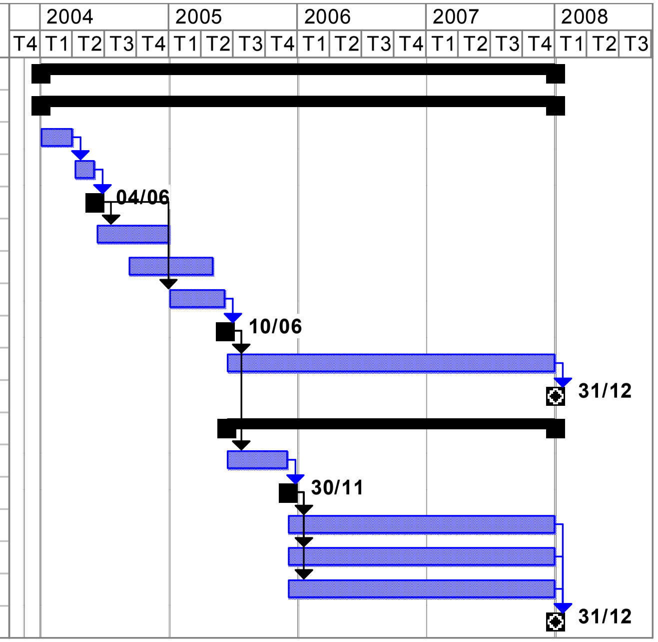
Task Name	Milestones	Main Deliverables
WP6 Material Analysis		
6.1 SQUID scanning		
6.1.1 Produce calibration defects		
6.1.1.1 Production of surface defects		
6.1.1.2 Production of bulk defects		
6.1.1.3 Calibration defects finished	**Status Report**	
6.1.2 Design components of Squid scanner		
6.1.2.1 Design of the scanning table and support		
6.1.2.2 Design of the SQUID cooling system		
6.1.2.3 Design Scanner finished	**Design report**	
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	**Commissioning**	
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	**Status Report**	
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		**Final Report**



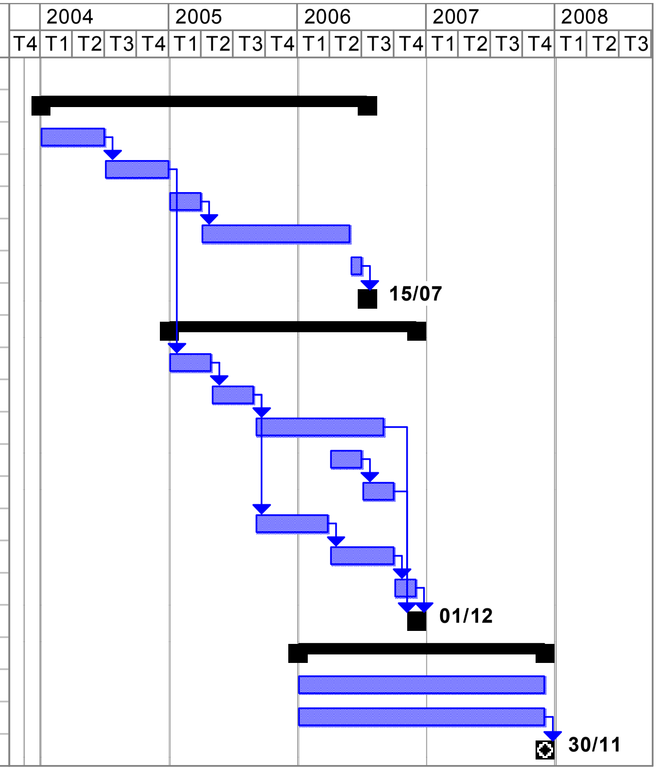
Task Name	Milestones	Main Deliverables
6.2 Flux gate magnetometry		
6.2.1 Produce calibration defects		
6.2.1.1 Production of surface defects		
6.2.1.2 Production of bulk defects		
6.2.1.3 Calibration defects finished	**Status Report**	
6.2.2 Design components of flux gate head		
6.2.2.1 Design electronics		
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	**Design report**	
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	**Design report, start operation**	
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	**Status Report**	
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	**Status Report**	
6.2.6 Comparison with SQUID scanner		
6.2.6.1 Compare measurements		
6.2.6.2 Conclude SQUID scanner vs. flux gate detector		**Final Report**



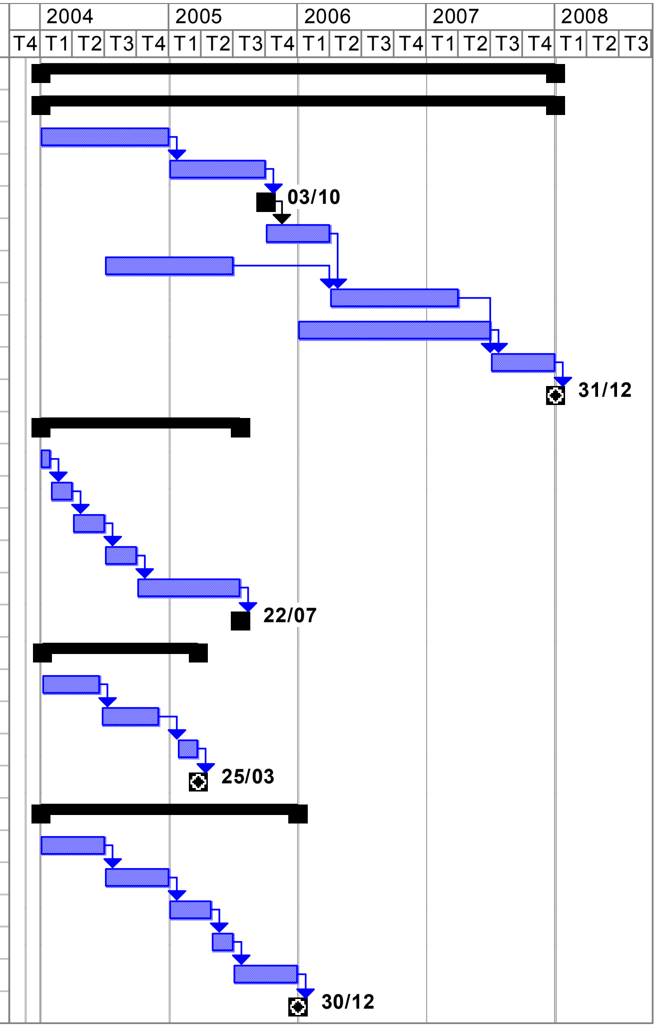
Task Name	Milestones	Main Deliverables
6.3 DC field emission studies of Nb samples		
6.3.1 Quality control scans		
6.3.1.1 Modification of Scanning apparatus		
6.3.1.2 Calibration of Scanning apparatus		
6.3.1.3 Start scanning activity	**Start Operation**	
6.3.1.4 BCP and HPR samples		
6.3.1.5 EP and HPR samples		
6.3.1.6 BCP/EP and DIC samples		
6.3.1.7 First report on BCP/EP and DIC surface	**Interim Report**	
6.3.1.8 Continue QA scanning		
6.3.1.9 Evaluation of scanning results		**Final Report**
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	**Start Measurements**	
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		**Final Report**



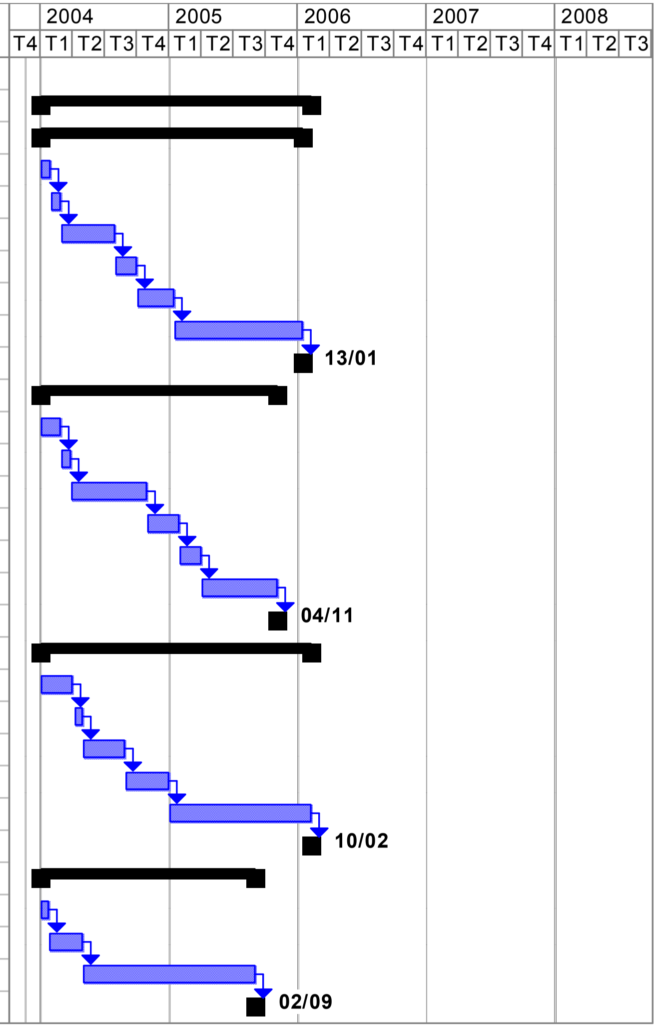
Task Name	Milestones	Main Deliverables
WP7 COUPLERS		
7.1 New Proto-type Coupler		
7.1.1 RF Simulations of Coupler		
7.1.2 Detailed Engineering Drawings		
7.1.3 Call for tenders		
7.1.4 Prototype Fabrication in Industry		
7.1.5 Low Power tests		
7.1.6 Ready for High Power Tests	**Coupler Prototype**	
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	**Commissioning**	
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		**Final report**



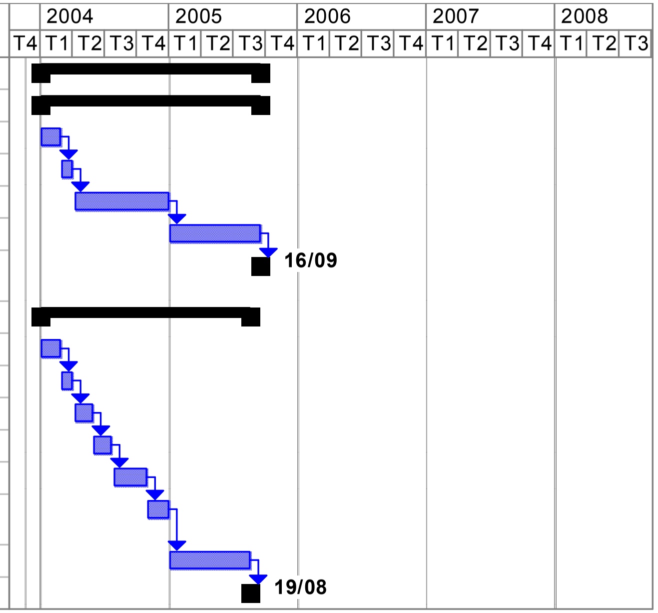
Task Name	Milestones	Main Deliverables
WP8 TUNERS		
8.1 UMI TUNER		
8.1.1 Control electronics		
8.1.2 Tuner design		
8.1.2.1 Tuner design finished	**Design report**	
8.1.3 Tuner fabrication		
8.1.4 Fast piezo tuner design		
8.1.5 Pieco fabrication and bench tests		
8.1.6 Cavity -tuner-coupler integration		
8.1.7 Pulsed RF tests		
8.1.8 Evaluation of tuner operation		**Final report**
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		
8.2.5.1 Report on magneto-strictive Tuner	**Status report**	
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 Experiments		**Tuner Prototype**
8.4 IN2P3 Activity		
8.4.1 Characterize actuators/piezo-sensors at low temperature		
8.4.2 Test radiation hardness of piezo tuners		
8.4.3 Integration of pieco and cold tuner		
8.4.4 Cryostat tests		
8.4.5 Tests with pulsed RF		
8.4.6 Report on IN2P3 tuner activities		**Final Report**



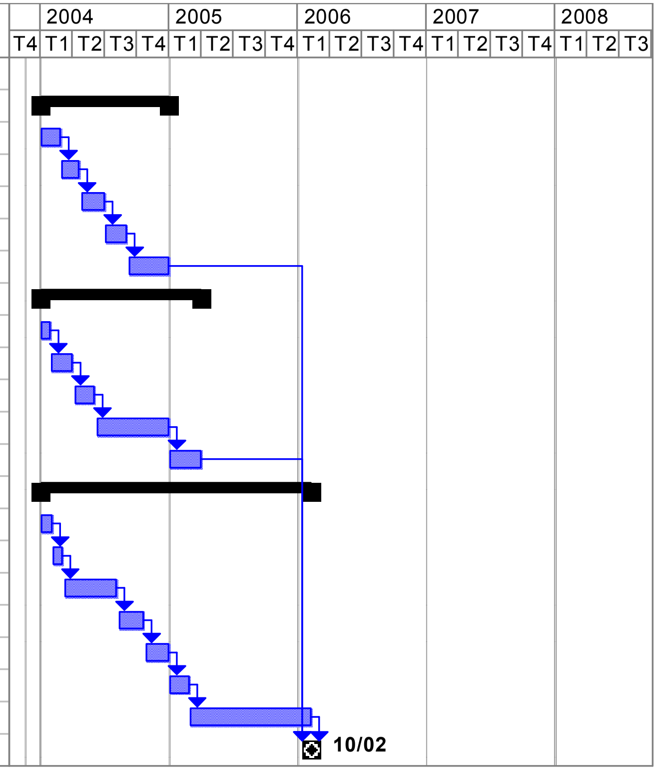
Task Name	Milestones	Main Deliverables
WP9 Low level RF		
9.1 Operability and technical performance		
9.1.1 Transient detector		
9.1.1.1 Define requirements		
9.1.1.2 Electronics design		
9.1.1.3 Build prototype and evaluate		
9.1.1.4 Final design of detector		
9.1.1.5 Installation and commissioning		
9.1.1.6 Test with beam		
9.1.1.7 Report on transient detector test	**Status Report**	
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	**Status Report**	
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	**Status report**	
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	**Status Report**	



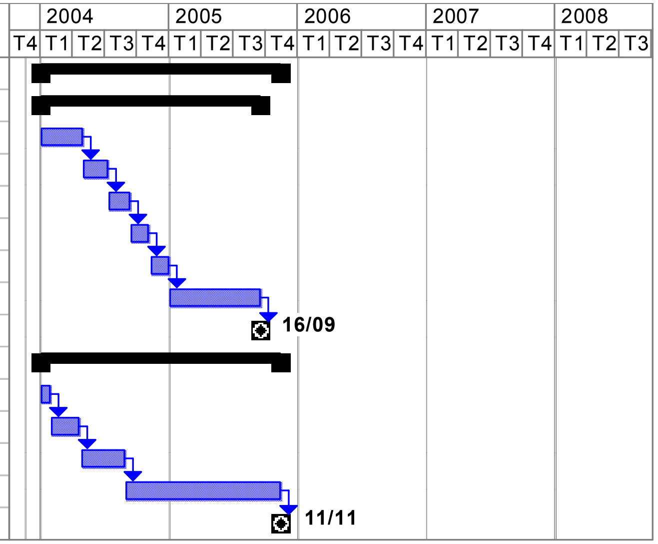
Task Name	Milestones	Main Deliverables
9.2 LLRF cost and reliability study		
9.2.1 Cost and reliability study		
9.2.1.1 Identify cost drivers of present LLRF		
9.2.1.2 Develop cost reduction ideas		
9.2.1.3 Build prototypes and evaluate		
9.2.1.4 Final design of LLRF system		
9.2.1.5 Complete design of LLRF system for reduced cost	**Status Report**	
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	**Status Report**	



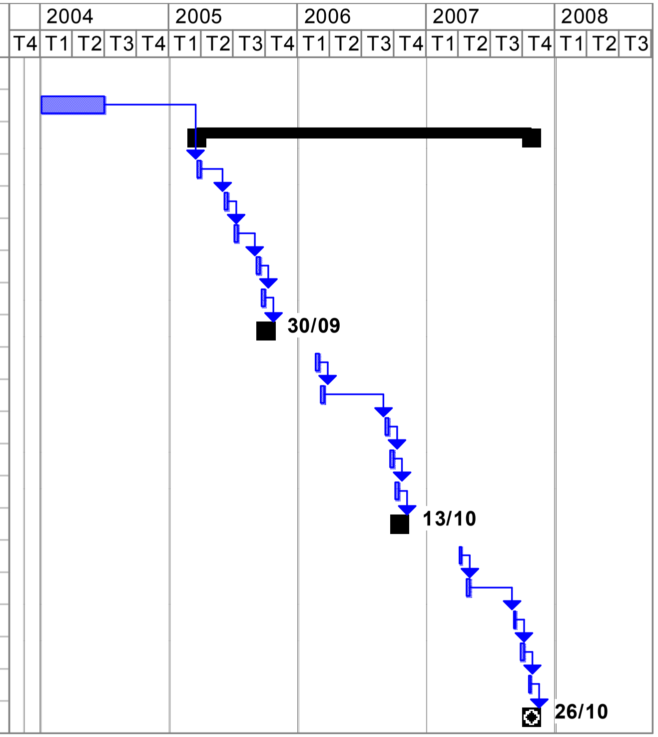
Task Name	Milestones	Main Deliverables
9.3 Hardware		
9.3.1 Multichannel downconvertor		
9.3.1.1 Study and compare technologies		
9.3.1.2 Select optimum PCB design		
9.3.1.3 Build prototype and evaluate		
9.3.1.4 Finalize multichannel downconverter		
9.3.1.5 Determine characteristics		
9.3.2 Third generation 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 Conceptional 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		**Final Report**



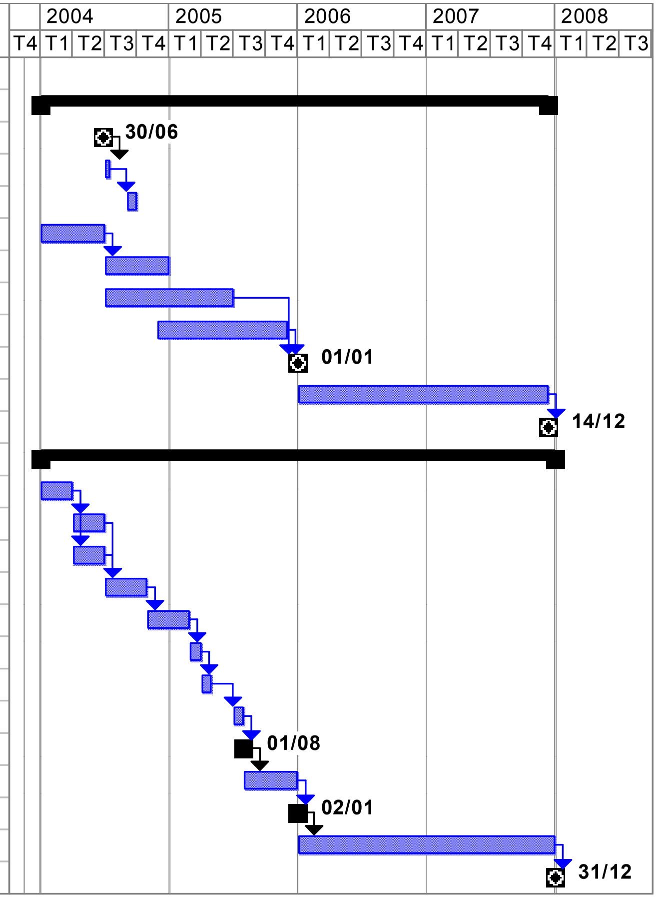
Task Name	Milestones	Main Deliverables
9.4 Software		
9.4.1 Data management development		
9.4.1.1 Specification		
9.4.1.2 Conceptional design with DOOCS		
9.4.1.3 Prototype		
9.4.1.4 User evaluation		
9.4.1.5 Finalize design		
9.4.1.6 Implementation in TTF		
9.4.1.7 Report on data management developments		**Final report**
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		**Final Report**



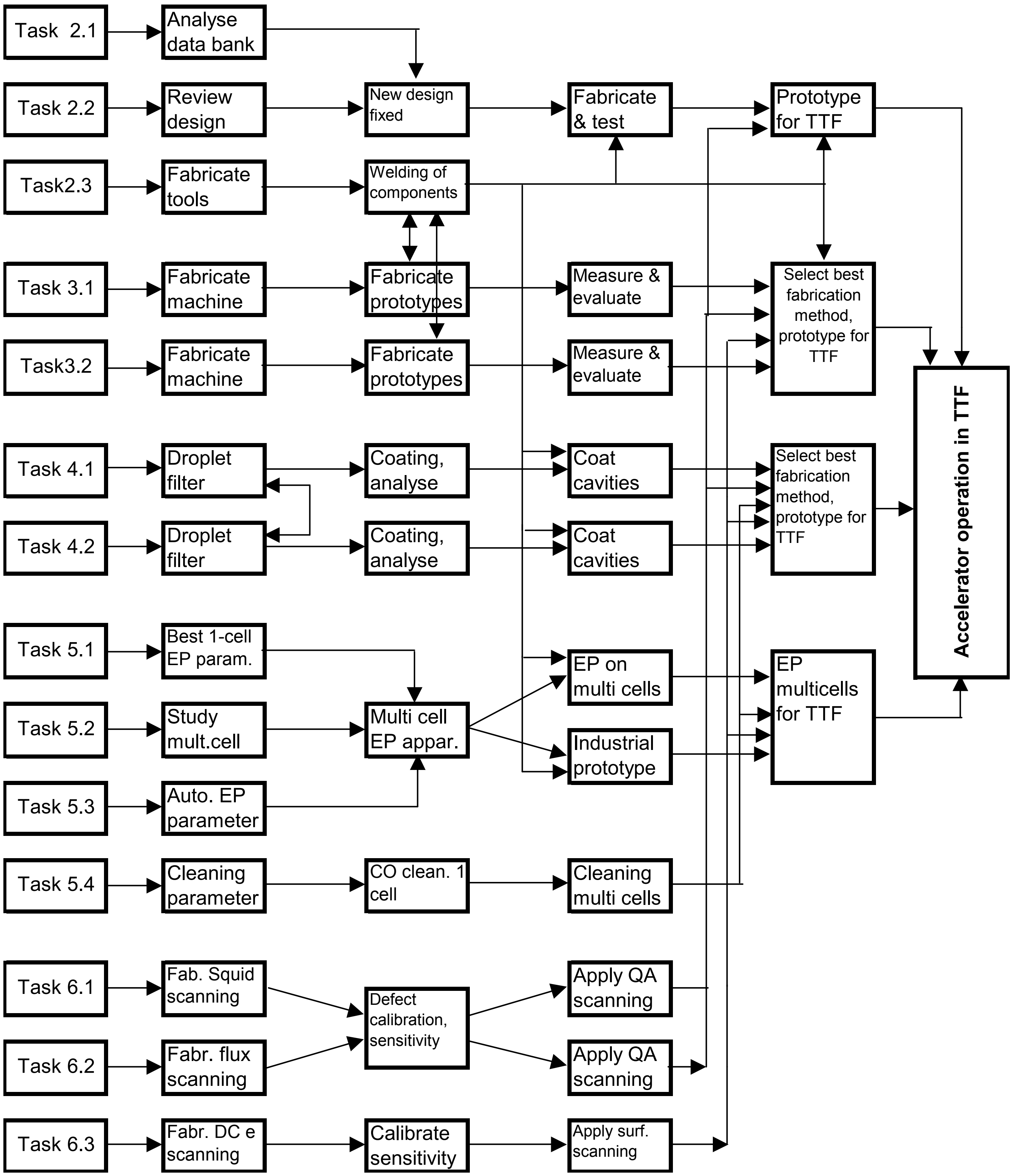
Task Name	Milestones	Main Deliverables
WP 10 CRYOSTAT INTEGRATION TESTS		
10.1 Displace CRYHOLAB		
10.2 Integration tests in Cryostat		
10.2.1 Test 1		
10.2.2 Test 2		
10.2.3 Test 3		
10.2.4 Test 4		
10.2.5 Test 5		
10.2.6 Evaluate experimental results	**Status report**	
10.2.7 Test 1		
10.2.8 Test 2		
10.2.9 Test 3		
10.2.10 Test 4		
10.2.11 Test 5		
10.2.12 Evaluate experimental results	**Status report**	
10.2.13 Test 1		
10.2.14 Test 2		
10.2.15 Test 3		
10.2.14 Test 4		
10.2.16 Test 5		
10.2.17 Final evaluation		**Final Report**

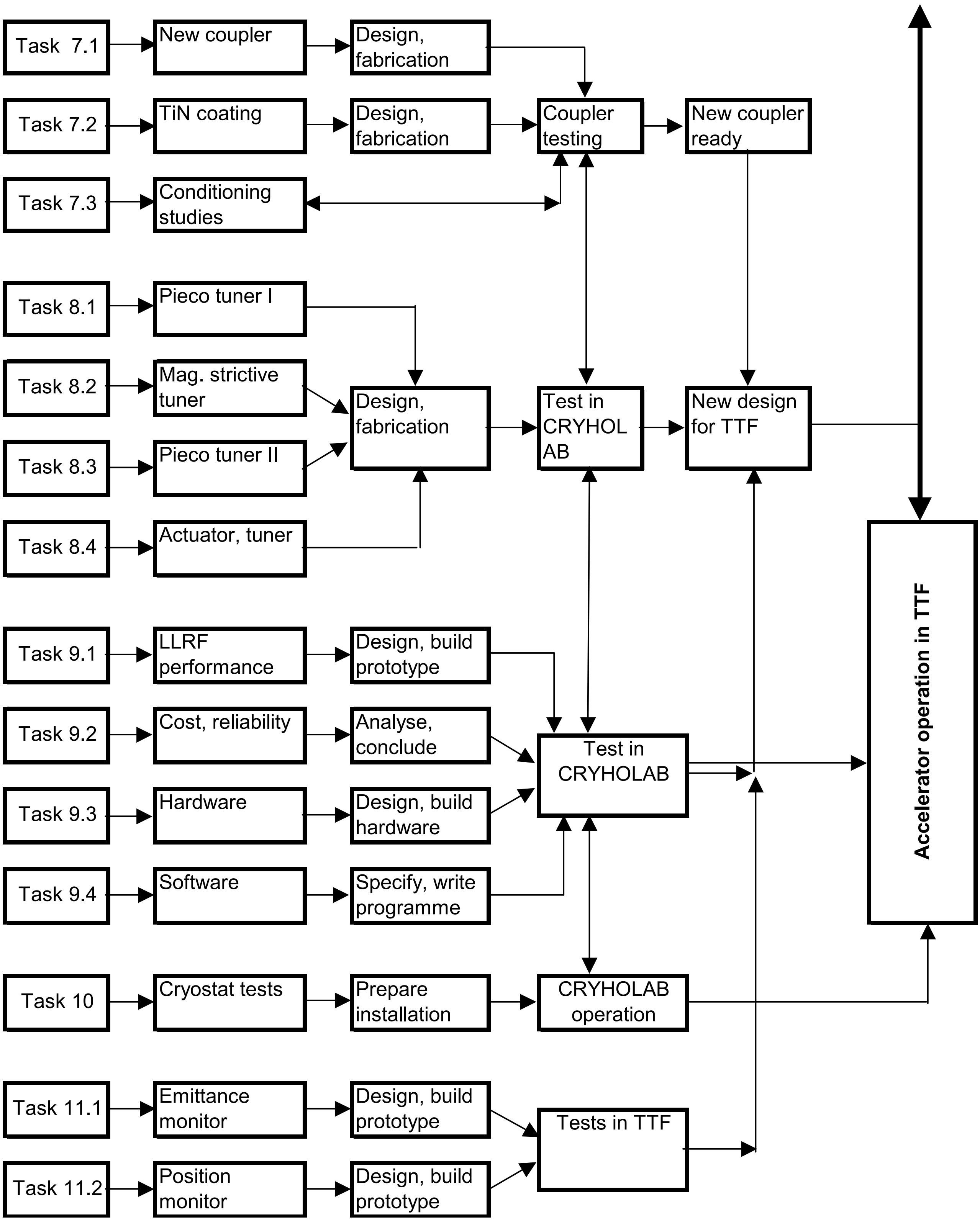


Task Name	Milestones	Main Deliverables
WP 11:BEAM DIAGNOSTICS		
11.1 Beam position monitor		
11.1.1 Present BPM installed in TTF module	**Start Measurements**	
11.1.2 Cryogenic measurements on BPM		
11.1.3 Beam tests of BPM on TTF		
11.1.4 Design of BPM Cavity		
11.1.5 Fabrication of BPM Cavity		
11.1.6 Development of new hybrid coupler and electronics		
11.1.7 Design of Digital Signal Processing		
11.1.8 New BPM ready for Installation		**BPM Prototype**
11.1.9 Beam Tests with new BPM		
11.1.10 Evaluation of BPM operation		**Final report**
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	**Start Measurements**	
11.2.10 Beam tests at TTF		
11.2.11 Evaluate first beam test result	**Status Report**	
11.2 12 Successive measurements		
11.2.13 Final evaluation		**Final Report**



The following Pert diagram shows the interdependencies between the tasks in SRF.




Task 7.1
New coupler
Design, fabrication
Task 7.2
TiN coating
Design, fabrication
Coupler testing
New coupler ready
Task 7.3
Conditioning studies
Task 8.1
Pieco tuner I
Task 8.2
Mag. strictive tuner
Design, fabrication
Test in CRYHOL AB
New design for TTF
Task 8.3
Pieco tuner II
Task 8.4
Actuator, tuner
Task 9.1
LLRF performance
Design, build prototype
Task 9.2
Cost, reliability
Analyse, conclude
Test in CRYHOLAB
Task 9.3
Hardware
Design, build hardware
Task 9.4
Software
Specify, write programme
Accelerator operation in TTF
Task 10
Cryostat tests
Prepare installation
CRYHOLAB operation
Task 11.1
Emittance monitor
Design, build prototype
Tests in TTF
Task 11.2
Position monitor
Design, build prototype

8. R1.4 Expected outcome

8. R1.4.1 Application to European research infrastructures

The technology of SRF accelerating systems was developed by several laboratories and institutes in the USA, Japan and Europe. Industrial competence in designing and building SRF components is established in Japan and Europe with a strong leadership of three European companies.

The challenging problems for increased exploitation of superconducting RF technology in accelerators are the achievable accelerating voltages of the cavities and the cryogenic losses. The accelerating gradient is ultimately determined by the properties of the superconducting material. Gradients are usually a factor of 2 to 5 below the intrinsic parameters of the commonly used Niobium. A better understanding of these limitations and their solutions therefore requires further R&D in this area.

The cryogenic loss is determined by the (dynamic) superconducting RF loss and the (static) cryostat loss. Large progress has been made with the development and construction of the TTF cryostats. There is hope to further reduce the superconducting losses by improving the cleaning methods for cavities (short term goal) or by thin-film technology (long term goal).

At present, four European accelerators use routinely superconducting RF technology: the heavy ion accelerator at INFN in Legnaro, the electron proton collider HERA, the electron linac at TTF (DESY) and DALINAC at Darmstadt. New projects in Europe using this technology are TESLA, the VUV-FEL (under construction at DESY), the ELBE accelerator at Forschungszentrum Rossendorf, the X-Ray FEL (proposal for a European FEL laboratory recently approved by the German government) and the planned proton linear accelerators needed for neutron spallation sources (ESS) or for transmutation machines.

Within the framework of an international collaboration, a unique SRF accelerator test facility (TTF) was established at DESY. Most partners of SRF are involved in this activity by developing, installing and commissioning components as well as by participating in the operation of TTF. This activity is documented in numerous TESLA reports, including the Technical Design Report for TESLA and the X-Ray FEL (http://tesla.desy.de/new_pages/TDR_CD/start.html, and http://tesla.desy.de/new_pages/tdr_update/start.html).

In addition to the central accelerator test facility TTF, there are SRF R&D activities at several European laboratories. These laboratories are participating to JRA1 (SRF) and to JRA PHIN (superconducting RF gun). There is vigorous communication, exchange of R&D results and coordination of research work amongst these partners within the TESLA collaboration. The bundled research activities of the participating institutions in the JRA will allow to develop and build new and innovative accelerator components and to test them in the TTF accelerator. This will not only be of importance for the performance of the TTF and the machines using superconducting RF technology, but it will also be an important and essential input for all future projects using this challenging technology.

In summary, the proposed research activities of SRF will strengthen the transfer and exchange of know how and expertise between the main European research centers interested in this field. In particular, the expected innovative results will improve the performance and accessibility of the above mentioned infrastructures. The joined experience – especially with TTF– will be essential for the design of future linear collider projects (TESLA), the European X-ray FEL, and planned transmutation machines and neutron spallation sources, projects which open new and exciting prospects to the European research community.

8. R1.4.2 Outline of the exploitation of results

The aim of SRF is to explore and apply novel fabrication technologies for superconducting accelerating structures. The expected progress due to the combined research activity will lead to prototype components, which – as a direct exploitation – can be installed into TTF and which will result in a superior operation of this device. Furthermore, concerning costs and performance, all future projects, which intend to use superconducting RF technology will benefit strongly from these developments. This is especially true for the proposed European X-Ray FEL, which will be the first large scale example, where this innovative technology can be applied.

In this respect, it is important that industrial partners be incorporated in the JRA on a partially self-financed basis. This will not only strengthen the competence and leadership of the involved European companies in this technology, but it will also allow them to be competitive and to occupy a large market share in the fabrication of superconducting accelerator components needed for the aforementioned future European and world-wide infrastructures.

The outcome of the project will not merely consist of the documentation of the results of our studies. Although prototypes of many devices will indeed be built, it is intended that certain tasks will conclude with the construction of **finalised versions** of components which can be fully exploited on the TTF linac. This is particularly true of intended developments on the LLRF system, cavity tuners and beam diagnostics. Thus, as examples, novel tuner designs, improved beam monitoring, and critical developments in RF controls will all be features of the improved infra-structure.

As a general rule, SRF participants will share freely all information related to their activity and will publish the results of their work in international journals and conferences.

8. R1.4.3 Monitoring success and impact of the activity

The success of the proposed research activities can be monitored by

- measuring the achieved accelerating gradients,
- measuring the RF losses and
- documenting the operating performance of the developed prototype cavities in TTF.

One can also monitor success of the research activity by comparing the results obtained in certain WP's with respect to the initial goals. For example the parameters and specifications aimed for in WP7 and WP8 will be tested in the Coupler Test Lab and CRYHOLAB respectively. The power handling capacity and conditioning period of couplers as well as the correctable 'de-tune' of cavities by the active tuners will be an obvious measure of success. Indeed CRYHOLAB will be the ideal instrument in which to quantify the level of progress made on many issues covered by this JRA. The practical applications of the developments made in WP9 to the TTF linac will provide direct evidence of the impact of the Low Level RF studies. The increased reliability of the machine which should result from these developments will have an impact on the programme of accelerator R&D foreseen on TTF as well as on the FEL user programme. Equally, the improvements in beam diagnostics emerging from WP11 will be evident from high resolution measurements of beam position and emittance. Evidently, the sum of the published literature resulting from the studies described in this JRA will be a measure of the progress achieved.

The impact of the results of JRA SRF will manifest itself in the use of the new fabrication methods such as vacuum arc coating, electropolishing for better surfaces and improved quality control

- by other laboratories for their research activities in superconducting RF technology thereby improving the performance and accessibility of their infrastructures,
- by industrial companies for the large scale production of superconducting cavities thereby rising their competitiveness and expertise in this modern technology.

8. R1.5 Subcontracts

Industrial subcontracts are foreseen for the work packages 2, 5 and 6 as detailed below.

Improved component design (ISCF task 2.2; task 2.3)

Topics for the industrial contracts are:

- the improvement of the design of cavities,
- the improvement of the design of auxiliary components, such as connections to vacuum tanks and to liquid He circuits, flange technology and so on,
- the identification of costly and critical fabrication steps,
- the development of methods suitable for industrial mass production.

There is a large experience with the production and operation of about 50 superconducting RF cavity units at the test facility TTF. Based on this expertise, the design, fabrication methods and quality assurance philosophy will be examined in order to reduce fabrication costs, increase reliability and introduce mass production technology.

Squid scanning apparatus (MA task 6.1)

In this task, a novel Squid scanner for quality control of the Niobium material will be developed. This will improve the present technology of eddy-current scanning of Niobium sheets with a normal conducting coil. The Squid sensor will:

- enhance the sensitivity for finding material defects,

- increase the penetration depth of the scanned bulk material,
- allow faster scanning by covering an enlarged sampling spot.

Electropolishing (EP) on multicell cavities (SP, task 5.2)

Electropolishing of the inner surface of a Niobium cavity will produce a much smoother surface than what can be obtained by the present method of chemical cleaning. As already demonstrated on single cells, this has also a high potential to improve the superconducting properties of multi-cell accelerating structures. After exploring the principle parameters on single cell experiments, this technology will be transferred to multi-cell preparation. The aim is to incorporate chemical industry at this stage in order to approach industrial standards as early as possible.

8. R2 Activity JRA2: Charge production with Photo-Injectors *(PHIN)*

8. R2.1 Description and objectives of the activity

The JRA on photoinjectors is mainly devoted to improve the characteristics of the electron sources for the future e^+e^- colliders. In particular the PHIN JRA is addressing the

- Development of the high charge e^- beam (drive beam) for the RF power source of the two-beam linear collider CLIC (CERN);
- Realisation of high brightness e^- beam for CLIC main beam studies and for tests of linear collider sub-systems;
- Realisation of the first photoinjector that uses a laser driven photocathode in a superconducting RF gun for application in ELBE (Rossendorf) and possible use in TESLA Test Facility (DESY);
- Study of the TESLA electron source;
- Realisation of new electron source for NEPAL (Orsay) test stand;
- Realisation of the new injector for TEU-FEL (Twente).

The technique of charge production studied in this JRA is the interaction of lasers with photoemissive materials within an RF field. The goal is to produce an electron source with brightness unachievable with conventional thermoionic guns. Two features contribute to improve simultaneously the charge, the current and the emittance of the beam: the first is the fact that the electron current density production is more efficient in the photoemission process than in the thermoionic one. The second is that the voltage on the cathode, necessary to reduce the space charge and the electron shielding effects, is much higher in an RF gun (100 MV/m) than in a DC thermoionic gun (200 kV/m). As a consequence, the peak current from a photoinjector is at least one order of magnitude higher than from a thermoionic injector and the emittance is one order of magnitude lower.

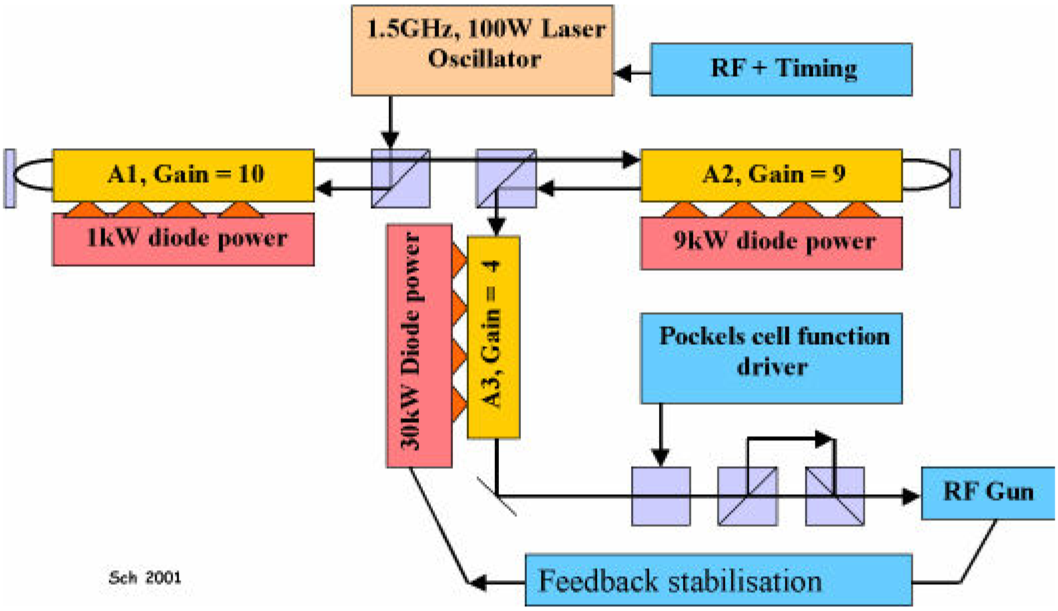
As said before, one of the main PHIN JRA topics concerns the CLIC drive beam: the requests on the CLIC test facility (CTF3) drive beam photoinjector are very challenging, as shown in the following table, for the long train of pulses, the high charge per pulse, the pulse to pulse charge stability, the photocathode lifetime and the temporal structure.

CTF3 Drive Beam Parameters

	Unit	CTF3
Pulse charge	nC	2.33
Pulse width (FWHH)	ps	10
Peak current	A	240
Number of pulses	-	2310
Distance between pulses	ns	0.667
Charge stability	%	± 0.1
Train duration	μs	1.54
Train charge	μC	5.4
Repetition rate	Hz	5
Average current	mA	0.026
Minimum QE at λ_{laser}	%	1.5
Minimum lifetime at QE_{min}	h	100
Laser Average power at the cathode	W	0.008

A layout of the laser proposed for CTF3 is shown in the figure below

CTF3 Laser system



An alternative photoinjector is also explored: an energetic and bright electron beam is generated from the interaction of a high intensity laser with a gas jet. The electric field generated in the plasma of the order of 1 TV/m boosts the plasma electrons from 0 to 200 MeV in less than 1 mm. The produced electron beam can have a very good quality with a normalized emittance smaller than 2π mm-mrad, and a transverse initial size of the order of a few hundred microns. Regarding this subject, PHIN JRA aims at the production of a mono-energetic electron beam of a few hundred MeV ($\Delta E/E<0.1$, normalized emittance<0.1 πmm-mrad), and of a mono-energetic electron beam with a variable energy from 1 to 50 MeV.

The development of a superconducting photoinjector is also proposed in the PHIN JRA: the superconducting cavity of the RF gun is a TESLA type half cell closed by shallow cone with a centered hole in which the cathode is situated. Special insulation and RF filters are inserted to decouple the cathode zone from the rest of the cavity. The goal is to produce very high quality beam with charge per pulse and temporal structure optimized for ELBE superconducting accelerator and for TESLA test facility.

The goal of the PHIN JRA is to perform R&D on charge-production by lasers and to improve or extend the existing infrastructures in order to fulfil their objectives. The JRA will allow one to create a synergy of efforts for various photoinjector applications and therefore to identify and deal with common problems.

The main objectives are:

- to produce long trains of high charge electron pulses with an unprecedented stability in terms of pulse-to-pulse charge, and transverse and longitudinal structure;
- to develop a new generation of photoinjectors with a superconducting RF gun;
- to test of a very promising alternative electron source based on laser-plasma acceleration.

The completion of these three subjects will put the participating laboratories at the forefront of electron production.

The specific objectives are:

- Study and model the beam dynamics in the RF gun;
- Develop normal and SC RF guns for medium-high charges;
- Optimize the RF guns in order to satisfy thermal constraints and vacuum requirements of photocathode;
- Optimize the combined system laser-photo-cathode for various applications, seeking for a trade-of between cathode lifetime, laser power and wavelength;
- Develop new photocathodes and methods to improve their stability and durability under various modes of operation, including laser duration and power;
- Study and develop optical and laser installations for the generation of the various space and time beam distributions related to the various applications;
- Investigate means of generating complex timing, and of shaping laser pulses;
- Develop necessary instrumentation;
- Make the necessary developments to improve existing installations.

The objectives are addressed by bringing together the expertise which the various European Institutes developed in one of the three main areas of interest for the photo-production of electrons, which are:

- Charge production and photocathodes.
- Lasers, including high-power, short-pulse and low-power, long-pulse lasers.
- RF guns, beam-dynamics studies, flat-beam optics.

An important aspect of the project is to make existing infrastructures available to all participants in order to perform tests and R&D experiments. Conversely, the R&D activities made in common may result in extensions and improvements of these existing infrastructures for the benefits of all partners.

Bringing the efforts of each laboratory together is one of the most beneficial aspects, since industry doesn't provide complete systems of photo-injectors, which, therefore, need to be specifically developed for each application.

The outcome of this R&D program is also of general interest for the industry working on related domains like the lasers.

8. R2.2. Participants in the activity

Table 8.R2.2a lists the participants and their involvement in the four work packages described in the following section.

Table 8.R2.2b shows the detailed involvement of each participant, with an estimate of their total contribution to the activity in person-months over the 4 years.

Table 8.R2.2a: List of participants

Participant number	Participant	WP1: M&C	WP2: CP	WP3: LAS	WP4: GUN
3	**CNRS**	X	X	X	X
	CNRS-Orsay	*X*	*X*	*X*	*X*
	CNRS-LOA		*X*	*X*	*X*
9	**FZR-ELBE**	X	X		X
10	**INFN**	X		X	X
	INFN-LNF	*X*		*X*	*X*
	INFN-Mi			*X*	
11	**TEU**		X	X	
17	**CERN**	X	X	X	X
20	**STFC**	X		X	
	STFC-RAL	*X*		*X*	

Table 8.R2.2b: Size of the research effort

Participant Number	Institute	WP/Topic	Roles	Person-month
3	**CNRS**	**TOTAL**	*Permanent staff 359, temporary staff 72 person·month*	**431**
	CNRS-Orsay	WP1: M&C	WP3-GUN Coordinator	3
		WP2: CP	Photocathodes study	32
		WP3: LAS	Laser commissioning	51
		WP4: GUN	Gun prototype construction. Test stand diagnostics	207
		TOTAL	*Permanent staff 245, temporary staff 48 person·month*	**293**
	CNRS-LOA	WP2: CP	Alternative photo electron production	60
		WP4: GUN	Measurement line for test with mono-energetic beams	78
		TOTAL	*Permanent staff 114, temporary staff 24 person·month*	**138**
9	**FZR**	WP1: M&C	WP2-CP Coordinator	3
		WP2: CP	Preparation equipment, cathode development	84
		WP4: GUN	Study and construction of the SC prototype gun.	87
		TOTAL	*Permanent staff 126, temporary staff 48 person·month*	**174**
10	**INFN**	**TOTAL**	*Permanent staff 150, temporary staff 72 person·month*	**222**
	INFN-LNF	WP1: M&C	JRA-PHIN Coordinator	6
		WP3: LAS	Laser-RF Synchronisation. Feedback	48
		WP4: GUN	Beam Dynamics studies	72
		TOTAL	*Permanent staff 90, temporary staff 36 person·month*	**126**
	INFN-MI	WP3: LAS	Waveform for laser ultra-short pulses	96
		TOTAL	*Permanent staff 60, temporary staff 36 person·month*	**96**
11	**TEU**	WP2: CP	Photocathode development	46
		WP3: LAS	Laser test for high current	10
		TOTAL	*Permanent staff 30, temporary staff 26 person·month*	**56**
17	**CERN**	WP1: M&C	JRA-PHIN Coordinator deputy	3
		WP2: CP	Photo-cathode development	64
		WP3: LAS	High power laser system for CTF3 commissioning	32
		WP4: GUN	CTF3 gun construction	50
		TOTAL	*Permanent staff 131, temporary staff 18 person·month*	**149**
20	**STFC**	**TOTAL**	*Permanent staff 6, temporary staff 24 person·month*	**30**
	STFC-RAL	WP1: M&C	WP3-LAS Coordinator	3
		WP3: LAS	Design, construction and test of complete laser system	27

8. R2.3 Outline implementation plan for the full duration of the activity (including milestones and deliverables)

The JRA-PHIN is divided into four work packages, which correspond to the main areas of interest indicated above. The content of each work-package is detail below.

Work Package 1: Management & Communication (M&C)
The following tasks are treated:

- Oversee and coordinate the work of the entire JRA. (INFN-LNF, CERN, STFC, FZR, CNRS-Orsay);
- Organize the Steering Committee meeting (INFN-LNF, CERN);
- Ensure proper reviewing and reporting as well as dissemination of the knowledge within the JRA and the CARE project (INFN-LNF, CERN);
- Create a web site with tools and databases (INFN-LNF, CERN, STFC, FZR, CNRS-Orsay).

Work Package 2: Charge Production (CP)
The objective of the charge production work package is the development of semiconductor photocathodes with improved properties, especially lifetime and quantum efficiency. The following tasks are treated:

- Construction, preparation and extension of test equipments (FZR, CNRS, TEU);
- Improvement of fabrication technology, basic knowledge (CERN, FZR);
- Study of new materials (CERN, FZR);
- Tests at different labs and comparative studies, time measurement diagnostics (CERN, FZR, TEU);
- Study of an alternative way for photoelectron production (CNRS-LOA), using a high-intensity laser with a gas jet. Acceleration of electrons by laser wake fields up to several 100 MeV. Production of mono-energetic electrons.

Work Package 3: Lasers (LAS)
The work-package is divided into two tasks:
First Task
Design and develop laser system to meet the requirements of the CTF3 photo-injector (program already undertaken in CTF2). The laser system will consist of:

- High power mode-locked oscillator.
- One or more high power amplifiers.
- Frequency conversion stage to generate the required UV wavelength for the photo-cathode.

Development activities:

- Increase the power of existing oscillators (STFC, CNRS-LOA).
- Optimise the design of the amplifiers for required power output at minimum cost and complexity (STFC, CERN, CNRS-LOA).
- Efficiently convert the laser output wavelength to UV using new harmonic generator crystals (STFC, CERN, CNRS-LOA).
- Establish ultra-high stability including the use of charge and pointing stability feedbacks (STFC, CERN, INFN-LNF).
- Ensure sub-picosecond synchronisation to the RF (CERN, INFN-Mi).

Second Task
Investigate and test systems for complicated, ultra-fast, optical waveforms according to user specifications, as those for the new generation of FEL, with benefits for linac photo-injectors. Test and study of Ti:Sa laser pulse jitter, laser diagnostics and stability on photocathode.
The waveform systems considered are:

- Liquid Crystal Modulator-Computer Programmable (LCM-CP) system.
- Collinear acousto-optic programmable dispersive filter (AOPDF-DAZZLER).

Development activities:

- Computer codes for the algorithm driving the shaping system (INFN-Mi, CNRS-LOA).
- Tests of both the LCM-CP and the AOPDF-DAZZLER (INFN-Mi, INFN-LNF, CNRS-LOA).

Work Package 4: RF guns and beam dynamics (GUN).

The aim of this WP is the development of RF guns for high charge and high average current or very short pulses. Improve the associated test stands. Spin-off for high power light-sources is expected. The work-package is divided into three tasks.

First Task

- Design and technical evaluation of photo-injectors for high charge, high average current, or short pulses (CNRS-Orsay, CERN).
- Numerical simulation and engineering optimisation for a Super-conducting RF photo-gun; cavity, coupler, RF focusing (FZR).
- Design optimisation and construction of new SC RF gun prototype (FZR).

Second Task

- Study and construction of two RF guns at 3 GHz for the injectors of the existing test facilities CTF3 and NEPAL (CNRS-Orsay).
- Installation and commissioning of long pulse train of high charge and short bunches in CTF3 (CERN, INFN-LNF).
- Improvement of test stand NEPAL in order to achieve the gun tests mentioned above (CNRS-Orsay).

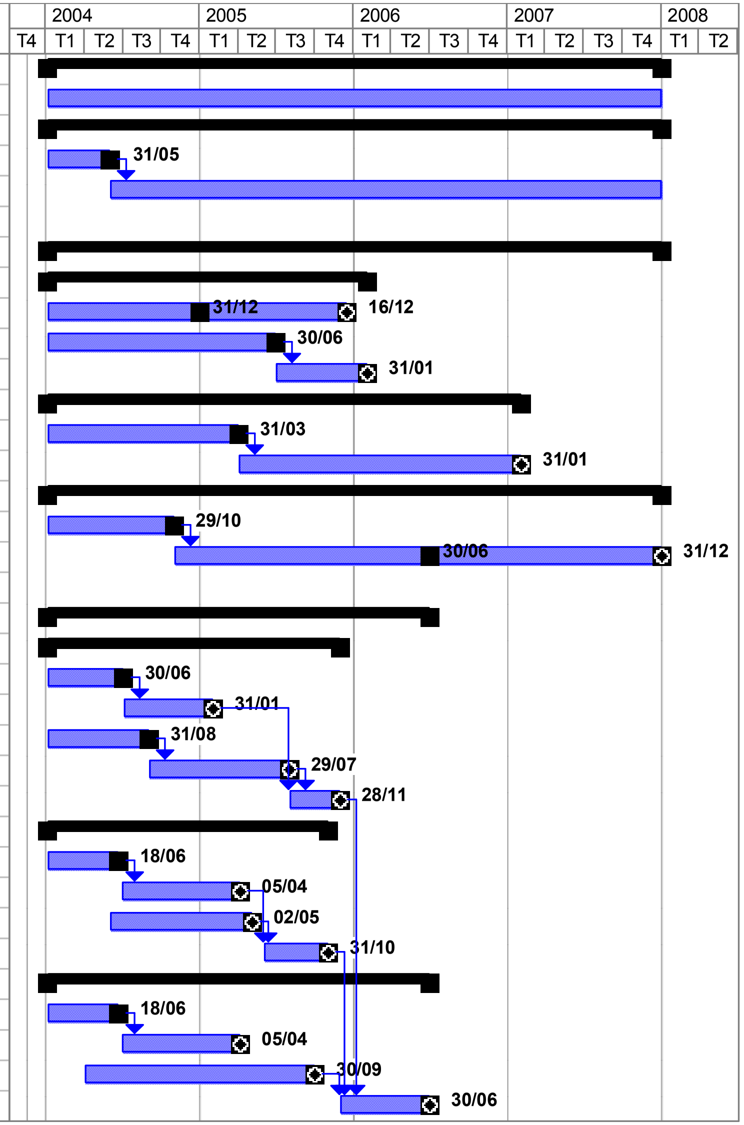
Third Task

For the alternative photocathode device proposed by CNRS-LOA, development (beam dynamics) and acquisition of:

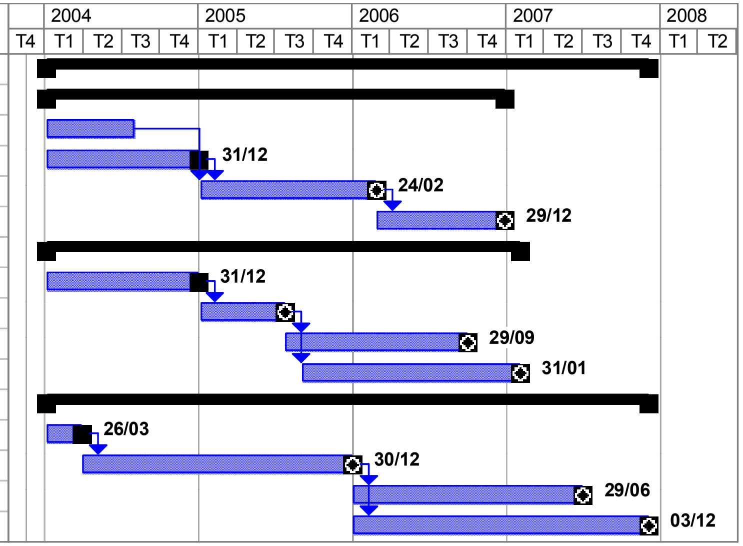
- 0-50 MeV compact electron spectrometer (CNRS-LOA, CERN)
- 0-1 GeV electron spectrometer (CNRS-LOA, CERN)

The following Gantt chart presents the implementation plan for the whole duration of the JRA-PHIN for each of the workpackages. Milestones and deliverables are included.

Task Name	Milestones	Main Deliverables
WP1 Management & communication		
Activity coordination		
Communication		
Web site creation	Release of the web site	
Maintainance and upgrade		
WP2 Charge Production		
High efficiency photocathode for 3 GHz RF gun		
High efficiency photocathode comparison	Intermediate report	**Final report**
Photocathode preparation equipment construction	Equipment ready	
Photocathode 3 GHz high field R&D	Intermediate report	**Photocathode ready**
Photocathode for SC cavity		
Photocathode preparation equipment upgrade	Equipment ready	
Photocathodes test		**Final report**
Laser driven plasma source		
High energy plasma source design	Design report	
100 MeV laser driven plasma source R&D	Intermediate report	**Final report**
WP3 Laser		
Laser System		
High power oscillator design	Oscillator design report	
High power oscillator construction		**Laser oscillator ready**
Amplifier design	Amplifier design report	
Amplifier construction		**Amplifier ready**
Oscillator + amplifier test		**Final report**
Pulse shaping system		
Simulation and design	Intermediate report	
Phase mask acquisition and test		**Final report**
Dazzler acquisition and test		**Final report**
Pulse shaping comparison		**Pulse shaper ready**
UV generation and Feedbacks		
UV Harmonic generator R&D	Intermediate report	
UV Harmonic generator test		**UV crystals ready**
Laser-RF Feedback development		**Feedback test**
Overall system assembly and tests		**Laser System ready**



Task Name	Milestones	Main Deliverables
WP4 GUN		
SC RF gun		
Technology development		
SC RF gun design	Design report	
SC RF gun realisation		**SC RF gun ready**
SC RF gun test		**Final report**
3 GHz RF gun		
3 GHz RF gun design	Design report	
Two 3 GHz RF guns construction		**3 GHz RF guns ready**
CTF3 3 GHz RF gun test at CERN		**Final report**
NEPAL 3 GHz RF gun test at Orsay		**Final report**
Spectrometer for e- beam		
1-50 MeV Spectrometer design	Design report	
1-50 MeV Spectrometer construction		**Spectrometer ready**
1-50 MeV Spectrometer test		**Final report**
0-1 GeV Spectrometer development		**Final report**



8. R2.4 Expected outcome

8. R2.4.1 Application to European research infrastructures

The R&D activities on photoinjector proposed in this JRA are devoted to improve the performances of the new generation of electron injectors for future accelerators. The project results are mainly addressed to the high-energy linear colliders community. Nevertheless, all European infrastructures that are involved in the accelerator physics and related uses should be extremely interested in the exploitation of the JRA results.

The existing infrastructures that immediately benefit of the JRA on photoinjector are:

- **CTF3** (CLIC test facility) is an intermediate step to demonstrate the technical feasibility of the key concepts of the new power source for CLIC. CTF3 will be used to test the CLIC critical components and in particular will provide the 30 GHz RF power needed to test the main beam accelerating structure. The photoinjector will be an important upgrade of this facility allowing:
    - Flexibility in manipulating the time structure of the electron beam.
    - Smaller transverse and longitudinal emittances, resulting in more efficient beam transport and bunch length manipulation.
    - No low energy tails.
    - Dramatic reduction of radiation losses.
- **NEPAL** is a multipurpose RF test stand. The new photoinjector will be a major improvement in order to test new beam dynamics models, instrumentation and diagnostics.
- **ELBE** is a super-conducting RF test stand. The SC RF Gun developed in the JRA allows to use such SC RF gun in the TESLA project and in the FEL community due to:
    - Small transverse and longitudinal emittances.
    - High charge electron pulse.
- **TEU FEL** is a Free Electron Laser emitting in the far-infrared range. The new photocathode material developed in the JRA could permit to increase significantly the brightness of this source and improve stability and operation time of photo cathodes.

8. R2.4.2 Outline of the exploitation of results

The aim of the PHIN activities is to study, design and realize a new series of photo-injectors for the applications described before. The first prototype of the entire system made up of laser, photo-cathode and RF gun will be immediately applicable, as direct exploitation, in the CLIC Test Facility (CTF3). The second prototype will be used for improving the performance of the NEPAL test stand and the superconducting RF gun will improve the ELBE test stand with large benefits for all the infrastructure users.

The results of the PHIN-JRA will be freely available to the entire scientific community.

The major benefits for other communities come from the studies on the more challenging characteristics of the different components of the photoinjector system (*i.e.*, very stable high power laser, high efficiency and long lifetime photocathode, etc.). The potential users are in the following research fields:

- light sources and free-electron lasers,
- medical imaging,
- picosecond and femtosecond chemistry,
- cancer therapy,
- high brightness e^- beams.

8. R2.4.3 Monitoring success and impact of the activity

The achievements of the electron beam parameters, in terms of charge per bunch, total current transverse and longitudinal emittance, energy at the photoinjector exit, pulse repetition rate, etc., for each photoinjector described before [8.R2.1], are the main indicators of the success of the activity.

The improvements of the overall performances of the existing facilities with the use of the developed or improved photoinjectors are also direct monitors of the success of the activity.

The number of citation of the reports published during the execution of PHIN as well as the adoption of the technical solution developed in PHIN for other projects are indicators of the impact of the PHIN activities.

8. R3 Activity JRA3: High Intensity Proton Pulsed Injector *(HIPPI)*

8. R3.1 Description and objectives of the activity

Requests from the various physics communities for secondary particle beams have recently drastically increased. Therefore, a number of European laboratories have pursued separate development programmes concerning the high intensity proton linac that can deliver the primary beam onto the target. In particular:

- CEA and CNRS-IN2P3-Orsay on the low-energy section (3 MeV) (IPHI project),
- Frankfurt University (Germany) on high-efficiency accelerating structures,
- CERN on chopping and medium-energy accelerating structures,
- STFC-RAL on the chopper design, ion source and RFQ development,
- INFN-Mi (Italy), CEA (France), FZJ (Germany), CNRS-IN2P3-Orsay and CNRS-LPSC (France) on superconducting accelerating structures.

All these laboratories, together with GSI (Germany), have developed beam dynamics tools aimed at mastering high-intensity beams in linacs.

The overall objective of the HIPPI JRA is to foster the development of a common European technology base for the construction of high intensity pulsed linear accelerators. The goal is to surpass the level of competence achieved on the other continents and provide the necessary knowledge to build world-class accelerators in Europe. To validate this goal, accelerating structure prototypes will be build and their performances will be documented.

This will be achieved by coordinating the above-mentioned efforts, realising a systematic study of several technological alternatives for beam energies 200 MeV.
Although the detailed specifications will only be defined at the first general meeting, the specific basic objectives are as follows:

- For normal-conducting accelerating structures: Achieving shunt impedance ZT^2 (power efficiency) higher than 40 MΩ/m in the energy range 3-100 MeV, at a competitive cost with respect to conventional DTL.
- For superconducting accelerating structures:
  - In the energy range 100-200 MeV, achieving gradient exceeding 7 MV/m with $Q \geq 10^{10}$ at a construction cost comparable to normal-conducting structures.
  - Developing efficient superconducting structures down to beam energies around 5 MeV.
- For beam chopping: Achieving switching time smaller than the distance between bunches at 352 MHz (about 2 ns). Moreover, the overall design of the chopper-line has to minimize emittance growth.
- For beam dynamics:
  - Validating experimentally simulation codes
  - Establishing rules for design allowing one to keep the uncontrolled beam loss below 1W/m (threshold for hands-on maintenance) all along a high energy linac (> 1 GeV) and the associated transfer lines.

The above specific objectives are treated within 4 Work Packages, which are described in the section on the implementation plan. A fifth Work package will concern the management of HIPPI.

8. R3.2. Participants in the activity

Table 8.R3.2a lists the participants and their involvement in the five work packages described in the following section.

Table 8.R3.2b shows the detailed involvement of each participant, with an estimate of their total contribution to the activity in person-months over the 5 years.

Table 8.R3.2a: List of participants

Participant number	Short name	WP1:M&C	WP2: NC	WP3: SC	WP4: CHOP	WP5: BD
1	**CEA**	X	X	X	X	X
3	**CNRS**	X	X	X	X	X
	CNRS-IN2P3-Orsay			*X*		
	CNRS-LPSC	*X*	*X*	*X*	*X*	*X*
4	**GSI**	X				X
5	**IAP-FU**		X	X		X
7	**FZJ**			X		X
10	**INFN**			X		X
	INFN-Mi			*X*		*X*
17	**CERN**	X	X		X	X
20	**STFC**		X		X	X
	STFC-RAL		*X*		*X*	*X*

Table 8.R3.2b: Size of the research effort

Participant number	Shot name	WP/Topic	Roles	Person-month
1	**CEA**	WP2/DTL	Design and construction of cold model, quadrupoles and alignment system. RF measurements	50
		WP2/CCDTL	Measurements	2
		WP3/Elliptical	Construction alternate cavity and coupler, construction and operation of the 700 MHz test stand, tests.	108
		WP4/Chopper line	Beam measurements	2
		WP5/Development	Transport in 3D map, space charge compensation	30
		WP5/Benchmarking	Comparison of codes	10
		WP5/Experiments	Participation to the measurements at CERN	2
		TOTAL	*Permanent staff 156, temporary staff 48 person·month*	**204**

Participant number	Participant	WP/Topic	Roles	Person-month
3	**CNRS**	**TOTAL**	*Permanent staff 143, temporary staff 44 person·month*	**187**
	CNRS-IN2P3-Orsay	WP3/Spoke	Evaluation of 2-gaps 352 MHz prototypes, design and construction of coupler & tuner, test of multi-gaps prototype	40
		TOTAL	*Permanent staff 32, temporary staff 8 person·month*	**40**
	CNRS-LPSC	WP2/DTL	Design of cold model, measurements	40
		WP2/SCL	Design of model, measurements	48
		WP2/CCDTL	Design of model, measurements	2
		WP3/Elliptical	Contribution to cavity and coupler design	24
		WP4/Chopper line	Beam measurements	3
		WP5/Benchmarking	Comparison of codes	30
		TOTAL	*Permanent staff 111, temporary staff 36 person·month*	**147**
4	**GSI**	WP5/Development	Improvement to codes, modelling of high current	33
		WP5/Benchmarking	Comparison of codes	60
		WP5/Experiments	Simulation and beam experiment at UNILAC	93
		WP5/Diagnostics	Profile measurement by fluorescence, non-interceptive bunch measurement, online transmission control	48
		TOTAL	*Permanent staff 66, temporary staff 168 person·month*	**234**
5	**IAP-FU**	WP2/HDTL	H-DTL prototyping	48
		WP3/CH	Study, design,fabrication and measurements of a prototype tuning system	54
		WP5/Development	LORASR code	20
		WP5/Benchmarking	Comparison of codes	10
		TOTAL	*Permanent staff 42, temporary staff 90 person·month*	**132**
7	**FZJ**	WP3/Spoke	Evaluation of 700 MHz prototype, design construction and testing of a 352 MHz b 0.48 prototype	117
		WP5/Development	Codes preparation for SC linacs	60
		WP5/Benchmarking	Comparison of codes	
		WP5/Diagnostics	Beam profile monitor for space charge dominated beams	
		TOTAL	*Permanent staff 150, temporary staff 27 person·month*	**177**
10	**INFN-Mi**	WP3/Elliptical	Preparation test cavity with tuners (fast and slow), tests	18
		WP5/Benchmarking	Comparison of codes	6
		TOTAL	*Permanent staff 12, temporary staff 12 person·month*	**24**

Participant number	Participant	WP/Topic	Roles	Person-month
17	**CERN**	WP2/DTL	*Design of cold model, measurements*	20
		WP2/SCL	*Design of model, measurements*	4
		WP2/CCDTL	*Design of model, measurements*	60
		WP4/Chopper A	*Design and test of pre-prototype and full prototype of chopper structure and driver, 2 ns rise time, 500 V*	36
		WP5/Development	*Code preparation for 3 MeV test stand*	18
		WP5/Benchmarking	*Comparison of codes*	18
		WP5/Experiments	*Simulations and measurements at 3 MeV test stand*	12
		WP5/Diagnostics	*Halo measurement device*	24
		WP5/Collimation	*Collimator for 3 MeV line*	24
		TOTAL	*Permanent staff 144, temporary staff 72 persons·month*	**216**
20	**STFC-RAL**	WP2/DTL	Beam dynamics design	72
		WP4/Chopper B	Design and test of prototype of chopper structure and driver, 2 ns rise time, 1 kV	96
		WP5/Development	3D code development, parallelisation, optimisation	30
		WP5/Benchmarking	Comparison of codes	6
		TOTAL	*Permanent staff 120, temporary staff 84 persons·month*	**204**

8. R3.3 Outline implementation plan for the full duration of the activity (including milestones and deliverables)

The five Work Packages are outlined. Management and communication matters are covered in the first. Each of the other four Work Packages is focused on a specific technology/competence. Different solutions will be investigated in parallel, and their progress and achievements will be regularly communicated and discussed. Finally, comparative assessments will be published to provide elements for well-justified choices for the upgrades foreseen in the three laboratories (CERN, GSI, and STFC-RAL).

Work Package 1: Management and Communication (M&C)
The following tasks are treated: oversee and coordinate the work of all work packages, organise steering committee meetings, ensure proper reviewing and reporting as well as dissemination of knowledge within the JRA and the CARE project.

Work Package 2: Normal Conducting Accelerating Structures (NC)
Normal conducting RF structures are good candidates for beam acceleration in a pulsed proton linac, up to an energy exceeding 100 MeV. This is especially true if this is the final energy, as in the case of the three foreseen upgrades, because investment in cryogenic infrastructure can be avoided. The CERN accelerator has the additional requirement to be able, with a high duty factor (14 %), to deliver a beam quality that is adequate for a cascaded high energy superconducting linac (no halo). Such differences lead to different choices of RF structures and beam dynamics, which have to be developed in parallel and experimentally compared to help optimise the designs. In the case of CERN, a classical beam dynamics is considered, and the types of structures considered are DTL (Alvarez) for the energy range from 3 to 40 MeV, Coupled Cavity Drift Tube Linac (CCDTL) for 40 to 100 MeV and probably Side Coupled Linac (SCL) above 100 MeV. Design, construction and test of prototypes are planned, to validate the technological choices and help select the economical optimum. For the GSI linac with a final energy of approximately 70 MeV, the “KONUS” beam dynamics is foreseen, with the use of H-mode structures over all the range of energies. Low power model cavities have to be built and measured, and a prototype 352 MHz CH cavity is proposed to be built and tested in a high power test stand at GSI or at CERN. Simultaneous development of these complementary structures in a single JRA will result in an optimum use of the existing infrastructure (high power RF test places, computer codes, etc.), an enlargement of the knowledge accessed by every individual contributor, and finally in a better justified choice of technological solutions in any future realisation.

Work Package 3: Superconducting Accelerating Structures (SC)
Superconducting (SC) RF cavities have much larger efficiency, accelerating gradient and bore aperture than normal conducting (NC) structures. This technology is then expected to be advantageous in a linac in terms of power consumption, construction cost and beam loss. Although this conclusion is well accepted for the high energy part of the accelerator, this is not the case at low energy, mostly because of the short distance required between focusing magnets which reduces the energy gain per real estate meter. On top of that, the Lorentz-force-induced detuning, which modulates the accelerating field in phase and amplitude, becomes larger as the lower energy. This effect has to be particularly taken into account in the case of a pulsed linac, because of the dynamic nature of the induced perturbations and of the possibility of exciting mechanical modes. It is therefore of high importance to improve the knowledge on the comparative performance of SC versus NC accelerating structures to help determine the lowest energy at which low beta superconducting cavities could safely and economically operate.

The associated critical component, required for any high intensity accelerating structure, is the input power coupler. The RF peak power transferred to the beam is typically 500 kW with duty cycles of the order of 10%, resulting also in a high average power. The peak power limitations come mainly from multipactoring and outgassing and are very frequency dependent. Couplers have to be tested up to 1 MW of forward peak power for reliability issues. High power couplers are also being developed in JRA2-WP2 for the needs TESLA but at much lower duty cycle and higher frequency. Tight links between both JRAs will be established to share the construction technology.

Three types of 700 MHz elliptical cavities will be tested in existing vertical cryostats at low power, and two of them in existing horizontal cryostats at full power. In the last test, the cavities will be fully equipped, housed in a helium tank, with tuning system and power coupler. There is presently no test site in Europe equipped with a 700 MHz high power RF source in the MW range. In the frame of this JRA, we propose to realise such a test stand at Saclay, and to make it available to the partners in HIPPI and later to any other interested European teams.

In parallel, two alternative cavity designs at 352 MHz will be analysed. Testing of two spoke-type cavities (two-gaps and multigap) is foreseen at low power, and possibly at high power, depending on the availability of a suitable infrastructure. A prototype of the tuning system for a CH resonator will built and tested.

Work Package 4: Beam Chopping (CHOP)

The next generation of high energy, high power proton accelerators must be designed for very low uncontrolled beam loss. In many cases, the beam from a linac is injected into a synchrotron, an accumulator or a compressor ring, and subsequently extracted. Unless suitable measures are taken to control the dynamics of the beam, both processes can lead to considerable particle loss. Loss-free injection and longitudinal capture can be achieved if the linac bunches are precisely injected inside the synchrotron buckets and no particles end-up outside. Beam loss at extraction may be minimised by ensuring that no circulating beam coincides with the field rise-time of the extraction magnet. These demands may be met by selective elimination of sets of bunches in the low energy stages of the linac by using a fast deflector or “beam chopper”. The field should rise and fall between the beam bunch intervals, so that no partially chopped bunches remain in the machine, and this usually has to be within a period of the order of 2 ns.

Specifications for these key components are technically challenging, and programmes have been implemented at CERN and STFC-RAL based on the development of slow wave (E-field) transmission line structures and high-voltage, fast-transition time pulse generators. Differences in the programmes ensure that a range of ideas will be investigated and there will be benefits from developing each in parallel over similar timescales. Both approaches rely on two successive sets of meander-line structures, but differ in the functioning of the meander lines, in the performance requirements of the driver amplifiers and in the design of the beam dumps. Prototypes of the slow-wave structures, drivers and the beam dumps will be designed, built and tested with beam.

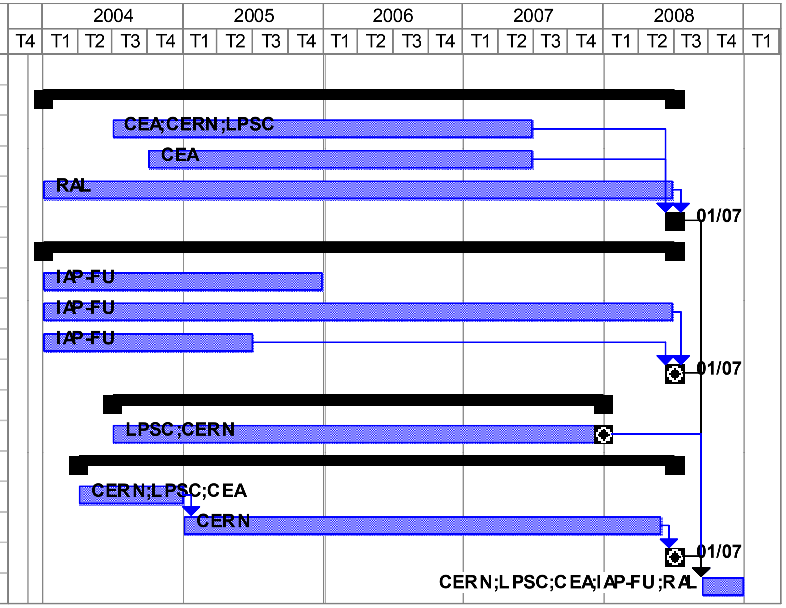
Work Package 5: Beam Dynamics (BD)

Recent studies with high intensity beams have shown that phenomena associated with space charge and beam loss have significant impact on the design of high power proton accelerators. In linacs, beam loss is associated largely with the appearance of a beam halo, which needs to be modelled theoretically and by simulation; it requires appropriate diagnostics and must be collimated to protect the equipment and avoid activation beyond tolerated limits. The joint activity proposed in this work package, combines resources available at the participating accelerator laboratories and universities for the analysis of the following issues:

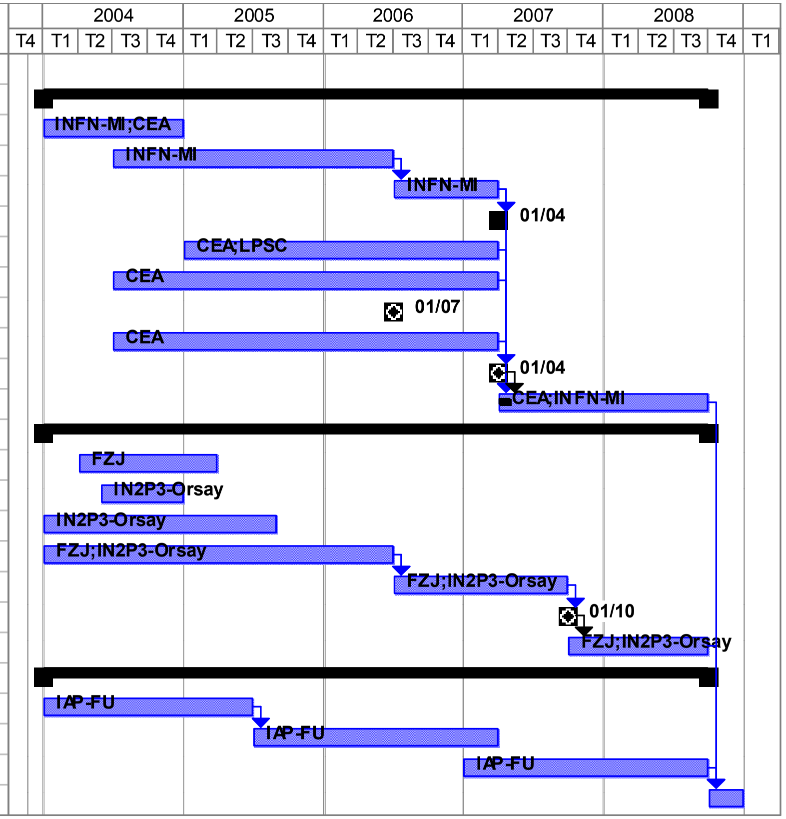
1. Validation and Benchmarking of Simulation Codes. The development of adequate 3D computer codes and the proper modelling of self-interaction by space charge is a crucial issue. Codes must be fast enough to allow large ensembles of particles in order to resolve very small loss fractions. Including the effect of errors jointly with space charge requires a significant enhancement of simulation capabilities. Benchmarking of computer simulation codes against each other and against analytical models will increase the level of confidence in their results. Strategies to minimize halo formation should result from these efforts.
2. Experiments on Beam Halo and Emittance Growth. So far, no conclusive experiments on beam halo in high intensity accelerators exist; hence this issue has highest priority. Beam experiments are proposed at CERN, STFC-RAL and GSI, where operational conditions, available intensities and diagnostics allow relevant measurements. Their interpretation by means of simulation programs should reveal the adequacy of theoretical and simulation approaches and the methods proposed to minimize beam halo and loss.
3. Diagnostics. The acceleration and transport of high power beams also present new challenges for beam diagnostics. While conventional methods continue to be needed, operating conditions at high intensity require modification. New measurement techniques are needed to diagnose the small fractional beam losses, which could cause serious damage to components and produce unacceptable levels of activation. Monitors for direct beam halo measurements must be designed, constructed and tested in existing machines.
4. Beam Collimation. Scrapers are needed to localize beam losses in areas designed for that purpose. Injection into rings, where much less aperture is available than in linacs (in particular superconducting linacs), requires highly effective collimators prior to injection. Such schemes should be designed based on simulation data and tested in experiments.

The enclosed Gantt chart presents the implementation plan for the whole duration of the HIPPI-JRA for each of the Work Packages. Milestones and main deliverables are included.

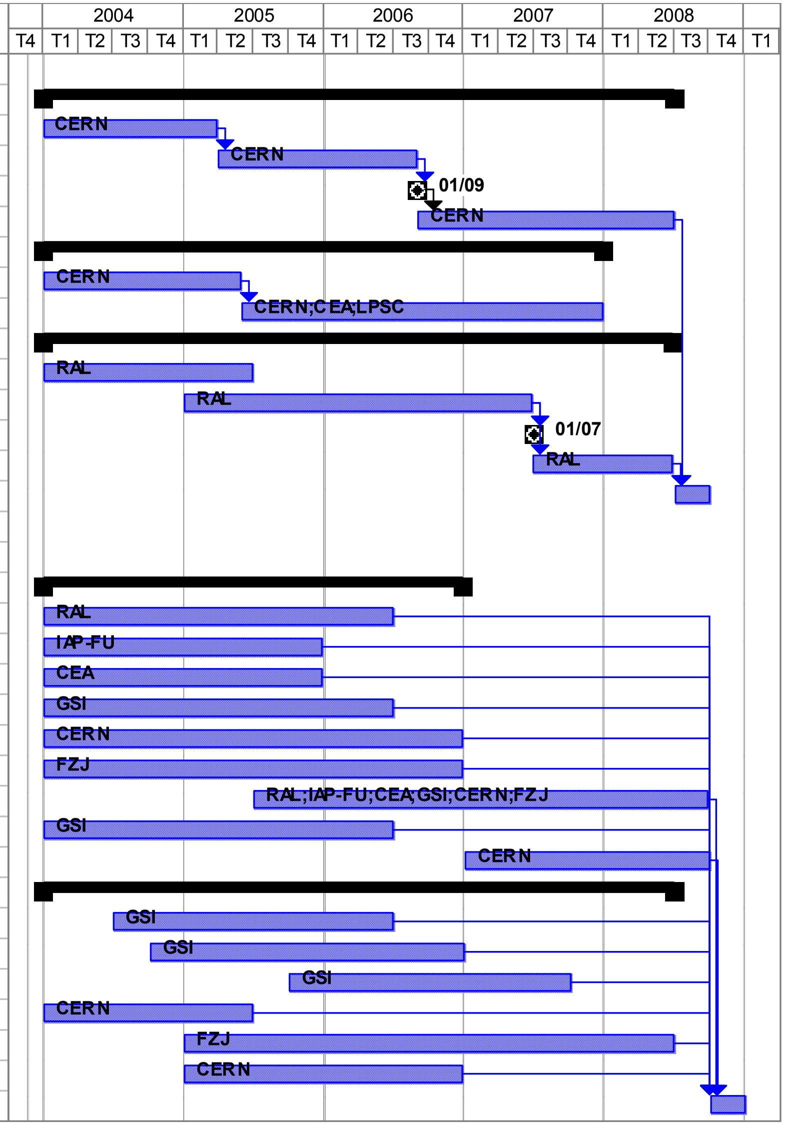
Task Name	Milestones	Main Deliverables
WP2: NORMAL CONDUCTING STRUCTURES		
Drift Tube Linac		
DTL design	Jun-07: Intermediate report	
Development of critical DTL components	Jan-07: Intermediate report	Jan-07: Prototype ready
DTL beam dynamics design	Jun-08: Intermediate report	
Optimised DTL design		Dec-08: Final report
H-mode Drift Tube Linac		
CH model cavity construction, tests	Dec-05: Intermediate report	
Prototype design, construction, tests		Dec-06: Prototype ready
H-DTL beam dynamics	Jun-05: Design report	
H-DTL design finished		Dec-08: Final report
Side Coupled Linac		
RF cold model prototype design, test		Dec-07: Final report
Cell Coupled Drift Tube Linac		
Pre-prototype testing	Jun-05: Intermediate report	
Prototype design, construction, test	Jun-06: Prototype ready	Dec-06: Design report
CCDTL design finished		Jun-08: Final report
Comparative assessment of NC structures		Dec-08: Final report



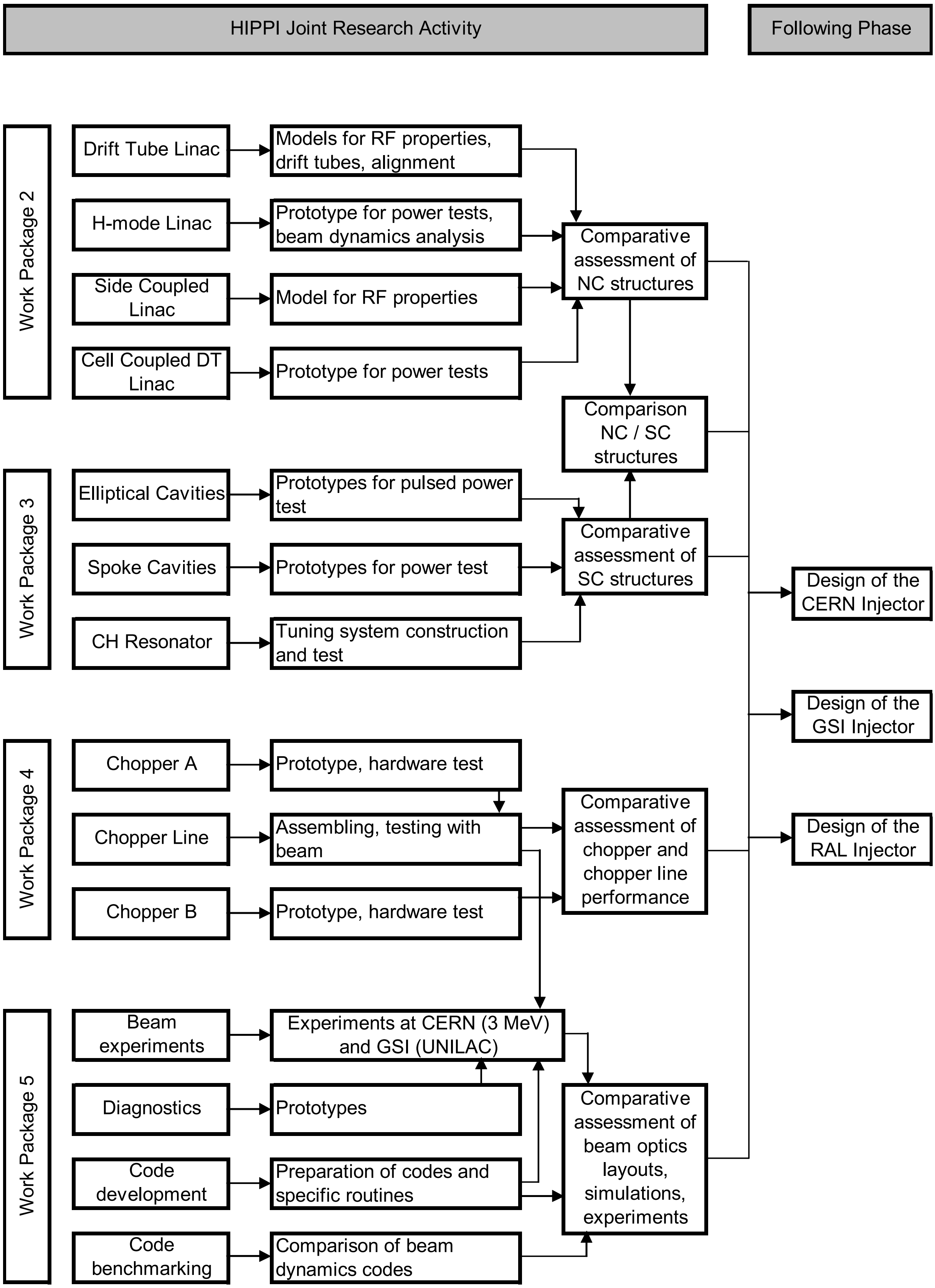
Task Name	Milestones	Main Deliverables
WP3: SUPERCONDUCTING STRUCTURES		
Elliptical cavities		
Cavity A vertical tests	Dec-04: Intermediate report	
Tuner design construction & test	Dec-05: Intermediate report	
Cavity A assembly		
Cavity A ready in CRYOLAB	Mar-07: Cavity A ready	
RF Coupler design and test		
Design, construction assembly cavity B		
Cavity B ready		Jun-06: Cavity B ready
700 MHz test stand preparation		
Test stand ready		Mar-07: Test stand ready
High power pulsed tests cavity A and B		Dec-08: Final report
Spoke cavities		
Evaluation of 700 MHz prototype	Mar-05: Intermediate report	
Evaluation of 352 MHz 2-gap prototype	Oct-05: Intermediate report	
Design and test of coupler prototype		
Design of 352 MHz multi-gap prototype	May-05: Design report	
Construction of multi-gap prototype		
Prototype ready for testing		Oct-07: Prototype ready
Testing of prototype		Dec-08: Final report
CH resonator		
Study of tuning system	Jun-05: Intermediate report	
Tuning design and fabrication		
Measurements		Dec-08: Final report
Comparative assessment of SC structures		Dec-08: Final Report



Task Name	Milestones	Main Deliverables
WP4: CHOPPING		
Chopper Structure A		
Pre-prototype design and test	Mar-05: Intermediate report	
Prototype design and construction	Jun-05: Design report	
Prototype ready		Aug-06: Prototype ready
Prototype testing (w/o and with beam)		Aug-07: Final report
Chopper Line		
Dump design and construction	Jun-05: Intermediate Report	
Beam line assembling and measurements	Mar-07: Measurement start	Dec-07: Final report
Chopper Structure B		
Pre-prototype design and test	Jun-05: Intermediate Report	
Prototype design and construction	Jun-06: Design report	
Prototype ready		Jun-07: Prototype ready
Prototype testing		Jun-08: Final report
Comparative assessment of chopper designs		Oct-08: Final Report
WP5: BEAM DYNAMICS		
Code development		
3D code development	Dec-07: Intermediate report	
LORASR development	Dec-05: Intermediate report	
Transport in 3D map, space charge comp.		
Improvement, modelling high current		
Code preparation for 3 MeV test stand	Jun-06: Intermediate report	
Codes preparation for SC linacs		
Code benchmarking		Oct-08: Final report
Simulations and experiment at UNILAC		Dec-06: Final report
Simulations and experiment at CERN		Dec-08: Final report
Diagnostics and collimation		
Profile measurement by fluorescence	Mar-05: Prototype ready	Jul-06: Final report
Non-interceptive bunch measurement	Jun-05: Components ready	Dec-06: Final report
Online transmission control		Oct-07: Final report
Halo meas. device design, construction	Jun-05: Prototype ready	Jun-05: Final report
Beam profile monitor for high intensity		Jun-07: Final report
Collimators design	Dec-06: Prototype ready	Dec-06: Final report
Comp. assessment of dynamics and meas.		Dec-08: Final report



The following Pert diagrams shows the interconnections between the tasks.



8. R3.4 Expected outcome

8. R3.4.1 Application to European research infrastructures

The R&D effort in HIPPI will be the basis for improvements at three major European laboratories, broadening at the same time their potential for physics and the size of the interested scientific community. More specifically, the following outcome are expected:

- CERN :
  - Improve the proton flux for fixed target experiments
  - Upgrade the neutrino beams for CNGS experiment
  - Increase the proton flux for the ISOLDE facility
  - Improve the stability, reliability and integrated luminosity of the LHC
- STFC-RAL :
  - Increase the neutron flux of ISIS and the potential for neutrino beams
- GSI :
  - Increase the proton flux of the heavy ion synchrotron (SIS)

Considering the magnitude of the resources that the European countries have already devoted to the construction of the CERN, GSI and STFC-RAL complex of accelerators, these improvements would significantly increase their potential value for physics research in the future for a marginal additional cost.

The following Physics programs will benefit from the proposed R&D and upgrades:

- Neutrino physics: The community has shown a substantial interest in the proposed upgrades at STFC-RAL and CERN. A high power proton driver is an important element for achieving very high intensity neutrino beams. The R&D overtaken in HIPPI will be directly instrumental to the realisation of such state-of-the-art facility.
- Radioactive ion physics: the ISOLDE experiments at CERN would immediately benefit from the higher proton flux from an improved injector. Furthermore, the EURISOL study, has shown that the next generation facility using the Isotope on line separation technique needs a two orders of magnitude larger proton flux. The upgrades considered in the HIPPI JRA could constitute a first step towards the necessary proton driver.
- Spallation Neutron sources: A high intensity proton driver reaching about 1 GeV is necessary for the next generation of Spallation Neutron Source. The HIPPI R&D program would be very useful for the design of such a future facility.
- High Energy frontier Physics: A more robust operation of the Large Hadron Collider would be achieved by an improved performance injector complex. The development undertaken in HIPPI will be directly applicable for such an improvement. Moreover, this improved injector will be the first step toward the luminosity upgrade of the LHC

8. R3.4.2 Outline of the exploitation of results

The results of the HIPPI JRA will consist in the development of new technologies for the design and construction of high intensity pulsed linear accelerators. The prototypes, the calculation tools and more generally the expertise developed in this frame will be the basis for the design and construction of the next generation of accelerators in Europe. They will be exploited in priority by the three laboratories interested in upgrading their accelerator complex.

However, the outcomes of HIPPI will not be patented, and according to the policy of the partner institutions, will be available to the scientific community and to industrial companies interested in accelerators for technological applications (generation of radio-isotopes for medicine, biology …).

The reports produced in the frame of HIPPI will be referenced and will be accessible through the scientific information distribution system of the partner laboratories. Part of the reports, integrally or in a condensed form, will be published in scientific journals and in the proceedings of international conferences.

8. R3.4.3 Monitoring success and impact of the activity

The specifications to be met by the various prototypes will be defined at the first general meeting of HIPPI with the approval of the External Scientific Advisory Committee. The ambition is to surpass the performance of the machines presently under construction in the US or in Japan. The success will be measured by comparing the technical goals described in the above mentioned objectives of the JRA to the achieved performances. An important parameter to evaluate the technical solutions will be their cost, which has to be smaller or equal (for a better performance) to that of the previous generation of European linear accelerators.

The number of citation of the reports published during the execution of HIPPI as well as the adoption of the technical solution developed in HIPPI for other projects are indicators of the impact of the HIPPI activities.

8. R4 Activity JRA4: Next European Dipole *(NED)*

8. R4.1 Description and objectives of the activity

Upgrades of existing high-energy particle accelerators and/or designs of new machines call for the development of higher-field and higher-field-gradient superconducting dipole and quadrupole magnets. Since the Tevatron, the most widely used superconductor is a ductile alloy of niobium and titanium (NbTi), whose world production is around 1500 t/year (mainly in the form of multifilamentary composite wire for Magnetic Resonance Imaging magnet systems). The LHC magnet R&D program has demonstrated that the limit of NbTi at 1.8 K lies in the 10-to-10.5-T range and that to go beyond the 10-T threshold, it is necessary to change the superconducting material.

At present, High Temperature Superconductors (HTS) are not yet ready for large-scale applications requiring high-current densities in high magnetic fields, and it is likely that it will take at least another decade before they become competitive. In the meantime, the only serious candidate to succeed NbTi is the intermetallic compound Nb_3Sn, whose world production is around 15 t/year (also in the form of multifilamentary composite wire, used mainly for high-field Nuclear Magnetic Resonance magnet systems).

Nb_3Sn has a critical temperature (T_C) and an upper critical magnetic flux density (B_{C2}) that are about twice those of NbTi. However, once formed, Nb_3Sn becomes brittle and its critical parameters (T_C, B_{C2} and J_C) are strain-sensitive. The brittleness and strain sensitivity of Nb_3Sn require a different approach to all manufacturing processes, and, so far, have limited its use to specific, small-scale applications.

Although Nb_3Sn technology is not yet mature, the recent progress, described above, indicates that it could be at hand for the high-field and high-field-gradient accelerator magnets needed for the LHC upgrade and beyond. However, the European laboratories are presently lagging behind the vigorous efforts carried out in the USA and they need to bridge the gap if they want to stay at the technology frontier achieved with LHC.

The main motivation of the NED JRA is to lay the foundation of an integrated European effort towards

- bringing Nb_3Sn technology to maturity for accelerator magnet applications and
- boosting the competitiveness of European laboratories and European industry with respect to their American counterparts.

Therefore the main objectives are

1. to promote high-performance Nb_3Sn wire development in collaboration with European industry to stay abreast of American manufacturers and produce a number of representative unit lengths of high-performance Nb_3Sn cables (aiming at a non-copper critical current density of 1500 A/mm^2 at 4.2 K and 15 T),
2. to develop a preliminary design of a large-aperture, high-field Nb_3Sn dipole magnet model that could push the technology well beyond present LHC limits,
3. to carry out some investigations on how to improve Nb_3Sn conductor insulation and its heat transfer properties by undertaking
    i. limited heat-transfer studies on insulated Nb_3Sn conductor
    ii. limited R&D studies on Nb_3Sn conductor insulation.

The program of this JRA will be accomplished by a collaboration made up of most European laboratories involved in high-field, superconducting accelerator magnet development, working together with preeminent industrial partners in superconducting wire and cable production. Such a collaboration, on forefront Nb_3Sn R&D, is original and unique in Europe.

In addition, the participants are investigating ways to obtain more resources either through their funding agencies and/or additional collaborators. The objective is to build a dipole magnet model which will allow one to bring Nb_3Sn technology to maturity for very high field accelerator magnet applications. Such magnets are necessary for the improvement of infrastructures, such as LHC.

8. R4.2. Participants in the activity

Table 8.R4.2a lists the participants and their involvement in the work packages described in the following section.

Table 8.R4.2b shows the detailed involvement of each participant, together with an estimate of their total contribution to the activity in person-months over the 3 years.

Table 8.R4.2a: List of participants and their involvement in the different work packages

Participant number	**Participants**	**WP1: M&C**	**WP2: TSQP**	**WP3: CD**	**WP4: IDI**
1	**CEA**	X	X	X	X
10	**INFN**	X	X	X	
	INFN-Ge	*X*		*X*	
	INFN-Mi	*X*	*X*	*X*	
11	**TEU**	X		X	
15	**WUT**	X	X		
17	**CERN**	X		X	
20	**STFC**	X		X	X
	STFC-RAL	*X*		*X*	*X*

Table 8.R4.2b: Involvement of each participant in person-months

Participant number	Participant (cost model)	Task	person-month
1	**CEA (FC)**	1.1 Activity Coordination	9
		1.2 Meetings	
		2.2 Heat Transfer Measurements	27
		3.4 Wire Development	
		3.5 Wire Characterization	9
		4.4 Innovative Insulation	6
		subtotal CEA	51
10	**INFN (AC)**	1.2 Meetings	
		2.1 TSQP Coordination	6
		2.3. Quench Protection Computation	12
		3.4 Wire Development	1
		3.5 Wire Characterization	12
		subtotal INFN	31
11	**TEU (FC)**	1.1. Activity coordination	3
		1.2 Meetings	
		3.4 Wire Development	1
		3.5 Wire Characterization	9
		3.7 Cable Characterisation	3
		subtotal TEU	16
15	**WUT (AC)**	1.2 Meetings	
		2.2 Heat transfer measurements	6
		subtotal WUT	6
17	**CERN (AC)**	1.2 Meetings	
		3.1 CD Coordination	
		3.3 Specifications' Drafting	3
		3.4 Wire Development	12
		3.6 Cable Development	3
		subtotal CERN	18
20	**STFC (FC)**	1.2 Meetings	
		3.2.Field calculations for a 15 T large bore magnet, conductor definition	9
		4.1 IDI Coordination	3
		4.2 Specifications' Drafting	3
		4.3 Conventional Insulation	15
		subtotal STFC	30

8. R4.3 Outline implementation plan for the full duration of the activity (including milestones and deliverables)

The work to be carried out in NED JRA is included within four Work Packages.

Work Package 1: Management and Communication (M&C) oversees and coordinates the work of all work packages, organizes Steering Committee meetings, ensures proper reviewing and reporting as well as dissemination of knowledge within the NED JRA and the CARE project.

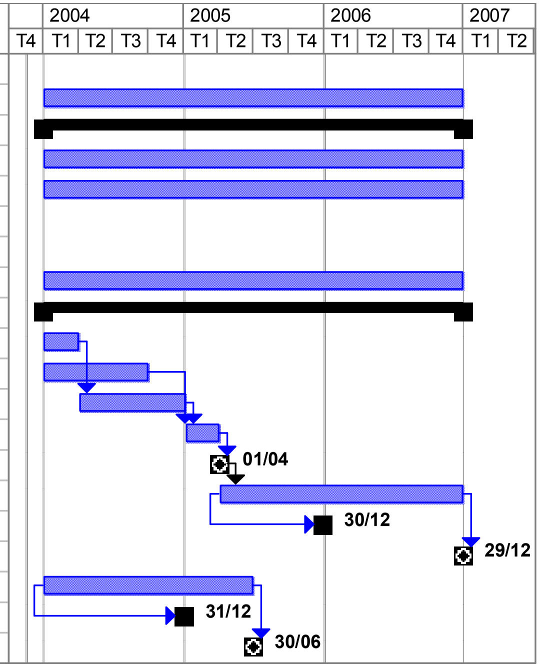
Work Package 2: Thermal Studies and Quench Protection (TSQP) includes measurements of heat transfer through Nb_3Sn conductor insulation and quench protection computations.

Work Package 3 Conductor Development (CD) encompasses Nb_3Sn conductor development and characterization.

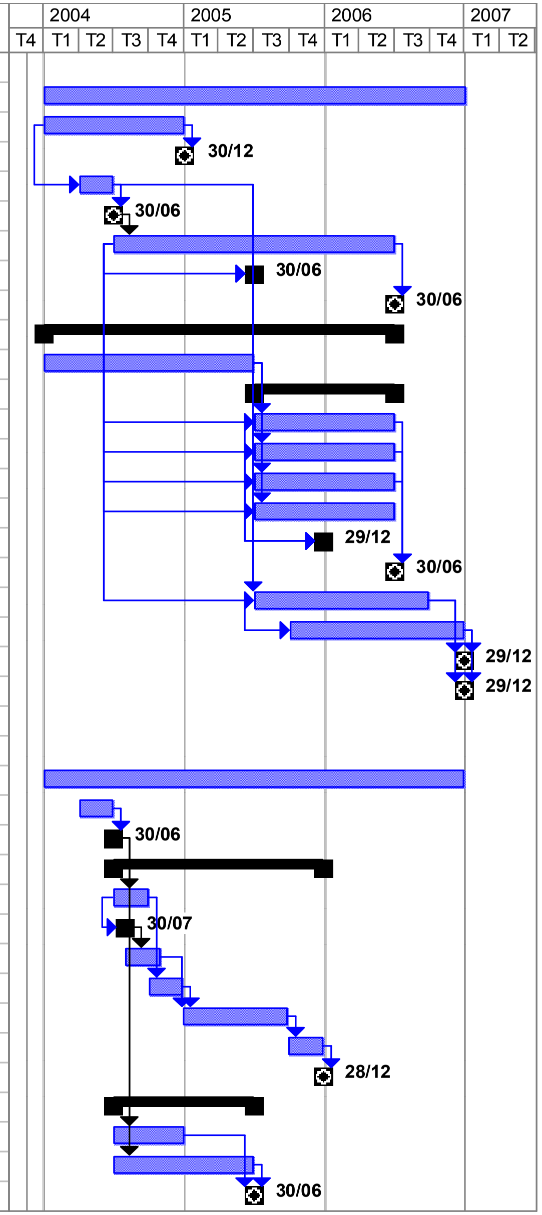
Work Package 4: Insulation Development and Instrumentation (IDI) includes implementation studies of various types of conductor insulation which are applied in the cable characterisation experiments in WP3.

The Work Packages are divided up into Tasks and Sub-Tasks, listed on the left-hand side of the enclosed Gantt chart which provides a detailed schedule over the 3 years of the Activity. Milestones and main deliverables are included.

Task Name	Milestones	Main Deliverables
WP1 Management and Communication (M&C)		
Activity Coordination		
Meetings		
Steering Committee Meetings		
External Scientific Advisory Committee Meetings		
WP2 Thermal Studies and Quench Protection (TSQP)		
Work Package Coordination		
Heat Transfer Measurements		
Drafting of Test Facility Specifications		
Cryostat Design and Fabrication		
Cryogenic Module Design and Fabrication		
Facility Integration and Qualification		
Commissioning of Heat Transfer Facility		**Commissioning**
Measurements and Analyses		
Interim Report on Heat Transfer Measurements	Interim Report	
Final Report on Heat Transfer Measurements		**Final Report**
Quench Protection Computation		
Interim Report on Quench Protection	Interim Report	
Final Report on Quench Protection		**Final Report**



Task Name	Milestones	Main Deliverables
WP3 Conductor Development (CD)		
Work Package Coordination		
Cable Definition from Field Computations of a 15 T Dipole Magnet		
Design of a 15T Dipole Magnet		**Design Report**
Specifications' Drafting		
Specifications on Wire and Cable		**Final Report**
Wire Development		
First Results on Wire Development	First Results	
Final Wire Production		**Production**
Wire Characterization		
Definition of Measuring Procedures		
Wire Ic Measurements		
At CEA		
At INFN-Mi		
At TEU		
Wire Magnetization Measurements		
More Results on Wire Development	Intermediate Results	
Final Report on Wire Characterization		**Final Report**
Cable Development		
Cable Characterization		
Final Cable Production		**Production**
Report on Cable Performance		**Final Report**
WP4 Insulation Development and Implementation (IDI)		
Work Package Coordination		
Specifications' Drafting		
Report on Specifications for Conductor Insulation	Report	
Implementation Study of Conventional Solution		
Litterature Survey		
Definition of the Test Programme	Report	
Tooling Preparation		
Compoment Supply		
Iterative Tests		
Data Analysis		
Report on Conventional Insulation		**Final Report**
Implementation Study of Innovative Solution		
Tape Weaving Trial		
Pre-impregnation and Wrapping Bench		
Report on Innovative Insulation		**Final Report**



8. R4.4 Expected outcome

8. R4.4.1 Application to European research infrastructures

During the last decades superconductivity has gained an unprecedented importance both in accelerator and detector technology for newly developed particle accelerator experiments and infrastructures. Apart from the superconducting RF-cavities, relying merely on Nb-film technology, all accelerator and detector magnets have utilized NbTi superconductors because of their price, relative ease of handling and matured industrial manufacturing infrastructure. Demanding state-of-the-art technology in every respect for these facilities with a projected life-time of at least 15 years has also pushed the usage, manufacturing and performance of NbTi conductors to their limits and it is now required to look for alternative candidates.

The urgency of developing Nb_3Sn technology beyond its current status has been clearly expressed during a workshop held at CERN in March 2002, discussing possible scenarios how to reach the projected luminosity of LHC in 2010 and how to further increase the luminosity in the Interaction Regions (IR) at the ATLAS and CMS detector in 2016. Even without concrete operational specifications for the specific IR-magnets it has been concluded that employment of Nb_3Sn magnets in the IR regions is mandatory to reach either of the above ambitions. More recently, at the Workshop on Advanced Accelerator Magnets, held in Archamps, France, in March 2003, further study on the expected and possible performance of LHC emphasized again the need for reliably operating high-field Nb_3Sn magnets in the IR regions. In addition to luminosity upgrade scenarios, an energy upgrade of the LHC accelerator as a whole, entering a new collision-energy range above 30 TeV by replacing the 8.34 T NbTi beam-steering dipole magnets by 15-16 T Nb_3Sn dipole magnets, is also being seriously considered.

Apart from LHC upgrade, Nb_3Sn technology is also considered for the final focusing quadrupole magnets of linear colliders. For instance, in the case of the first Interaction Region of TESLA, the machine optics requires that the final focusing quadrupole magnets be as close as possible from the interaction point. As a result, they end up inside the detector magnet and must sustain its background field. The TESLA Technical Design Report calls for four 56-mm-aperture, 250 T/m quadrupole magnets that must operate in a 4-T solenoidal background field. Such magnets can only be made from Nb_3Sn. Most technological developments carried out within the NED JRA will be directly applicable to them and will help assessing their feasibility.

In summary, the NED JRA will provide the benefits to European Research Infrastructures:

- It will allow to improve the luminosity of the LHC well beyond the present specifications. On a longer term, it might allow one to increase its energy.
- Beyond the LHC upgrades, the developments carried out within the framework of the NED JRA will significantly contribute to improving, supplying and controlling the technology for high-field accelerator magnets, and will complement the vigorous programs presently conducted in the USA.

8. R4.4.2 Outline of the exploitation of results

Superconducting wire development and production

A key feature of the NED JRA is the ambitious superconducting wire and cable development program to push the Nb_3Sn technology well beyond what is presently available in Europe. The development and production of the wire unit lengths will be subcontracted to industrial manufacturers who have the know-how and infrastructure to carry out this work. It will enable European manufacturers to bridge the gap with their American counterparts and, possibly, take the lead in the competitive market of high performance Nb_3Sn wires. It will help them to improve the quality, yield and cost of their commercial productions, in particular, for the ITER project, which will be running in parallel. It will help also the R&D on Nb_3Sn wires for high-field NMR applications.

Developments on conductor insulation

The development of more reliable insulation schemes could allow higher overall current densities in magnet coils, thereby enhancing the performances of high-field NMR magnet systems.

Whenever appropriate, the outcome of the work will be made available to industrial partners, thereby helping the dissemination of Nb_3Sn technology, inside and outside accelerator magnet applications.

8. R4.4.3 Monitoring success and impact of the activity

Wire Development

The bore field of a dipole magnet model is directly proportional to the overall current density in the conductor.

The Nb_3Sn technology has marked outstanding improvements over the last 20 years, with a fourfold increase of the critical current density (see Figure 3.3). The highest achievements, mostly by US companies, set the benchmark to which the result of the superconducting wire development can be compared throughout the development program.

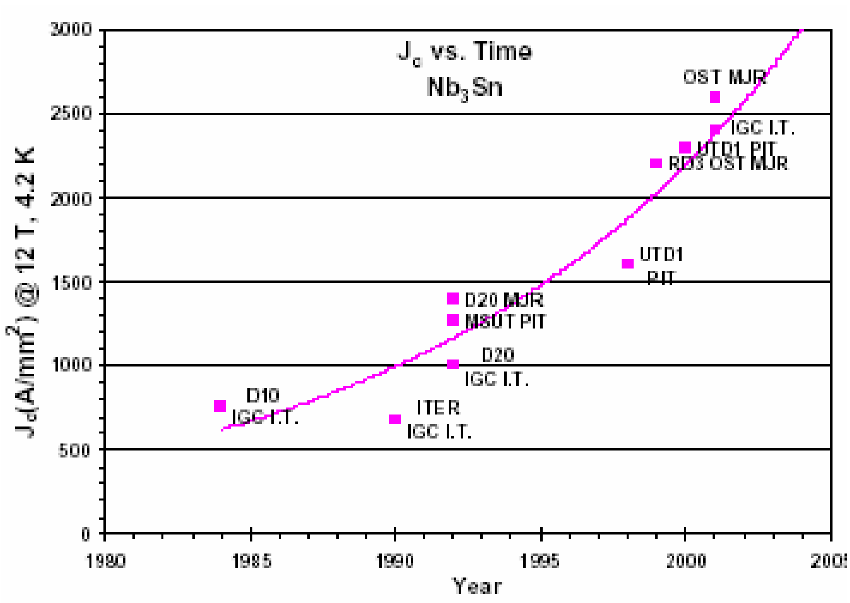


Figure 8.R4.4.3: Improvements of J_C (12 T, 4.2 K) of Nb_3Sn wires since 1984 (from Fermilab Report TD-01-01, 14 Feb 2001).

8. R4.5 Subcontracts

Cryostat for Heat-Transfer Measurements (TSQP, Task 2.2)

The subcontract to manufacture the cryostat that will house the experiment on heat transfer through Nb_3Sn conductor insulation will be placed with a manufacturer well experienced in cryogenic scientific equipment design, construction and commissioning

Wire Development and Manufacturing (CD, Task 3.4)

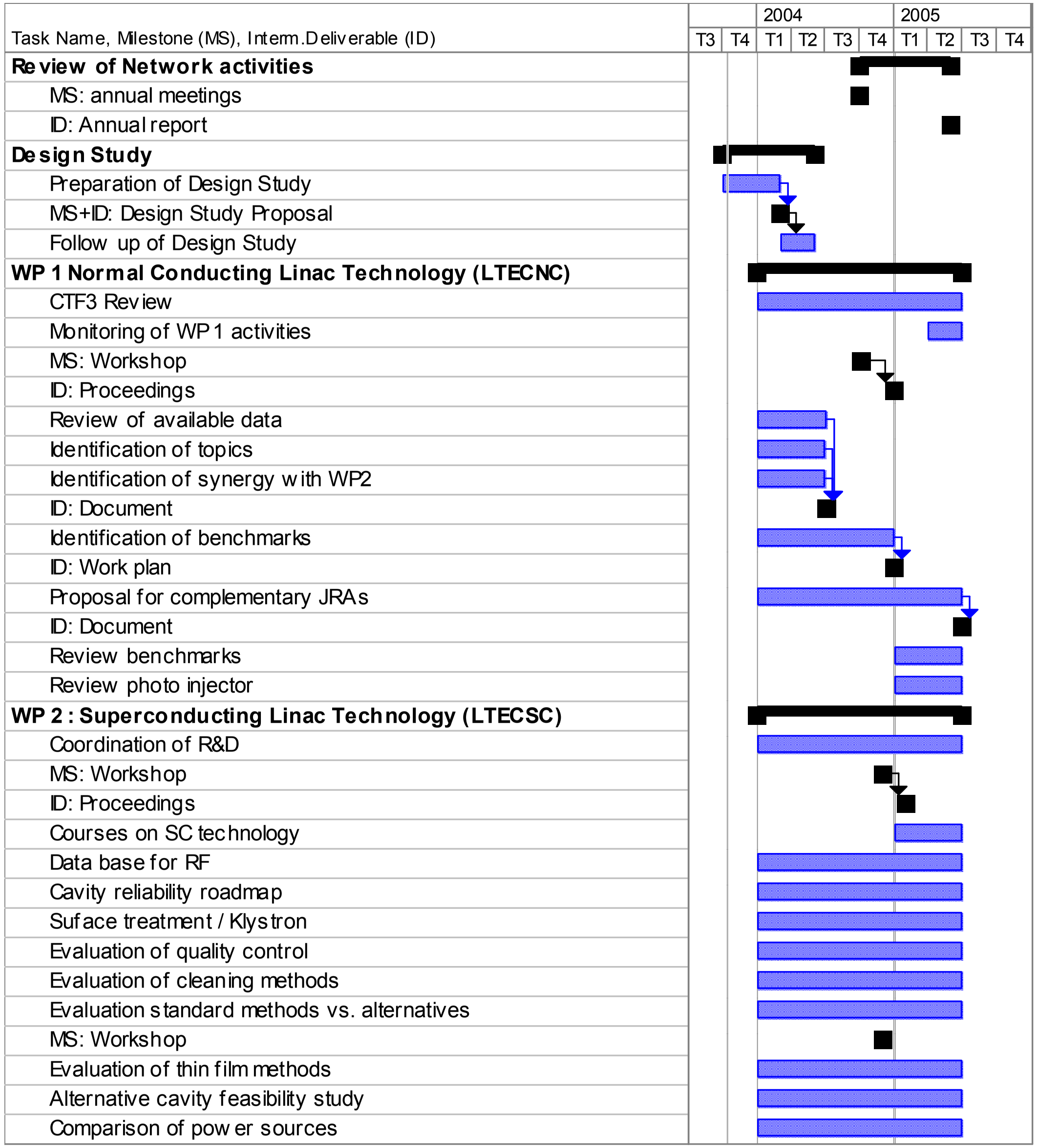
Subcontracts will be placed with manufacturers already active in the field of superconducting multifilamentarty composite wires. The wire structure depends on the chosen technology. A common approach of all the technologies consists in the assembly of a billet made of copper, tin and niobium rods or tubes. The billets are cylindrical and have diameters in the 80-to-100-mm range. They are extruded and subsequently drawn-down to final size in specialized machines. Only specialized manufacturers have the know-how and infrastructures to perform these operations and produce long unit lengths superconducting wires and cables, while national laboratories have the competences and facilities to characterize the performances of the final products.

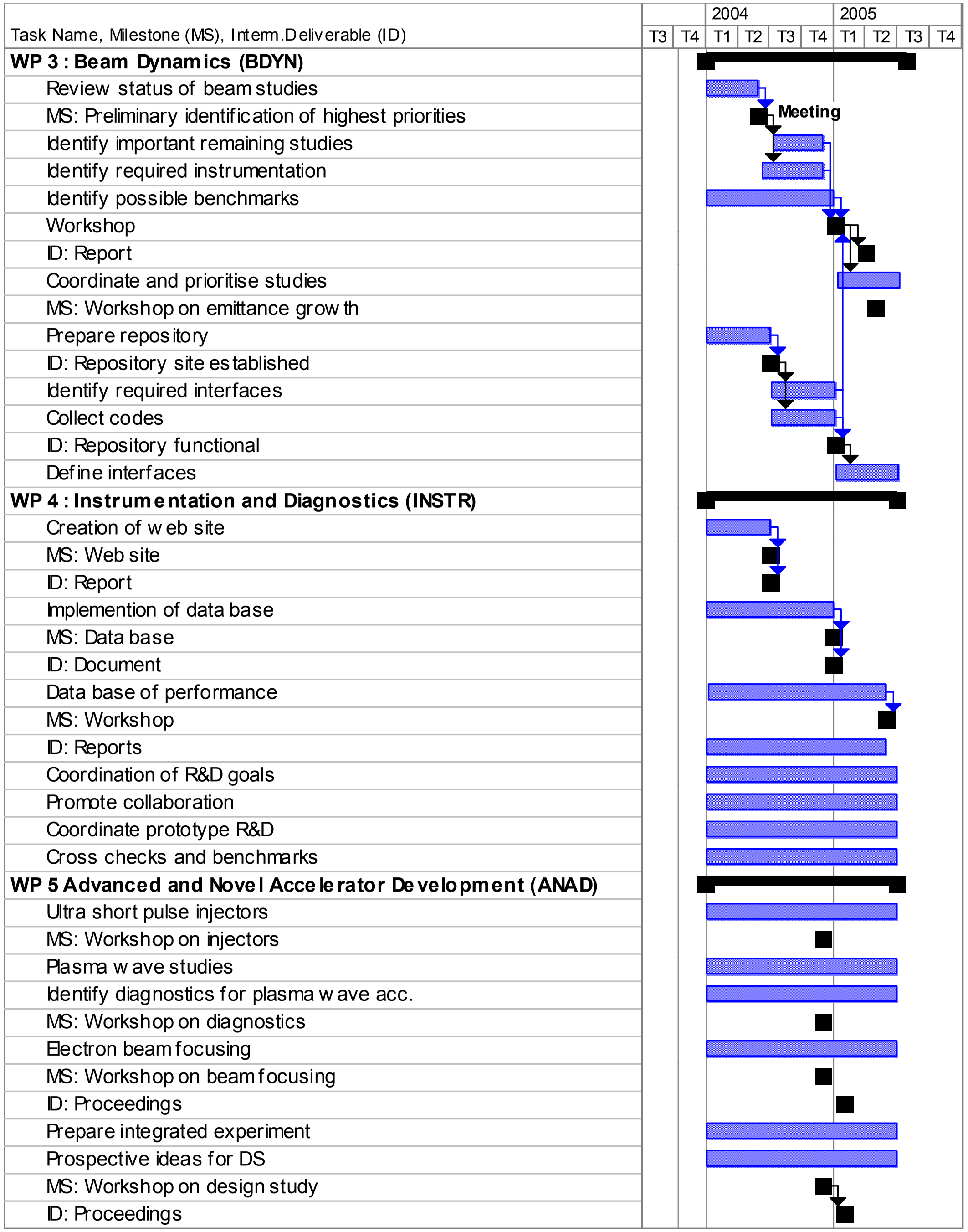
All European manufacturers are presently engaged in the construction of LHC and have made large capital and human investments to reach the high degree of quality required for this production. The proposed JRA will give them an opportunity to extend their domain of expertise beyond the NbTi technology and to take a major step into Nb_3Sn technology. This will be profitable not only for accelerator magnet applications but also for ITER and high-field NMR applications as well.

Since the conductor development program is regarded as an iterative process the subcontracts per company will be split up in time. Monitoring of quality and progress will be carried out by several participants (task 3.4) whose findings are fed back to the task coordinator (CERN) on a regular basis. Together with the results from extensive wire characterisations this information will guide the timing and the stepwise extension of the subcontracts.

9. Detailed implementation plan for the first 18 months period

9. N1 Activity N1: Electron Linear Accelerator Network *(ELAN)*




Task Name, Milestone (MS), Interm.Deliverable (ID)
2004
2005
T3
T4
T1
T2
T3
T4
T1
T2
T3
T4
WP 3 : Beam Dynamics (BDYN)
Review status of beam studies
MS: Preliminary identification of highest priorities
Meeting
Identify important remaining studies
Identify required instrumentation
Identify possible benchmarks
Workshop
ID: Report
Coordinate and prioritise studies
MS: Workshop on emittance growth
Prepare repository
ID: Repository site established
Identify required interfaces
Collect codes
ID: Repository functional
Define interfaces
WP 4 : Instrumentation and Diagnostics (INSTR)
Creation of web site
MS: Web site
ID: Report
Implemention of data base
MS: Data base
ID: Document
Data base of performance
MS: Workshop
ID: Reports
Coordination of R&D goals
Promote collaboration
Coordinate prototype R&D
Cross checks and benchmarks
WP 5 Advanced and Novel Accelerator Development (ANAD)
Ultra short pulse injectors
MS: Workshop on injectors
Plasma wave studies
Identify diagnostics for plasma wave acc.
MS: Workshop on diagnostics
Electron beam focusing
MS: Workshop on beam focusing
ID: Proceedings
Prepare integrated experiment
Prospective ideas for DS
MS: Workshop on design study
ID: Proceedings

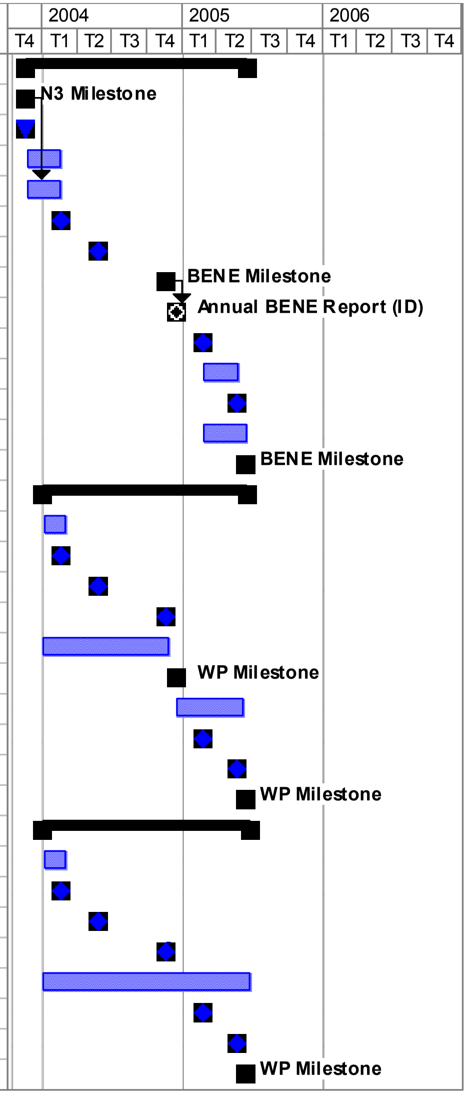
9. N2 Activity N2: Beams in Europe for Neutrino Experiments *(BENE)*

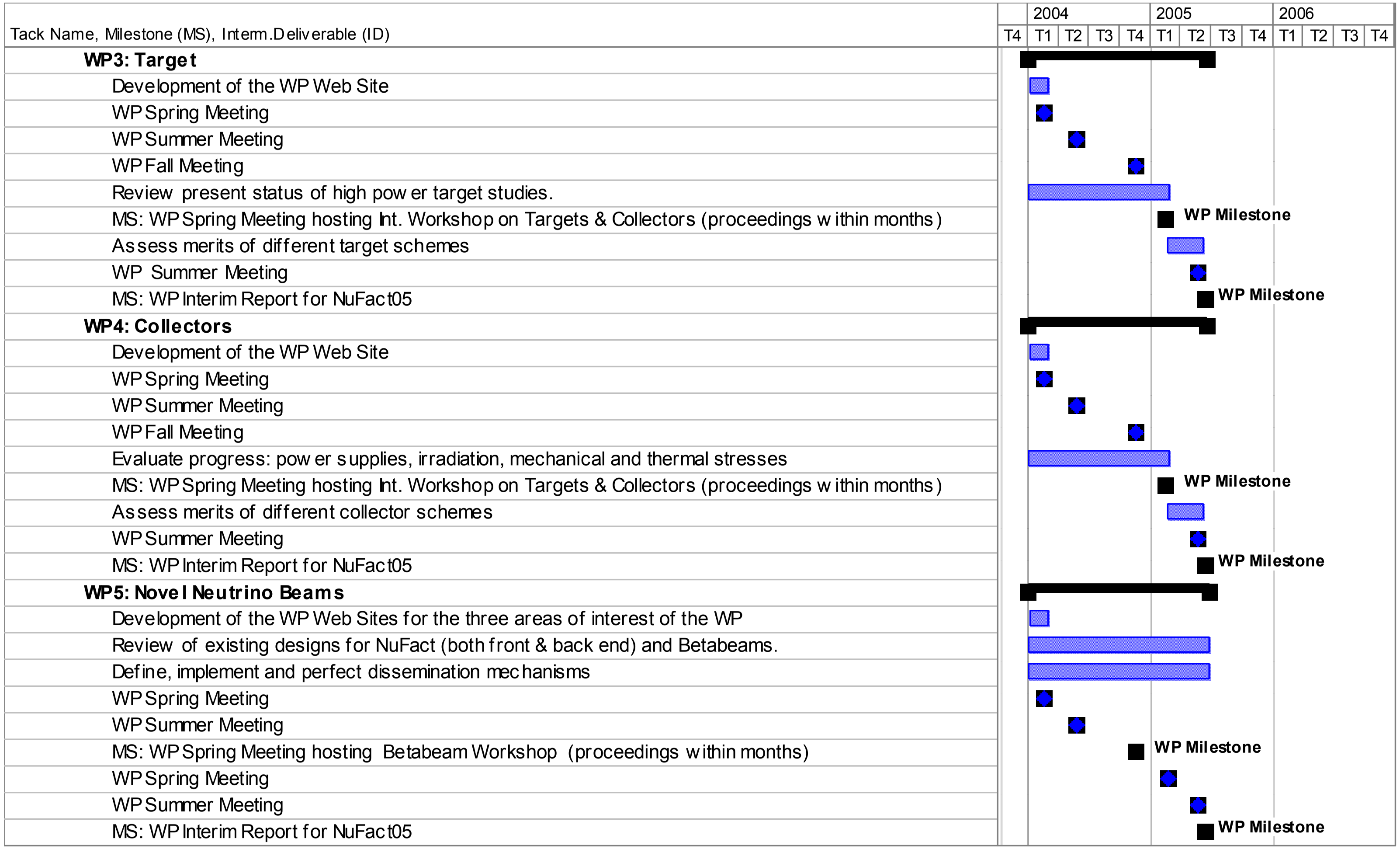
Tack Name, Milestone (MS), Interm.Deliverable (ID)

Establish the Network framework
- MS: Kick-off meeting: Planning and w ork organization
- Establish connexion betw een Labs and universities in all Work Packages. Organize w ork in all WP.
- Establish priorities in all WP, create BENE Website
- Assess state of the art of technologies, prepare Design Studies and R&D proposals
- BENE Spring Meeting
- BENE Summer Meeting
- MS: Annual CARE/BENE meeting
- ***ID: BENE Annual Report***
- BENE Spring Meeting
- Prepare short BENE Interim Report for NuFact05
- BENE Summer Meeting
- Organization of NuFact05 International Workshop
- MS: NUFact05 International Workshop

WP1: Physics
- Development of the WP Web Site
- WP Spring Meeting
- WP Summer Meeting
- WP Fall Meeting
- Plan strategy of unambiguous measurement of all oscillation parameters
- MS: Topical Physics Workshop (proceedings within months)
- Assess potentials of different beam baseline detector configurations
- WP Spring Meeting
- WP Summer Meeting
- MS: WP Interim Report for NuFact05

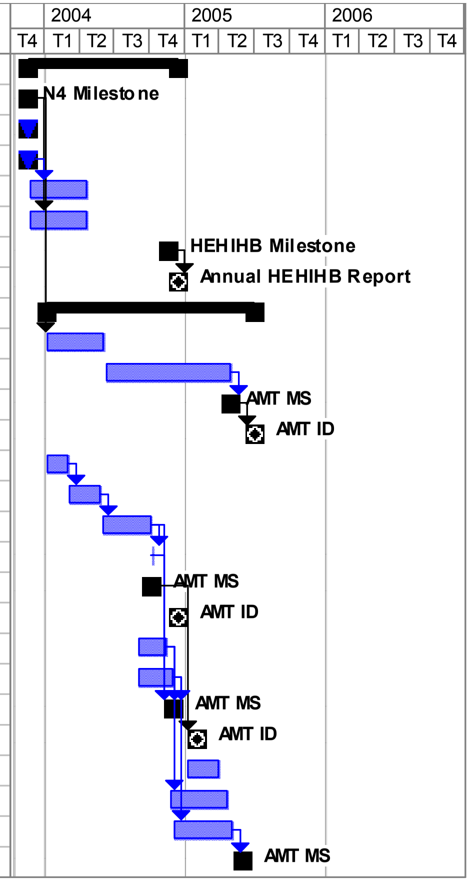
WP2: Driver
- Development of the WP Web Site
- WP Spring Meeting
- WP Summer Meeting
- WP Fall Meeting
- Define criteria of SPL vs RCS. Perform comparison. Identify R&D plans beyond HIPPI.
- WP Spring Meeting
- WP Summer Meeting
- MS: WP Interim Report for NuFact05



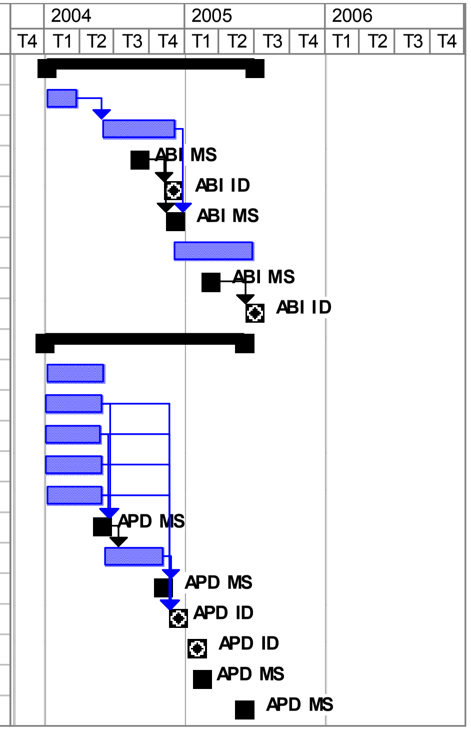

Tack Name, Milestone (MS), Interm.Deliverable (ID)
2004
2005
2006
T4
T1
T2
T3
T4
T1
T2
T3
T4
T1
T2
T3
T4
WP3: Target
Development of the WP Web Site
WP Spring Meeting
WP Summer Meeting
WP Fall Meeting
Review present status of high pow er target studies.
MS: WP Spring Meeting hosting Int. Workshop on Targets & Collectors (proceedings w ithin months)
WP Milestone
Assess merits of different target schemes
WP Summer Meeting
MS: WP Interim Report for NuFact05
WP Milestone
WP4: Collectors
Development of the WP Web Site
WP Spring Meeting
WP Summer Meeting
WP Fall Meeting
Evaluate progress: pow er supplies, irradiation, mechanical and thermal stresses
MS: WP Spring Meeting hosting Int. Workshop on Targets & Collectors (proceedings w ithin months)
WP Milestone
Assess merits of different collector schemes
WP Summer Meeting
MS: WP Interim Report for NuFact05
WP Milestone
WP5: Novel Neutrino Beams
Development of the WP Web Sites for the three areas of interest of the WP
Review of existing designs for NuFact (both front & back end) and Betabeams.
Define, implement and perfect dissemination mechanisms
WP Spring Meeting
WP Summer Meeting
MS: WP Spring Meeting hosting Betabeam Workshop (proceedings within months)
WP Milestone
WP Spring Meeting
WP Summer Meeting
MS: WP Interim Report for NuFact05
WP Milestone

9. N3 Activity N3: High-Energy High-Intensity Hadron Beams *(HEHIHB)*

Task Name, Milestone (MS), Interm.Deliverable (ID)
Establish the Network framework
MS: Kick-off meeting: Planning and work organization
Establish connexion between Labs and universities in all Work Packages (AMT, ABI and APD)
Organization of all Work Packages (AMT, ABI and APD)
Establish priorities in all WP
Assess state-of-the-art Technologies
MS: Annual HEHIHB meeting
ID: HEHIHB Annual Report
WP1 Accelerator Magnet Technology (AMT)
Development of the AMT Web Site
Development of Web based database for SC Cables and Magnets
MS: Specific meeting on database
ID: First report on Web based database
Establish a catolog of numerical codes for AMT1 and AMT4
Comparison of codes for design, stability and protection studies for AMT1 and AMT4
Identification of main limiting issue
Proposal for integration of European program in the international framework (AMT1, AMT4)
MS: First AMT topical workshop on superconductors
ID: Report on AMT organization and conductor development roadmap
Comparative studies of alternatives using low field magnets for AMT2 and AMT3
Identification of general issues relevant for magnet design for AMT5
MS: Reporting of AMT activities at the first general CARE meeting
ID: Proceedings of the 1st AMT topical workshop
Review of developments in the US and for ITER on conductors and magnet technology relevant for AMT1 and AMT2
Comparative studies of alternatives using low field magnets for AMT2 and AMT3
Determination of scaling law for magnet and cryogenic cost for AMT5
MS: Preliminary report on scaling law for magnet and cryogenic cost for AMT5

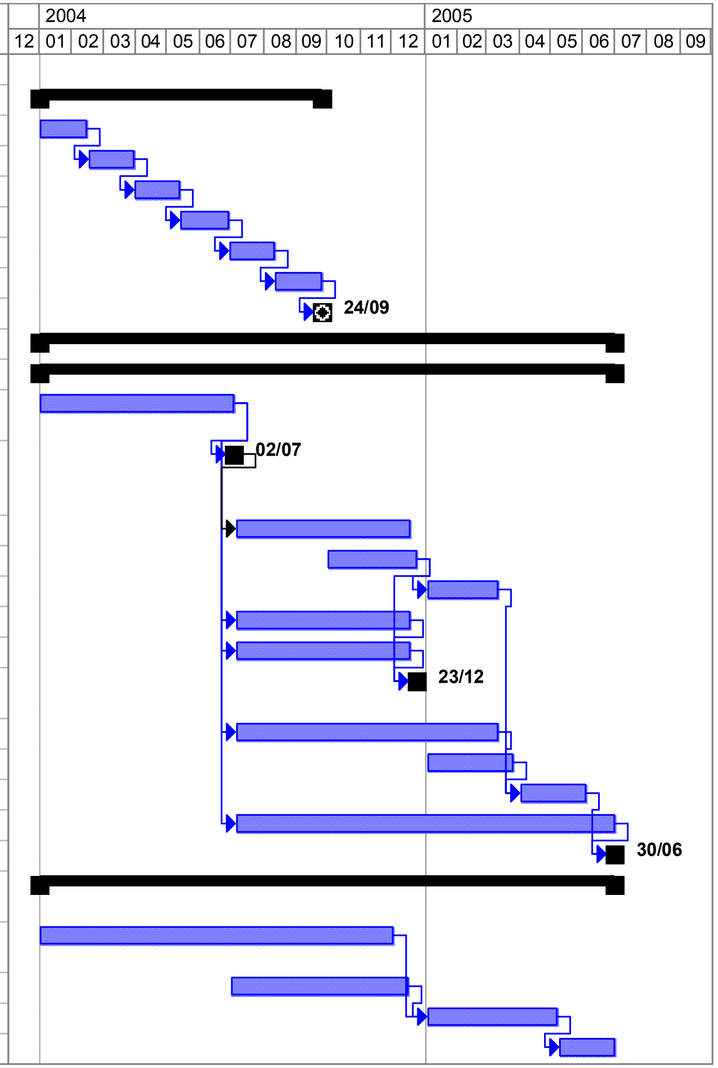


Task Name, Milestone (MS), Interm.Deliverable (ID)
WP2 Accelerator Beam Instrumentation (ABI)
Establishing the list of priorities relevant for ABI and selection of 1st topic
Study of the 1st topic after identification of its main limiting issue
MS: First ABI topical workshop
ID: Proceedings of the 1st ABI topical workshop
MS: Reporting of ABI activities at the first general CARE meeting
Study of the second topic after identification of its limiting issues
MS: Second topical workshop
ID: Proceedings of the 2nd topical workshop
WP3 Accelerator Physics and Synchrotron Design (APD)
Development of the APD Web Site with structured information flow
Establish a catalog of existing simulation codes for APD1-APD7
Comparison of alternative synchrotron and IR designs
Determination of beam dynamics studies and experiments to validate different options (APD1-2, APD6-7)
Studies relevant for APD3, APD4 and APD5
MS: General APD meeting
Identification of beam intensity limitation and determination of roadmap for Synchrotron and ID designs
MS: Topical APD workshop on Optics/Collective effets
ID: Interim report on APD activities and reporting at the general CARE meeting
ID: Proceedings of the first APD topical workshop
MS: meeting on simulation code benchmarking and web based code repository
MS: General APD meeting

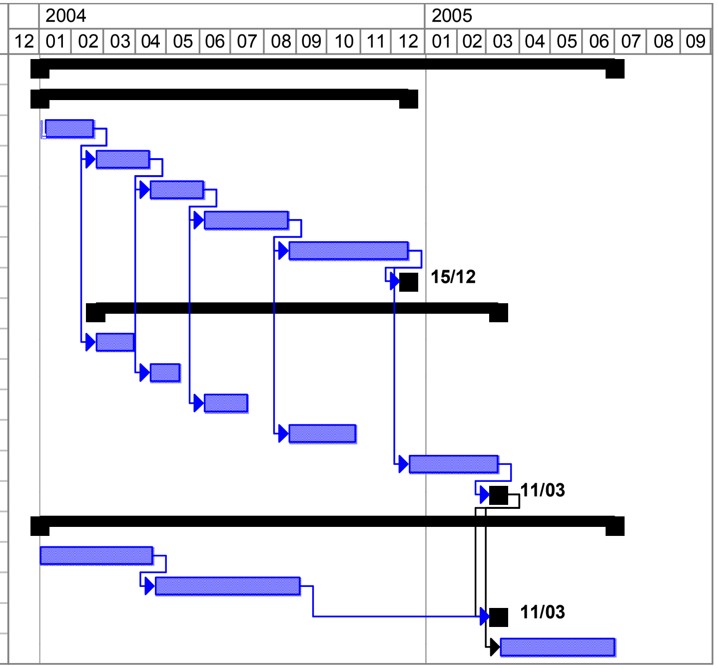


9. R1 Activity R1: Superconducting Radio Frequency *(SRF)*

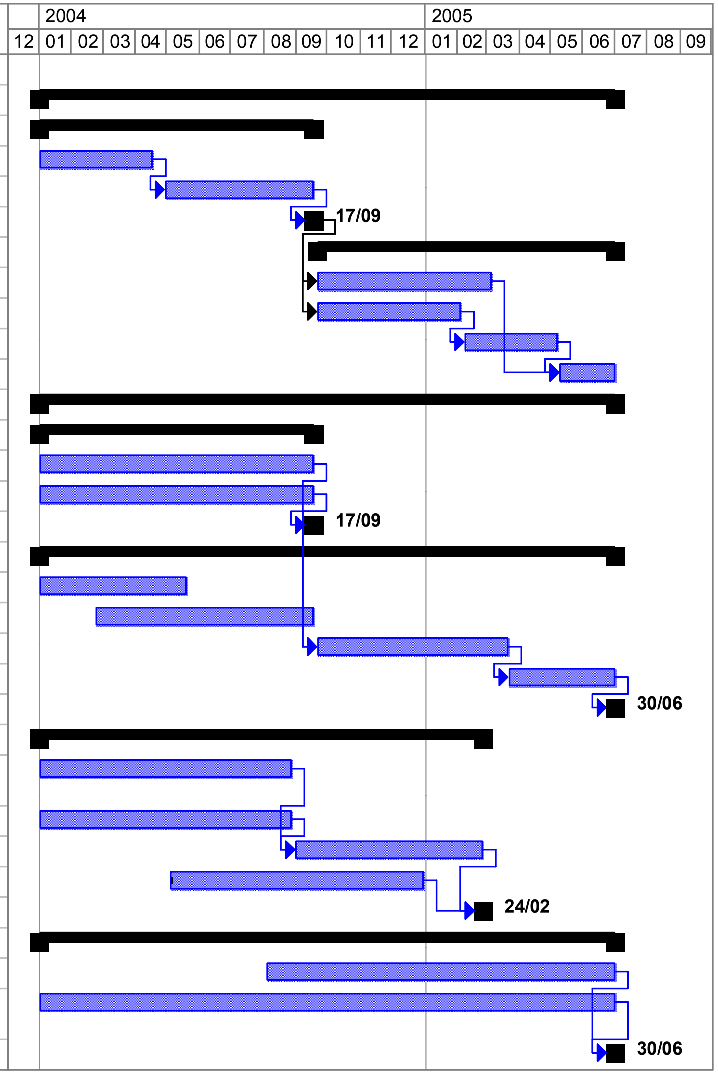
Task Name	Milestones	Deliverables
WP2 Improved standard cavity fabrication		
2.1 Reliability Analysis		
2.1.1 Review of data bank: cavity fabrication		
2.1.2 Review of data bank :cavity treatment		
2.1.3 Review of data bank: cavity VT performance		
2.1.4 Review of data bank: string assembly		
2.1.5 Review of data bank: string performance		
2.1.6 Establish correlations		
2.1.7 Final report on reliability issue		**Final report**
2.2 Improved component design		
2.2.1Documentation retrieving		
2.2.1.2 Access and study of Jlab, DESY, LLAN, KEK experience and solution on components		
2.2.1.3 Summary report on the status of the art on ancillaries on the experience of various laboratories involved in SCRF	**Report**	
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	**Report**	
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 Report for new components	**Report**	
2.2.2 Review with vendors 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		



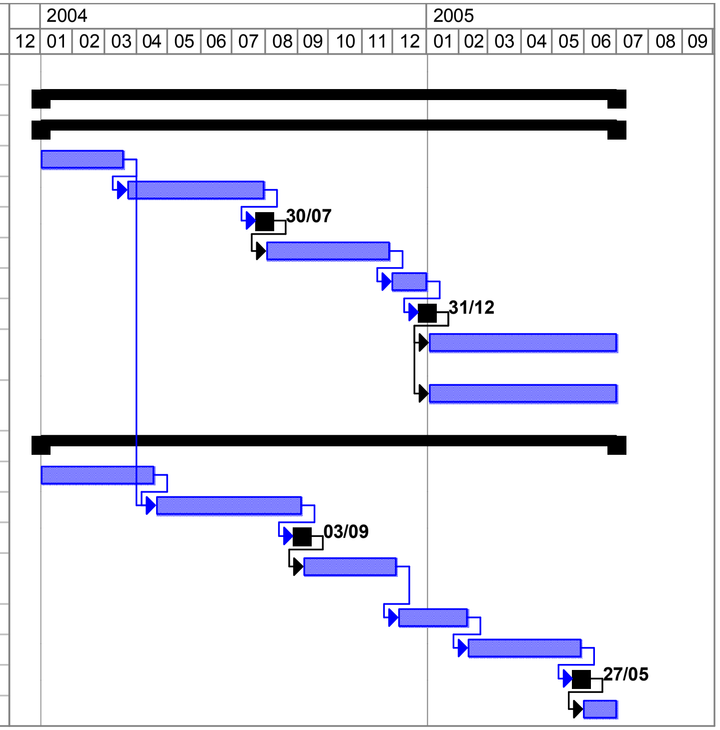
Task Name	Milestones	Deliverables
2.3 EB welding		
2.3.1 Design tooling		
2.3.1.1 Tools for flange welding		
2.3.1.2 Tools for pipe welding		
2.3.1.3 Tools for stiffening rings		
2.3.1.4 Tools for single cell welding		
2.3.1.5 tools for 9-cells		
2.3.1.6 Tools design finished	**Design finished**	
2.3.2 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	**Prototypes fabricated**	
2.3.3 Welding		
2.3.3.1 Commissioning welding machine		
2.3.3.2 Test welding		
2.3.3.3 Start production welding	**Start of welding components**	
2.3.3.4 Single cell welding		



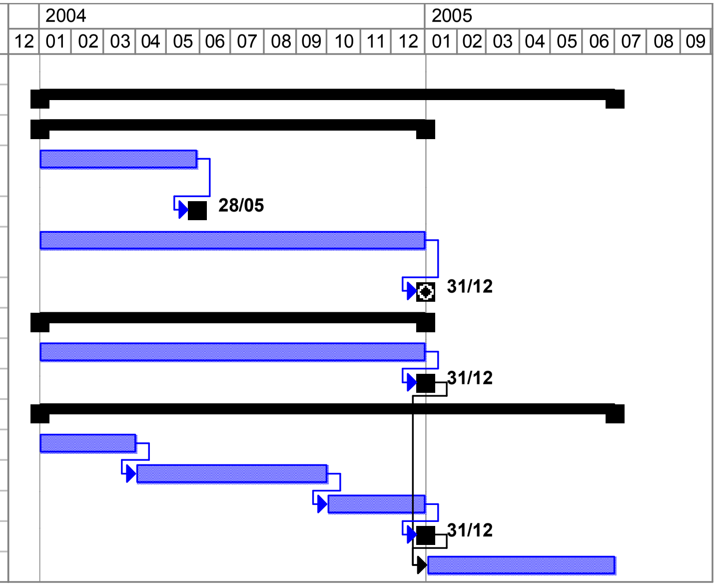
Task Name	Milestones	Deliverables
WP3 Seamless cavity production		
3.1 Seamless by spinning		
3.1.1 Design spinning machine		
3.1.1.1 Drawings of the matrices		
3.1.1.2 Drawings of the support system		
3.1.1.3 Design finished	**Design finished**	
3.1.2 Construction of spinning machine		
3.1.2.1 fabrication 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		
3.2 Seamless by hydroforming		
3.2.1 Design hydroforming machine		
3.2.1.1 Drawings of the matrices		
3.2.1.2 Drawings of the support system		
3.2.1.3 Design finished	**Design report**	
3.2.2 Construction of hydroforming 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 Commissioning finished	**Hydroforming 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 Construction of the tube necking machine		
3.2.3.4 Software for the tube necking machine		
3.2.3.5 Necking machine ready	**Necking machine ready**	
3.2.4 Development of seamless tubes for 9-cell cavities		
3.2.4.1 Fabrication and inspection of bulk Nb test tubes		
3.2.4.2 Fabrication and inspection of bimetallic NbCu test tubes		
3.2.4.3 Seamless tubes ready	**Prototypes of tubes finished**	



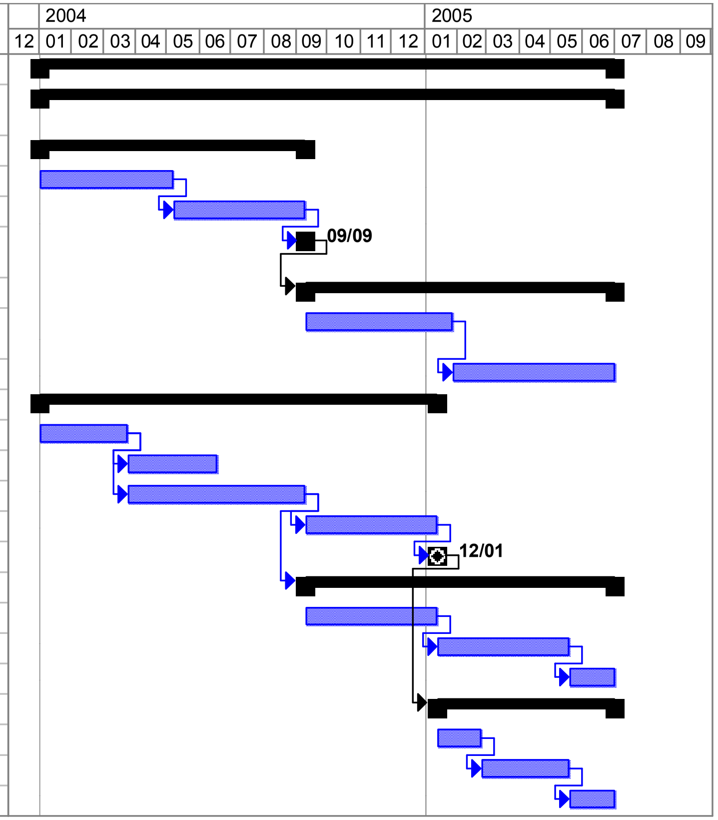
Task Name	Milestones	Deliverables
WP4 Thin film cavity production		
4. Thin film cavity coating		
4.1 Linear-arc cathode coating		
4.1.1 Modification of a prototype facility for single cells		
4.1.2 Optimization of a triggering system		
4.1.3 Prototype ready	**Prototype facility ready**	
4.1.4 Study of arc current reduction and stabilization		
4.1.5 Optimization of the powering system		
4.1.6 Start of coating	**Start coating**	
4.1.7 Coating of single cells without micro droplet filtering		
4.1.8 Design and construction of a micro droplet filter system		
4.2 Planar-arc cathode coating		
4.2.1 Modification of a planar-arc system		
4.2.2 Optimization of the laser triggering system		
4.2.3 Prototype ready	**Prototype facility ready**	
4.2.4 Characterization of samples coated at different conditions		
4.2.5 Characterization of Nb-coated sapphire samples		
4.2.6 Characterization of Nb-coated copper samples		
4.2.7 Planar arc system fully tested	**Report**	
4.2.7 First investigation of the micro droplet problem		



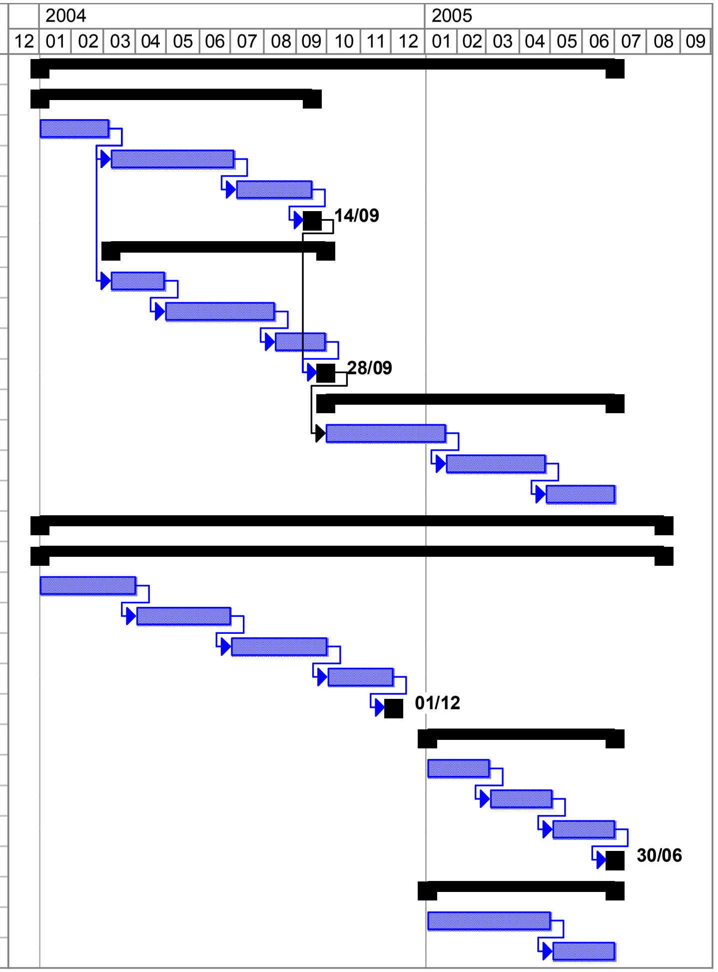
Task Name	Milestones	Deliverables
WP5 Surface preparation		
5.1 EP on single cells		
5.1.1 EP on samples		
5.1.1.1 Establishing method of surface characterization (roughness, reflectometry)		
5.1.1.2 Surface characterization fixed	**Report**	
5.1.1.3 Series of EP with samples for surface investigations		
5.1.1.4 Best EP parameters		**Report**
5.1.2 Single cell cavities		
5.1.2.1 Order Nb and fabricate 3 cavities		
5.1.2.2 3 cavities fabricated	**Test cavities**	
5.1.3 EP chemistry on 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	**EP set up operational**	
5.1.3.5 Operation of EP set-up		



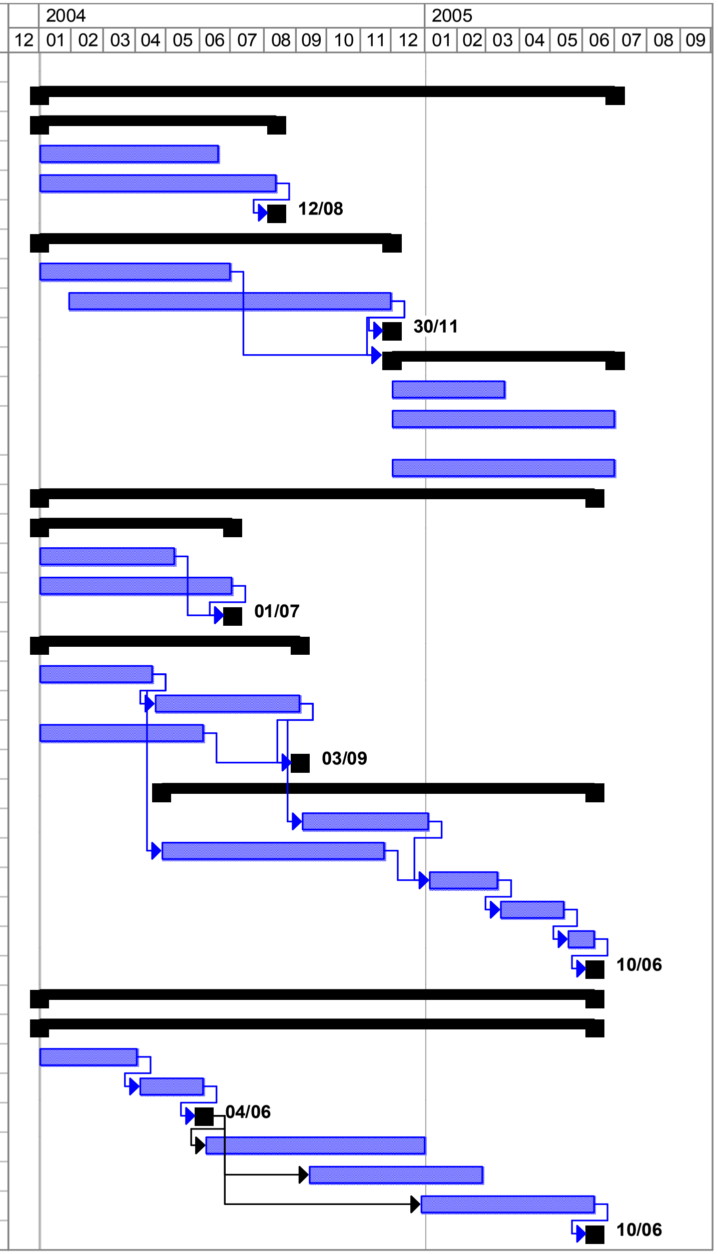
Task Name	Milestones	Deliverables
5.2 EP on multi-cells		
5.2.1 Transfer of parameters from single cell to multi cell equipment		
5.2.1.1 Finish EP setup nine-cells at DESY		
5.2.1.1.1 Improved gas cleaning system		
5.2.1.1.2 Design for hot water rinsing		
5.2.1.1.3 Proof-of-Principle experiment hot water rinse	**Report**	
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		
5.2.1.3 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		**Report**
5.2.2 Laser roughness		
5.2.2.1 Evaluate existing systems		
5.2.2.2 Specify laser system		
5.2.2.3 Build laser system		
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		



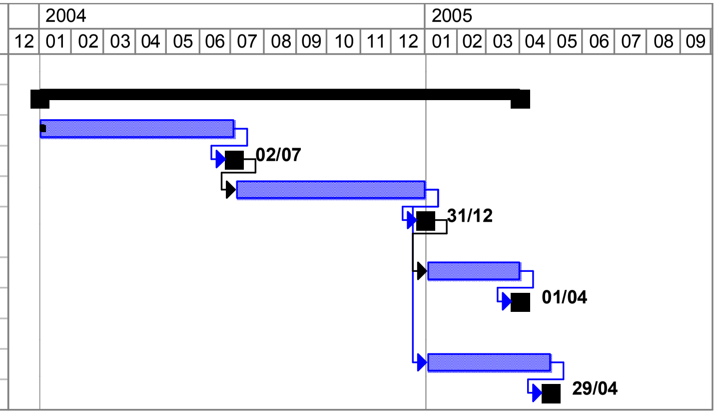
Task Name	Milestones	Deliverables
5.3 Automated EP (AEP)		
5.3.1 prototype EP installation		
5.3.1.1 Design installation		
5.3.1.2 Fabricate/ order components		
5.3.1.3 Assemble EP installation		
5.3.1.4 EP installation ready	**First operation**	
5.3.2 EP computer control		
5.3.2.1 Design control architecture		
5.3.2.2 develop software		
5.3.2.3 Test of software		
5.3.2.4 Software ready	**Report**	
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		
5.4 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	**Start operation**	
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	**Report**	
5.4.3 VT 9-cell cleaning apparatus		
5.4.3.1 Design 9-cell apparatus VT		
5.4.3.2 Fabricate 9-cell apparatus		



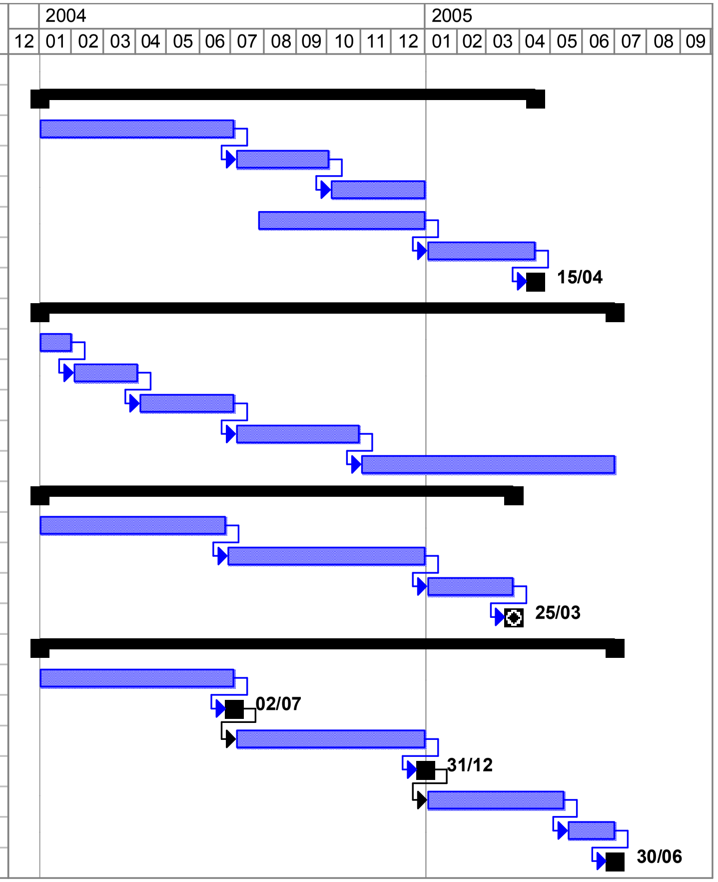
Task Name	Milestones	Deliverables
WP 6 Materials analysis		
6.1 SQUID scanning		
6.1.1 Produce calibration defects		
6.1.1.1 Production of surface defects		
6.1.1.2 Production of bulk defects		
6.1.1.3 Calibration defects finished	**Report**	
6.1.2 Design components of SQUID scanner		
6.1.2.1 Design of the scanning table and support		
6.1.2.2 Design of the SQUID cooling system		
6.1.2.3 Design Scanner finished	**Design report**	
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 scanner		
6.1.3.3 Software for the SQUID scanner		
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	**Report**	
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		
MS 6.2.2.4 Design flux gate head finished	**Design report**	
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	**Report, Start operation**	
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	**Start operation**	
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	**Report**	



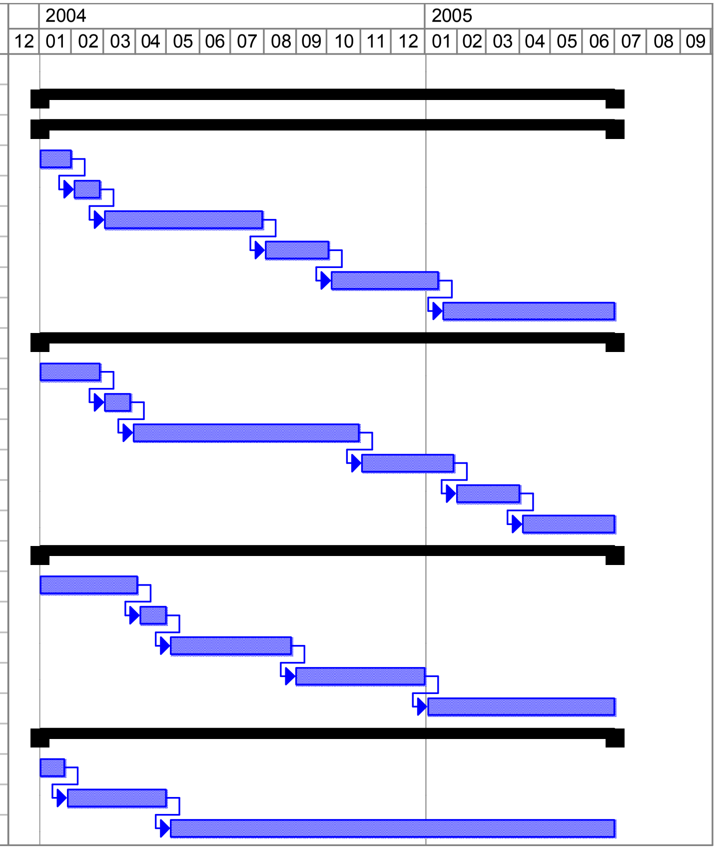
Task Name	Milestones	Deliverables
WP7 Input Couplers		
7.1 New prototype coupler		
7.1.1 RF simulation of coupler		
7.1.1.1 Report on simulation	**Report**	
7.1.2 Detailed engineering drawings		
7.1.2.1 Engineering complete	**Completion of prototype coupler design**	
7.1.3 call for tenders		
7.1.4 Start prototype fabrication	**Start prototype production**	
7.2 Fabrication of TiN coating system		
7.2.1 Mechanical design of vacuum chamber		
7.2..1 Mechanical design finished	**Design report**	



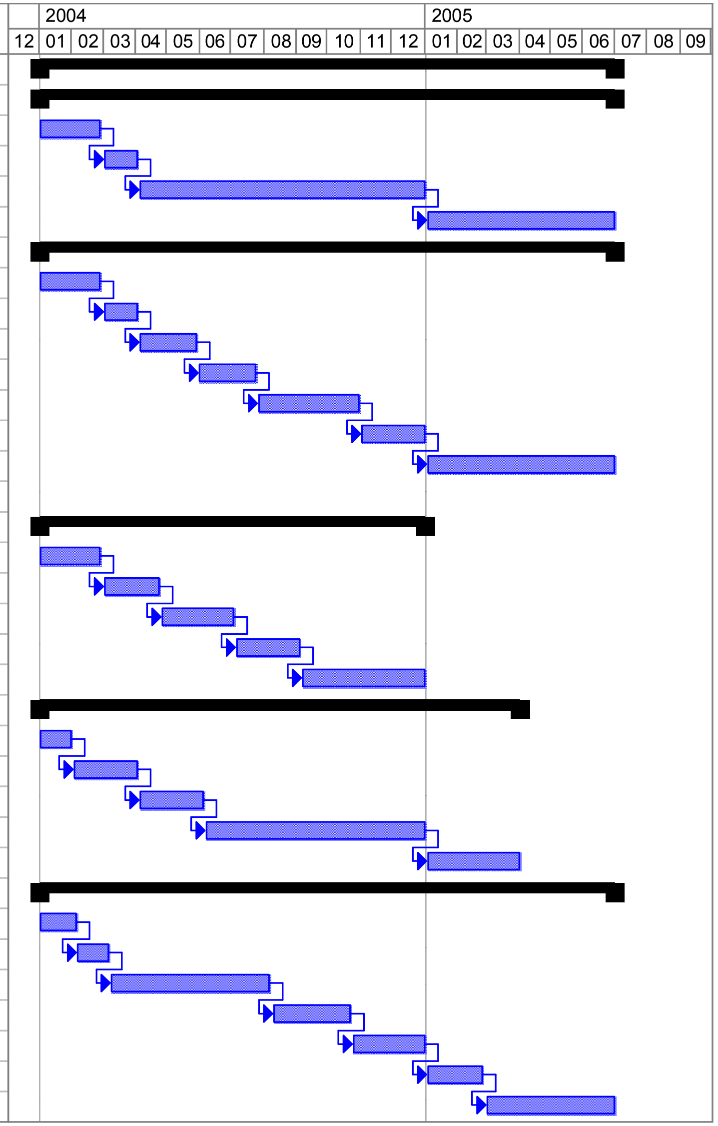
Task Name	Milestones	Deliverables
WP8 Tuners		
8.1 UMI tuner		
8.1.1 Develop control electronics		
8.1.2 Mechanical design of tuner		
8.1.3 Study leverage system/motor		
8.1.4 Integration of piezo design		
8.1.5 Choice of transducer / actuator		
8.1.5.1 Report on UMI tuner	**Design Report**	
8.2 Magneto-strictive tuner		
8.2.1 Complete specification		
8.2.2 Conceptional design		
8.2.3 Prototype and performance		
8.2.4 Finalize drive electronics		
8.2.5 Installation and test of tuner		
8.3 CEA tuner		
8.3.1 Design pieco tuning system		
8.3.2 Fabrication of prototype		
8.3.2 Installation of driver electronics		
8.3.4 CEA tuner ready for experiment		**Prototype**
8.4 IN2P3 activities		
8.4.1 Characterize actuator/piezo sensor		
8.4.2 Report on actuator/piezo sensor	**Status report**	
8.4.3 Test radiation hardness		
8.4.4 Report on radiation hardness tests	**Status Report**	
8.4.5 Integration of piezo and cold tuner		
8.4.6 Cryostat tests		
8.4.7 Ready for pulsed RF test	**Start of operation**	



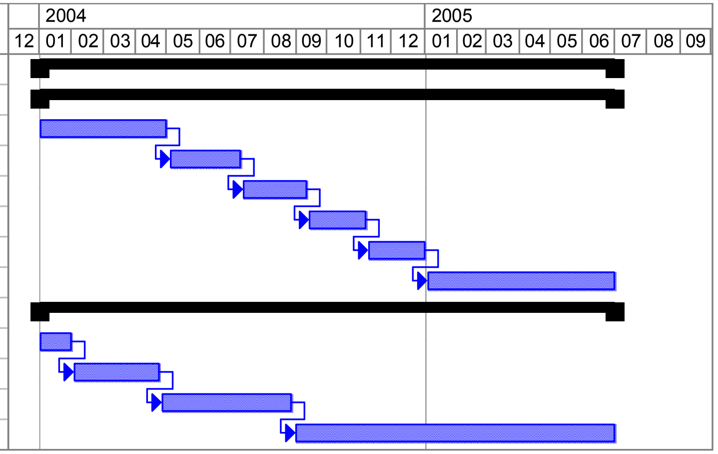
Task Name	Milestones	Deliverables
WP9 Low level RF		
9.1 Operability and technical performance		
9.1.1 Transient detector		
9.1.1.1 Define requirements		
9.1.1.2 Electronics design		
9.1.1.3 Build prototype and evaluate		
9.1.1.4 Final design of detector		
9.1.1.5 Installation and commissioning		
9.1.1.6 Test with beam		
9.1.2 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		
9.1.3 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		
9.1.4 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		



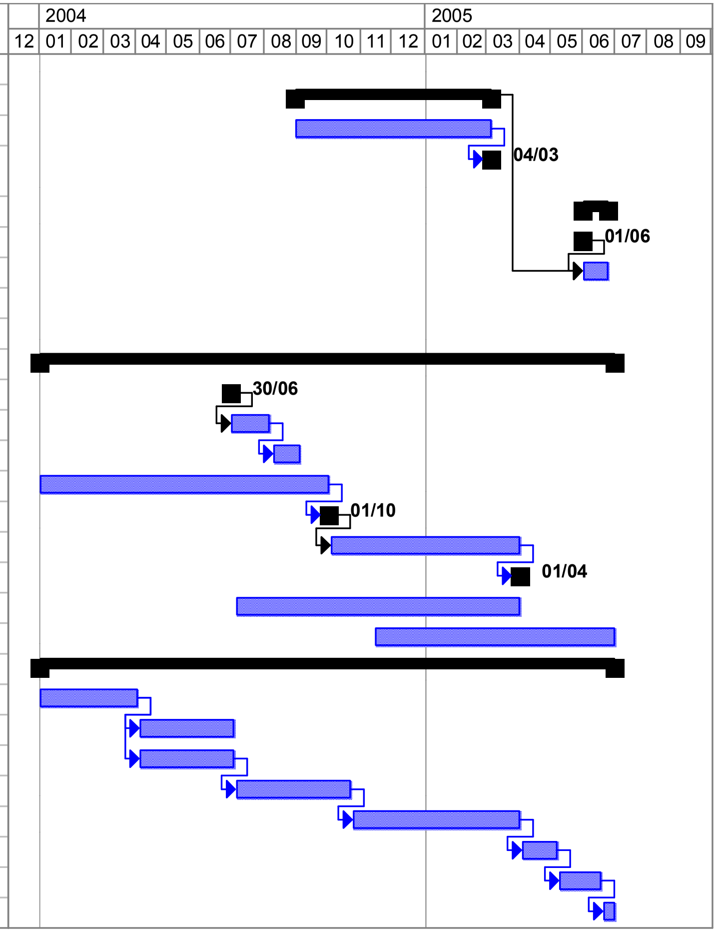
Task Name	Milestones	Deliverables
9.2 LLRF cost and reliability study		
9.2.1 Cost and reliability study		
9.2.1.1 Identify cost drivers of present LLRF		
9.2.1.2 Develop cost reduction ideas		
9.2.1.3 Build prototypes and evaluate		
9.2.1.4 Final design of LLRF system		
9.2.2 Radiation damage study		
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 assemble 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		
9.3 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 Conceptional 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		



Task Name	Milestones	Deliverables
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		
9.4.2 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		

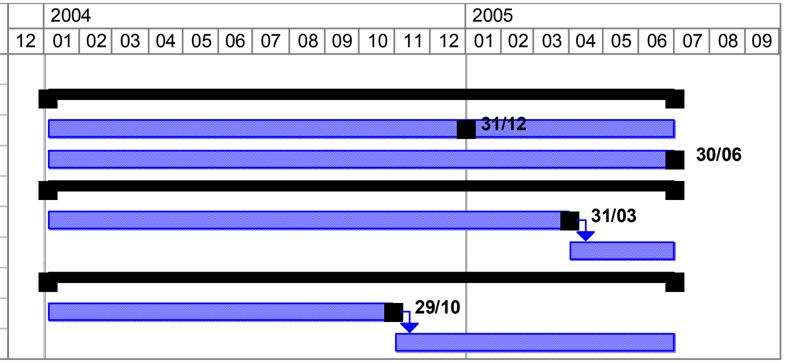


Task Name	Milestones	Deliverables
WP10 Cryostat integration tests		
10.1 Displace CRYHOLAB		
10.1.1 Move CRYHOLAB, commissioning		
10.1.1.2 Report on intended integration tests in CRYHOLAB	**Schedule of integration tests**	
10.2 Integration tests in cryostat		
10.2.1 First experiment in CRYHOLAB	**Start operation**	
10.2.1 Test 1		
WP11 Beam diagnostics		
11.1 Beam position monitors		
11.1.1 Present BPM installed in TTF	**Start of measurements**	
11.1.2 Cryogenic measurements on BPM		
11.1.3 Beam tests of BPM on TTF		
11.1.4 Design of BPM cavity		
11.1.4.1 Design of BPM cavity ready	**Design report**	
11.1.5 Fabrication of BPM cavity		
11.1.5.1 BPM cavity ready	**BPM cavity**	
11.1.6 Development of new hybrid & electronics		
11.1.7 Design of digital signal processing		
11.2 Beam emittance monitors		
11.2.1 Slit with simulations		
11.2.2 Slit design		
11.2.3 Optics simulation		
11.2.4 Optics appropriation		
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		

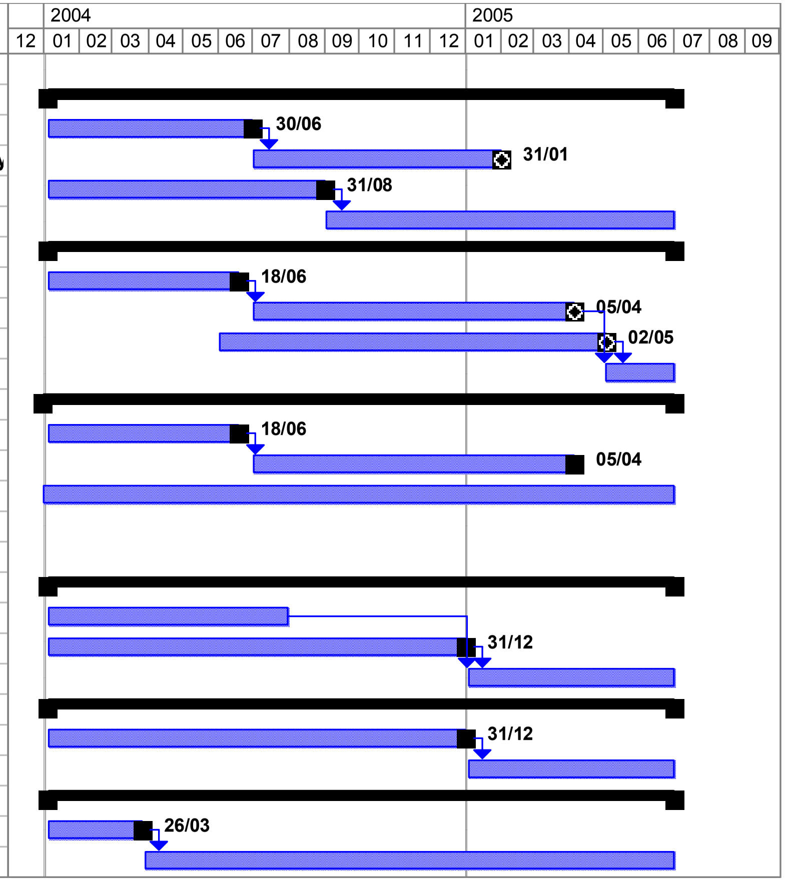


9. R2 Activity R2: Charge production with Photo-Injectors *(PHIN)*

Task Name	Milestones	Main Deliverables
WP2 Charge Production		
High efficiency photocathode for 3 GHz RF gun		
High efficiency photocathode comparison	Intermediate report	
Photocathode preparation equipment construction	Equipment ready	
Photocathode for SC cavity		
Photocathode preparation equipment upgrade	Equipment ready	
Photocathodes test		
Laser driven plasma source		
High energy plasma source design	Design report	
100 MeV laser driven plasma source R&D		

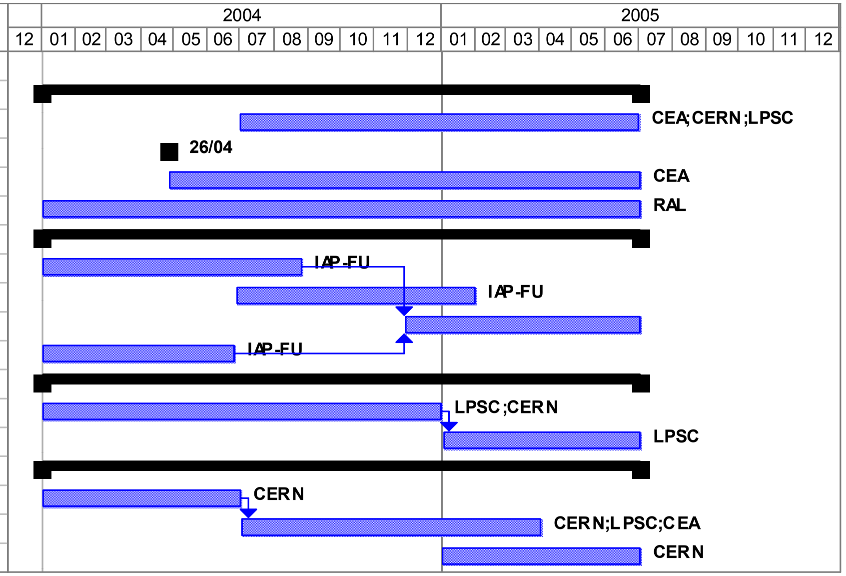


Task Name	Milestones	Main Deliverables
WP3 Laser		
Laser System		
High power oscillator design	Oscillator design report	
High power oscillator construction		**Laser oscillator ready**
Amplifier design	Amplifier design report	
Amplifier construction		
Pulse shaping system		
Simulation and design	Intermediate report	
Phase mask acquisition and test		**Final report**
Dazzler acquisition and test		**Final report**
Pulse shaping comparison		
UV generation and Feedbacks		
UV Harmonic generator R&D	Intermediate report	
UV Harmonic generator test		**UV crystals ready**
Laser-RF Feedback development		
WP4 GUN		
SC RF gun		
Technology development		
SC RF gun design	Design report	
SC RF gun realisation		
3 GHz RF gun		
3 GHz RF gun design	Design report	
Two 3 GHz RF guns construction		
Spectrometer for e- beam		
1-50 MeV Spectrometer design	Design report	
1-50 MeV Spectrometer construction		

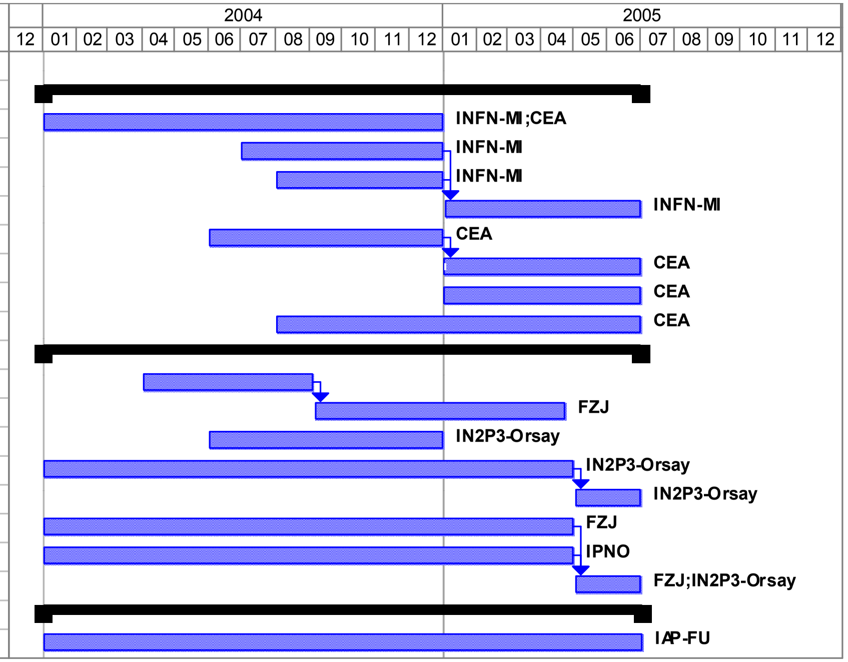


9. R3 Activity R3: High Intensity Pulsed Proton Injector *(HIPPI)*

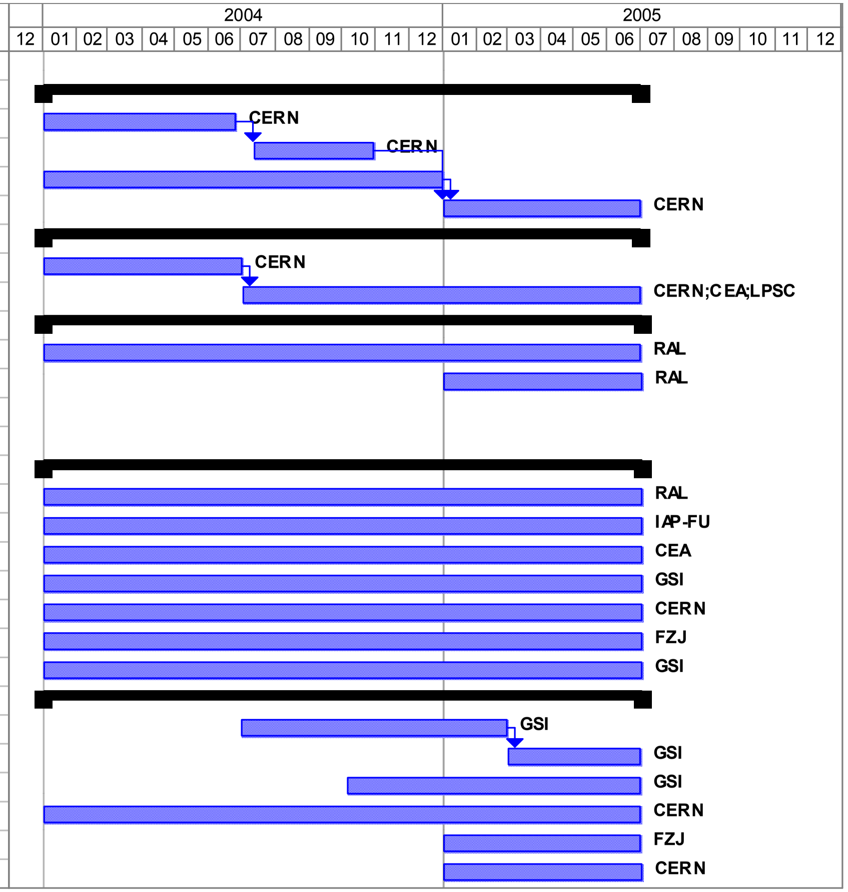
Task Name	Milestones	Main Deliverables
WP2: NORMAL CONDUCTING STRUCTURES		
Drift Tube Linac		
DTL design		
Decision on prototyping		
Prototype component development		
DTL beam dynamics design		
H-mode Drift Tube Linac		
RF model CH tank1 RF design		
RF cold model design & construction		
RF model construction		
Beam dynamics design CH tank1	Jun-05 Design report	
Side Coupled Linac		
RF model RF design		
RF model mechanical design		
Cell Coupled Drift Tube Linac		
Pre-prototype construction		
Pre-prototype high-power RF tests	Jun-05 Intermediate Report	
Prototype mechanical design		



Task Name	Milestones	Main Deliverables
WP3: SUPERCONDUCTING STRUCTURES		
ELLIPTICAL CAVITIES		
Cavity A vertical tests	Dec-04 Intermediate Report	
Mechanical design of tuner, leverage system, motor	Dec-04 Design report	
Integration of piezo design		
Tuner construction		
Design cavity B		
Construction cavity B		
Power coupler design & engineering		
RF source order & preparation		
SPOKE CAVITIES		
Test stand preparation at FZJ		
Evaluation of 700 MHz resonator in vertical cryostat	Mar-05 Evaluation report	
Evaluation of 352 MHz 2-gap res. in vertical cryostat		
Design of coupler prototype		
Test of coupler prototype		
Design of 352 MHz multi-gap resonator	May-05 Design report	
Design of coupler and tuner		
Engineering of resonator, coupler and tuner		
CH RESONATOR		
Study of tuning system	Jun-05 Conceptual report	

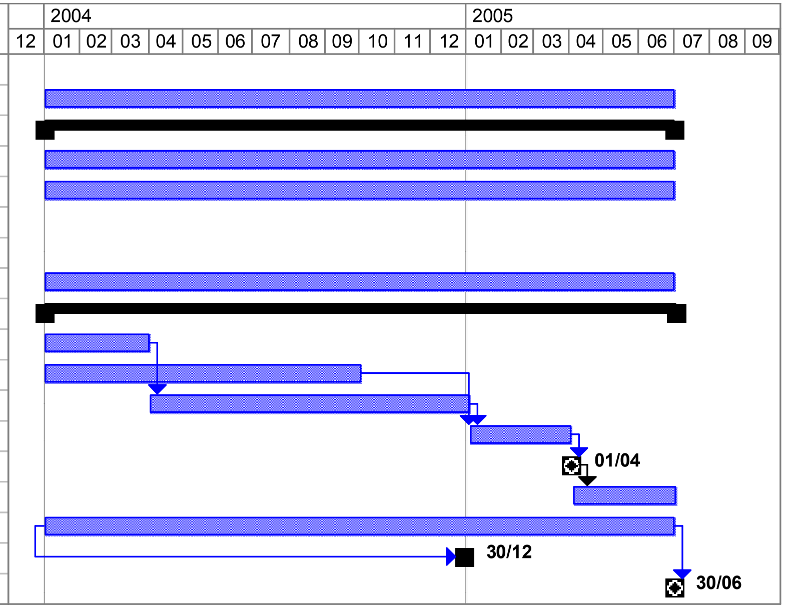


Task Name	Milestones	Main Deliverables
WP4: CHOPPING		
CHOPPER STRUCTURE A		
Pre-prototype construction	Mar-05 Intermediate report	
Pre-Prototype testing	Jun-05 Design report	
Driver construction, testing		
Full scale prototype design		
CHOPPER LINE		
Dump design	Jun-05 Intermediate Report	
Dump construction		
CHOPPER STRUCTURE B		
Pre-prototype design and test	Jun-05 Intermediate Report	
Prototype design		
WP5: BEAM DYNAMICS		
Code development		
Preparatio, 3D space charge routines dev., testing		
LORASR development		
Transport in 3D map implementation		
Improvement, modelling high current		
Code preparation for 3 MeV test stand		
Codes preparation for SC linacs		
Experiment at UNILAC preparation, simulations		
Diagnostics and collimation		
Profile measurement prototype design, construction		
Profile measurement testing		
Non-interceptive bunch measurement design		
Halo meas. device design, construction	Jun-05 Prototype ready	Jun-05 Final report
Beam profile monitor design		
Collimators design		

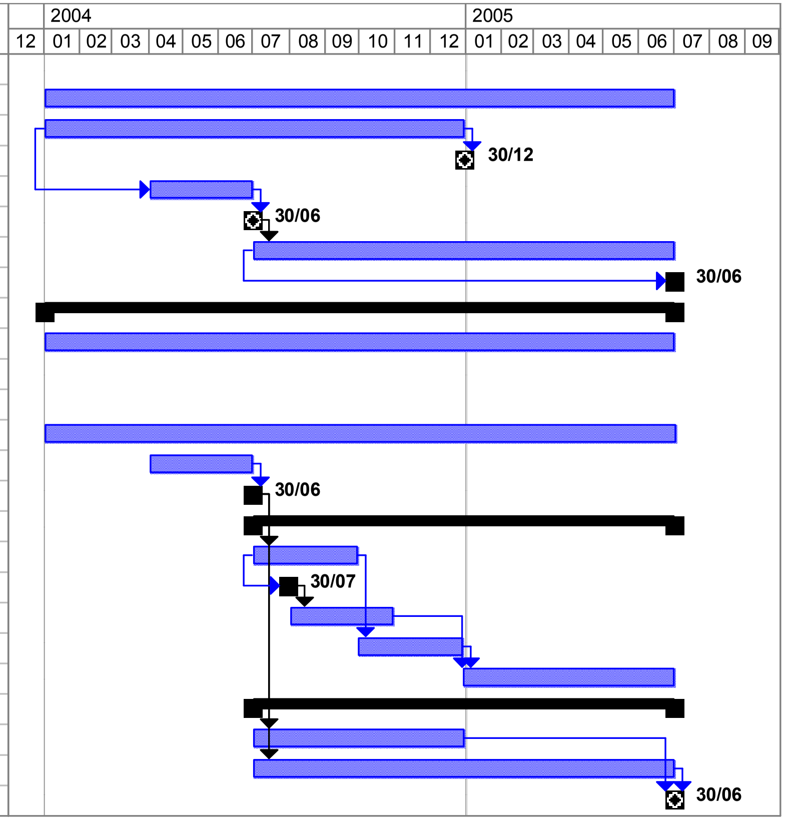


9. R4 Activity R4: Next European Dipole *(NED)*

Task name	Milestones	Main Deliverable
WP1 Management and Communication (M&C)		
Activity Coordination		
Meetings		
Steering Committee Meetings		
External Scientific Advisory Committee Meetings		
WP2 Thermal Studies and Quench Protection (TSQP)		
Work Package Coordination		
Heat Transfer Measurements		
Drafting of Test Facility Specifications		
Cryostat Design and Fabrication		
Cryogenic Module Design and Fabrication		
Facility Integration and Qualification		
Commissioning of Heat Transfer Facility		**Commissioning**
Measurements and Analyses		
Quench Protection Computation		
Interim Report on Quench Performance	Interim Report	
Final Report on Quench Protection		**Final Report**



Task name	Milestones	Main Deliverable
WP3 Conductor Development (CD)		
Work Package Coordination		
Cable Definition from Field Computations of a 15 T Dipole Magnet		
Design of a 15T Dipole Magnet Design		**Design Report**
Specifications' Drafting		
Report on Specifications for Wire and Cable		**Final Report**
Wire Development		
First Results on Wire Development	First Results	
Wire Characterization		
Definition of Measuring Procedures		
WP4 Insulation Development and Implementation (IDI)		
Work Package Coordination		
Specifications' Drafting		
Report on Specifications for Conductor Insulation	Report	
Implementation Study of Conventional Solution		
Litterature Survey		
Definition of the Test Programme	Report	
Tooling Preparation		
Compoment Supply		
Iterative Tests		
Implementation Study of Innovative Solution		
Tape Weaving Trial		
Pre-impregnation and Wrapping Bench		
Report on Innovative Insulation		**Final Report**



10 Financial information for the duration of the detailed implementation plan

Proposal Number	506395	Proposal Acronym	CARE

Financial information – "Reporting period 4 + first six months of Reporting period 5"														
		Cost model used				Costs and EC contribution per type of activities								
									Other specific activities					
Partici-pant n°	Organi-sation short name	For transnational Access	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
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										

Please use as many copies of form A3.3 as necessary for the number of participants	***Form A3.3 page***	*1*	***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)	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
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										

Note on header "Costs and EC contribution per type of activities": Erreur ! Source du renvoi introuvable.

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										

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
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										

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										

Please use as many copies of form A3.3 as necessary for the number of participants	***Form A3.3 page***	5	***of***	6

Proposal Number[1]	506395	Proposal Acronym[2]	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)***	

Please use as many copies of form A3.3 as necessary for the number of participants	***Form A3.3 page***	*6*	***of***	*6*

**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)*