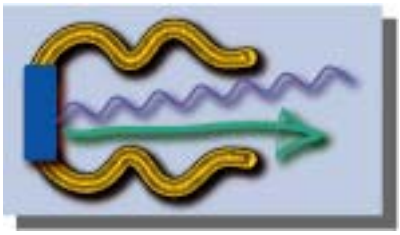
CARE/JRA2: 1st Quarterly Report 2005

PHIN: Charge production with Photo-injectors

Coordinator: A. Ghigo (INFN-LNF)

Deputy: R. Losito (CERN)



Participating Laboratories and Institutes:

Institute	Acronym	Country	Coordinator	PHIN Scientific Contact	Associated to
CCLRC Rutherford Appleton Lab. (20)	CCLRC-RAL	UK	P. Norton	G. Hirst	
CERN Geneva (17)	CERN	CH	G. Guignard	G. Suberlucq	
CNRS-IN2P3 Orsay (3)	CNRS-Orsay	F	T. Garvey	G. Bienvenu	CNRS
CNRS Lab. Optique Appl. Palaiseau (3)	CNRS-LOA	F	T. Garvey	V. Malka	CNRS
ForschungsZentrum ELBE (9)	FZR-ELBE	D	J. Teichert	J. Teichert	
INFN-Lab. Nazionali di Frascati (10)	INFN-LNF	I	S. Guiducci	A. Ghigo	INFN
INFN- Milan (10)	INFN-MI	I	C. Pagani	I. Boscolo	INFN
Twente University- Enschede (12)	TEU	NL	J.W.J. Verschuur	J.W.J. Verschuur	

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

Cost:

Total Cost	Requested Cost
3.851 M€(FC) + 2.150 M€(AC) Total = 6.001 M€	**3.542 M€**

1. Management Activities

1.1 Meetings:

CARE Steering Committee and Dissemination Board teleconference was held on January 21st.

CARE Steering Committee Meeting and Dissemination Board meeting was held on April 5th-6th at CERN.

Video conferences between RAL and CERN on common activities were held on February 3rd and April 14th.

1.1.1 List of meetings

CARE Steering Committee Teleconference 2005/1/21

CARE Dissemination Board Teleconference 2005/1/21

CARE Steering Committee Meeting meeting at CERN 2005/4/5-6

CARE Dissemination Board meeting at CERN 2005/4/5-6

RAL-CERN Videoconference 2005/2/3

RAL-CERN Videoconference 2005/4/14

Table 1.1.1a: Overview of meeting, workshop and event (co)organized by the Activity or with Actvity contributions

NA/JRA Activity	January	February	March	April
CARE steering Committee meeting	21/1/2005 Videoconference			5-6/4/2005
Meeting WP1				
Meeting WP2				
Meeting WP3		2005/2/3 RAL-CERN Videoconference		2005/4/14 RAL-CERN Videoconference
Meeting WP4				
Joint meeting /workshop with other CARE activity				
Joint meeting with other collaborations				
Conferences & workshops with activity contrib.				
CARE Dissemination Board	21/1/2005 Videoconference			5-6/4/2005

Table 1.1.1b: List of meeting, workshop and event (co)organized by the Activity

Date	Title/subject	location	Main organizer	Number of participants	Comments and Web site
21/1/05	CARE Steering Committee	Teleconference	CERN		
21/1/05	CARE Dissemination Board	Teleconference	CERN		
3/2/2005	RAL-CERN Videoconference	Videoconference			
5-6/4/05	CARE Dissemination Board	CERN	CERN		
14/4/2005	RAL-CERN Videoconference	Videoconference			

2. Dissemination Activity

2.1 List of talks

Technology challenges for SRF Guns as ERL source in view of Rossendorf work
D. Janssen (FZ Rossendorf)
The 32nd Advanced ICFA beam Dynamics Workshop on Energy Recovering Linacs
ERL 2005, Newport News, USA, March 19-23, 2005

Status of superconducting module development suitable for ERL application: The ELBE modules
J. Teichert (FZ Rossendorf)
The 32nd Advanced ICFA beam Dynamics Workshop on Energy Recovering Linacs
ERL 2005, Newport News, USA, March 19-23, 2005

A diode-pumped laser system for the photo-injector of an accelerator.
CLEO Europe
2005 CA8-6-TUE

CARE PHIN laser system.
Poster for RAL R&D open afternoon

2.1 List of talks

Table 2.1: List of talks to workshops and conferences made by NA/JRA members and which are about (or include) activities carried within your NA or JRA

#	Subject	Speaker/Lab	Event	Date
1	Technology challenges for SRF Guns as ERL source in view of Rossendorf work	D. Janssen (FZ Rossendorf)	The 32nd Advanced ICFA beam Dynamics Workshop on Energy Recovering Linacs	March 19-23, 2005
2	Status of superconducting module development suitable for ERL application: The ELBE modules	J. Teichert (FZ Rossendorf)	The 32nd Advanced ICFA beam Dynamics Workshop on Energy Recovering Linacs	March 19-23, 2005
3	A diode-pumped laser system for the photo-injector of an accelerator	CCLRC staff	CLEO Europe	
4	CARE PHIN laser system.	CCLRC staff	RAL R&D open afternoon	

2.2 Web sites

Since January 2005 the Dynamic database on Photocathodes is available. This web library on photocathodes shows the information on photocathodes used in the CARE project and introduces the basic knowledge on other photocathodes.
The web page is available at the URL

http://www.fz-rossendorf.de/projects/CARE

or via the link in the PHIN web page.

The PHIN web page, available at the URL

http://www.infn.it/phin/

has been renewed. The page provides information about the JRA, links to the participating institutes and to related web pages and activities.
A complete collection of the PHIN related documentation is also available with full bibliographic reference, including Quarterly and Annual Reports, presentations given at PHIN meetings and publications. All the documentation is accessible and continuously updated.
Every Work Package has a dedicated section which includes reports on their activities and other specific documents.

3. Status of the Work

3.1 WP 2, Charge production

FZR:

The final tests of the components of the new equipment for photocathode preparation were performed. The Tellurium and Cesium deposition processes were tested. Deposited samples were investigated by Rutherford backscattering (RBS) and compared with in-situ measurements using the thickness monitors. The electronic equipment was installed and the main part of software for the computer control of the deposition process was developed. The first tests for preparation of CsTe photocathodes are being performed.

TEU:

Preparations are being made for setup of diagnostic methods to characterizing photo cathodes. A flexible elipsometry setup is designed and parts are ordered. Research on Magnesium cathodes for applications in photo injector for Laser Wake Field Accelerators is started. A temporary preparation chamber is being modified to handle the preparation of these photo cathodes. Diagnostics for monitoring cathodes during the preparation process are under evaluation.

CERN:

After having rejuvenated the photocathode preparation chamber, the next step was to upgrade the system for the co-evaporation process. A completely new control system based on VME and Linux-Java console has been implemented. The main objective is to be able to follow in real time the stoichiometric ratio and to maintain it constant. Here the challenge is to produce a homogeneous alloy on the cathode and at the same time to measure as close as possible, separately, the two components. For this purpose new evaporators with masks are under development.
To study the different contaminants reducing the photocathode lifetime an accurate controlled leak was installed and a new tool based on a mass spectrometer is under development to follow, in real time, the partial pressure of the most important poisoning species like O2, H2O, CO, CO2 etc.

3.2 WP 3, Laser

CCLRC-RAL:

After the major design of the system was completed in 2004, the first quarter of this year has been spent purchasing the main components for the amplifiers.
Oscillator and preamplifiers: a visit was made to the supplier, HighQLasers, at the beginning of March to check progress on the oscillator and preamplifier assembly. The acceptance test measurements and control issues were discussed. The system will be delivered to CERN at the beginning of May, and then to RAL to perform a full optical timing synchronisation measurement.
Amplifiers: the decision was made to buy the 18kW total peak power QCW diodes from DiLas Diodenlaser GmbH. They will be delivered at the end of June. The price enquiry for the

second amplifier's diodes will close on June 6th. The price enquiry for the diode drivers has been sent out to suppliers, also with a closing date of June 6th. The laser head mechanical design has been completed after the decision about the diodes, and it is being manufactured with a delivery date in mid June. Cooling equipment for the diodes and the laser head will be delivered at the end of June. With the long leadtime Nd:YLF rod, the assembly of the first amplifier head is expected to start at the beginning of August.
Nd:YLF: 50 Hz operation of the laser system means increased average power and, therefore, increased thermal load on the Nd:YLF rods. This material is known to be thermally fragile but a definitive value for the fracture limit is not available in the literature. A memorandum of understanding has been signed between CCLRC RAL and MPQ concerning fracture limit measurements. MPQ will measure the fracture limit of Nd:YLF rods with different surface treatments and from different manufacturers, also investigating different cooling agents and cooling chamber designs.
Timing structure and coding: work has begun on specifying the hardware needed for the time-structuring and coding systems. The former will cut 1.54 microsecond macropulses from the amplifiers' output. The latter will introduce a 333 ps delay to the micropulses, switched on and off every 140 nanoseconds. The requirement for fast risetime and high repetition rate make the coding system design very challenging. Alternatives to ultrafast Pockels cells, including fibre-optic modulation at low power, are being investigated.

INFN-LNF:

The production of few ps, UV square laser pulse at wavelength of 266 nm has been carried out at Development Laboratory of the Brookhaven National Laboratory. The beam shape has been controlled by an acousto optic programmable filter placed between a Ti:SA laser oscillator and the amplifiers. In a previous report we presented the experimental results on the production of tens mJ, 10 ps flat top pulse at 800 nm. The temporal and spectral distortions introduced by the third harmonic generator (THG) on flat top input has been extensively characterized. For the UV temporal measurement we used two complementary optical-based techniques: a single shot, ps resolution streak camera and multishot, 150 fs resolution cross correlator. In this diagnostic the 100 fs, 800 nm pulse from the oscillator was mixed with the UV pulse to produce the difference frequency at 400 nm. The shorter pulses were delayed and acted as a gate for the reconstruction of the UV intensity. We found a strong correlation between the spectrum and the time profile indicating the pulse was linear chirped.
We optimized the THG design and the filter transfer function to minimize the non linear effects in the harmonic crystals. The measured UV profile is close to the predicted optimum pulse shape: the duration is 8 ps fhwm, the rise and fall time are about 1 ps and ripples on the plateau are limited to 25%. The pulse length can be controlled changing the compressor length inside the amplifier from 5 to 20 ps. The efficiency of the THG was few percent, enough to obtain the nominal charge for the SDL photoinjector and further studies on the electron beam.

3.3 WP 4, RF gun and Beam Dynamics

FZR:

For the SRF-Gun the superconducting niobium cavities were delivered. The test bench for the warm tuning of the cavities was designed and fabricated. The bead-pull measurement system for field profile measurement is ready and tested. The experimental work on the cathode cooling system has been continued. At present, the results are unsatisfying and improvements in the cooler and cathode design are necessary. This work is being continued.
The fabrication of main parts of the cryomodule could be finished: the stainless steel vacuum vessel, the aluminum cryogenic shield and the mu-metal magnetic shield have been delivered. The magnetic properties of the mu-metal shield were measured. The tender for the helium transfer line was placed.

LAL:

After the choice of the supplier, a first piece for testing the iris profile has been worked out. If the dimension profiles are good (within the 10 µm of our tolerance), the number of facets which describe the ellipse is too low (4 facets). We have asked a new test piece machined with an upgraded program. With this, the number of facets has been increased significantly and now the profile fulfills our specifications. A test of roughness will be carried out in week 20 with the right copper and diamante tools. We are hopeful to order the machining of the RF gun prototype by the end of May.
During this period, some elements for cold RF measurements have been machined in our mechanical workshop.
As for the brazing of the definitive RF guns, two drawings have been prepared: in the first the cells are embedded in each other while in the second, in CERN style, the cell faces are planes.
The external vacuum chamber and pumping systems have been revised after discussion with CERN specialists and now the design is frozen and the drawings are finished.

NEPAL
The implantation of the injector in the NEPAL room with this shielding is fixed. The last incertitude is related to the date of the take out of asbestoses of the adjacent room (used for the transport of heavier elements). The final design of the beam analysis line is in progress according to the implantation scheme.
After the call for tenders we have six replies for the NEPAL laser, and the normal administrative procedure is in progress. In parallel the first propositions for the furniture of the focalization coil and the bucking coil have arrived.

Acknowledgements:
We acknowledge the support of the European Community-Research Infrastructure Activity under the FP6 “Structuring the European Research Area” programme (CARE, contract number RII3-CT-2003-506395).