CERN-ACC-2013-0280

# EuCARD-2

Enhanced European Coordination for Accelerator Research & Development

# Newsletter

# Accelerating News Issue 6

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Issue 6: Summer 2013

NEWS



## From the editors

*by Mathilde Chaudron (CERN), Agnes Szeberenyi (CERN), Celine Tanguy (CEA)*

**In this summer issue we are approaching the end of EuCARD and have welcomed the beginning of EuCARD-2. We are pleased to report on the recent fruitful events including the workshop on "Visions for the future of particle accelerators" and the TIARA workshop on RF power generation.**

We find out about the improvements for FAIR and SPIRAL2 within the CRISP project, the successful 11 Tesla project and the lastest achievements within EuCARD. The approval of the update of the European Strategy for Particle Physics by the CERN council is also highlighted.

In the headlines, we have found stories about cherry pie colliders, ILC technical report published lately and further developments towards industrial and medical applications of accelerators. Amongst the events, we also highlight the upcoming ICAN Symposium.


**Order an EuCARD booklet**: 18 topics on Accelerator Science and Technology have been addressed in total. Click here to see all the topics and request a copy (free of charge). Image credit: EuCARD.

**Your feedback is important for us.** Please take 2 minutes to fill the short questionnaire on Accelerating News available here.

We hope you enjoy this issue. Please contact us with any news or events that you would like added to future issues.

***Read more >>***

*Keywords: editors; introduction*

## From EuCARD to EuCARD-2

*by Mathilde Chaudron (CERN)*

**The EuCARD'13 annual meeting took place on 10-14 June at CERN. The event, which brought together more than 180 accelerator specialists from all over the world, drew the conclusions from the EuCARD project and kicked-off its continuation, EuCARD-2.**

EuCARD-2 kick-off meeting in the Council Chamber at CERN. Image credit: CERN.

EuCARD-2 officially started on 1st May 2013 and will run for four years. With a total budget of 23,4M€, including 8M€ of EU contribution, it will build upon the success of EuCARD and will push it into an even more innovative regime. EuCARD-2 brings a global view to particle accelerator research in order to address challenges for future generation of accelerators. By promoting complementary expertise, cross-disciplinary fertilisation and a wider sharing of knowledge and technologies throughout academia and with industry, EuCARD-2 aims at significantly enhancing multidisciplinary R&D for European accelerators, actively contributing to the development of a European Research Area in accelerator science.

***Read more >>***

*Keywords: EuCARD, EuCARD²*

## Collimator upgrades toward HL-LHC

*by Mathilde Chaudron (CERN) with Stefano Redaelli (CERN)*

## EVENTS

**27-28 June 2013**
ICAN Symposium - International Coherent Amplification Network
*CERN, Switzerland*

**25-26 July 2013**
5th TLEP Workshop - TLEP Physics and Technology
*Fermilab, US*

**6-16 August 2013**
INSS 2013 - International Neutrino Summer School
*Beijing, China*

**19-24 August 2013**
Nufact 2013 - 15th International Workshop on Neutrino Factories, Super Beams and Beta Beams
*Beijing, China*

**25-30 August 2013**
FEL 2013 - 35th International Free-Electron Laser Conference
*New York, US*

**9-13 September 2013**
ERL 2013 - 53th ICFA Advanced Beam Dynamics Workshop on Energy Recovery Linacs
*Novosibirsk, Russia*

**16-19 September 2013**
IBIC 2013 - 2nd International Beam Instrumentation Conference
*Oxford, UK*

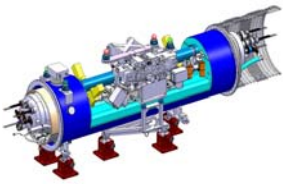
**16-20 September 2013**
Cyclotrons'13 - 20th International Conference on Cyclotrons and their Applications
*Vancouver, Canada*

**18-20 September 2013**
Pontecorvo 100 - Symposium in honour of Bruno Pontecorvo for the centennial of the birth
*Pisa, Italy*

**22-27 September 2013**
SRF2013 - 16th International Conference on RF Superconductivity
*Paris, France*

**29 September- 4**

**In the frame of the LHC upgrades towards the High Luminosity LHC (HL-LHC), the improvement of the LHC collimation system is a critical aspect. The Achromatic Telescopic Squeezing (ATS) optics, foreseen to be used in the HL-LHC, introduces major changes to the optics in the experimental Interaction Regions (IR).**



3D drawing of the by-pass cryostat/collimator assembly designed to install a warm collimator in the cold dispersion suppressor between two 11 T dipoles that would replace a standard dipole. Image credit: A. Bertarelli (CERN).

The development carried out within the HiLumi LHC Work Package 5 aims at verifying that the cleaning of beam halo (the safe and controlled removal of the unavoidable beam losses by collimators during standard operation) and losses in the high-luminosity experimental regions remain appropriate for all the HL-LHC challenges, including higher beam stored energies and optics layout changes. Proposed collimation upgrades in Long Shutdown 1 (LS1) and LS2 are designed to be compatible already with the ultimate HL-LHC requirements.

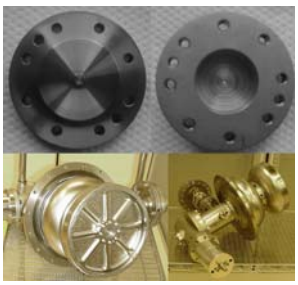
Large losses are created by the collisions inside the LHC experiments. These so-called “physics debris” losses have to be studied separately from beam halo matters in order to make sure that the local protection of the cold magnets downstream of the experiments is appropriate, i.e. that they can operate below the quench limit and that radiation damage remains under control. The studies performed so far indicated that the proton beam operation in IR1 and IR5 until LS3 could be compatible with the expected LHC parameters with an upgrade layout proposed for implementation in LS1. On the other hand, collision losses during ion beam operation will induce losses well above the quench limit of superconducting magnets in the dispersion suppressor. This calls for an action that might be already taking place in LS2, with priority given to IR2 where the ALICE detector is installed.

***Read more >>***
*Keywords: HL-LHC, Collimation, ATS, beam halo*

## Thin films for Superconducting RF

*by Sergio Calatroni (CERN)*

**The activity led by CERN in close collaboration with several other laboratories (CI-Lancaster, CEA, CNRS-IPNO, DESY, SINS) within the EuCARD Work Package 10.4 aims to address diverse topics in the thin film technology applied to SRF.**



Pb-coated photocatode plug, and global view of the 1.5-cell 1.3 GHz cavity used for testing. Image credit: CERN

The analysis of the relative merits of several state of the art thin film coating technologies and the establishment of a network of SRF thin film test facilities were the first goal of this activity. The second goal was the establishment of state of the art Nb/Cu deposition on QWR cavities by sputtering techniques, including also the novel HIPIMS technique which has been demonstrated first on elliptical cavities. The third goal was the successful demonstration of the compatibility of arc-coated Pb photocathodes with the stringent requirements needed for achieving high surface fields, when used in conjunction with state of the art Nb superconducting cavities.

The several positive results obtained in this task have led to the establishment of two new tasks in EuCARD-2, which are devoted to the further development of innovative thin films (multilayers, HIPIMS, new materials) and of photocathode manufacturing processes.

***Read more >> [1] [2]***
*Keywords: EuCARD, SRF, thin film*

## Phase Control at CLIC

*by Fabio Marcellini (INFN)*

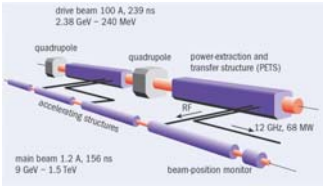
**October 2013**
NA-PAC'13 - Particle Accelerator Conference
*Pasadena, CA, US*

**6-11 October 2013**
ICALEPCS 2013 - 14th International Conference on Accelerator and Large Experimental Physics Control Systems
*San Francisco, US*

**25-27 November 2013**
TIARA final general meeting
*Daresbury, UK*

**10-14 February 2014**
ICTR-PHE 2014
*Geneva, Switzerland*

**Extremely precise beam phase control is required for CLIC two-beam acceleration technology as well as in Free Electron Lasers (FELs). The development of beam arrival time measurement systems has been carried out within Task 5 of the EuCARD Work Package 9, in collaboration with CERN, INFN/LNF and PSI.**




In a two-beam system, the RF power is provided by the drive beam to the main beam accelerating structure. Drive Beam timing errors must be avoided to maximize the acceleration gradient uniformity in the accelerating structures, and consequently to stabilize the Main Beam energy and optimize the collider luminosity. Image credit: CERN.

In CLIC the Main Beam must be precisely synchronized with respect to the RF power produced by the Drive Beam. Timing errors would have an impact on the collider performance. The Drive Beam phase errors should be controlled, by means of a feed forward system, within 0.1° at 12 GHz, corresponding to a timing stability below 23 fs, to avoid a luminosity reduction larger than 2%. A prototype of such a system is being installed in the CLIC Test Facility CTF3 and the performances of the beam phase arrival monitor have been already successfully tested.

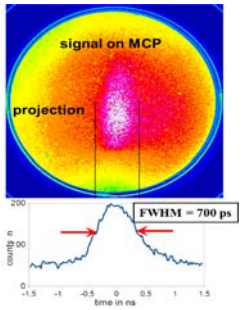
FELs also require a tight synchronization of the beam with respect to photo injector lasers, RF and other systems. The beam phase measurement has been pursued at PSI with a different approach based on electro optical modulators. It has the advantage of very high band width, allowing the measurement of individual bunches arrival time with a potential resolution below 10 fs. The system was tested and the performance with beam validated at the PSI FEL test injector.

***Read more >> [1] [2] [3]***
*Keywords: EuCARD, CLIC, beam phase control*

## Improved ion sources and beam diagnostics for FAIR and SPIRAL2

*by Peter Forck (GSI) and Christophe Peaucelle (IN2P3) with Agnes Szeberenyi (CERN)*

**Under the CRISP project framework, WP3 aims at developing improved ion sources and beam diagnostics for SPIRAL2 at GANIL and FAIR Proton LINAC at GSI. Modern high power proton and ion LINACs aim for an effective acceleration and low RF-power consumption. This is realized by a high electric field gradient and non-standard beam dynamics settings.**




An image of the bunch shape as recorded at the GSI LINAC with a beam of U28+ ions at 11.4 MeV/u. The plot shows the 70 mm MCP original image created by residual gas electrons on top and the projection to the horizontal axis results in the bunch shape below. Image credit: GSI.

SPIRAL2 is based on the detection of X-rays as emitted from a thin tungsten wire inserted in the beam path. These X-rays are detected by a fast Multi-Channel Plate mounted outside of the beam path. Conclusive tests at Institute de Physique Nucleaire in Orsay and GANIL lead to the realization of a compact device. The FAIR Proton LINAC's monitor is based on the detection of secondary electrons as liberated from the residual gas molecules by beam impact. By the electric field within an RF-deflector the electrons are bent to transform the time information to a difference in space.

FAIR and SPIRAL2 facilities need both a high performance electron cyclotron resonance ion source (ECRIS) to create the high intensity beams. PHOENIX V2, a 18 GHz room temperature ECRIS developed by LPSC Grenoble will be the starting heavy ion source on SPIRAL 2. An evolution to PHOENIX V3 is being studied in order to increase the beam intensity by a factor of 2. The first beam with PHOENIX V3 is scheduled for November 2013.

Low-energy beam transport line of SPIRAL-2 with PHOENIX V2 ion source during commissioning. Image credit: LPSC/IN2P3.

***Read more >>***
*Keywords: CRISP, FAIR, SPIRAL2, ECRIS, PHOENIX*

## IN THE HEADLINES

## Mechanical stabilisation of CLIC quadrupoles to the sub nanometre

*by Kurt Artoos (CERN)*

**From *LC Newsline***
June 2013
Next-generation particle accelerator is ready for

construction

**From *Nature News Blog***
June 2013
Canadian accelerator produces a city's worth of medical isotopes overnight

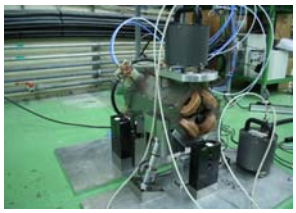
**From *Symmetry***
May 2013
The cherry pie collider

**From *CERN bulletin***
May 2013
The success of the 11-Tesla project and its potential beyond particle physics

**From *Medicalphysicsweb***
April 2013
The potential of proton CT

**From *Interactions.org***
April 2013
New UK particle accelerator heralds exciting opportunities for industry

**In order to reach the luminosity of $2.10^{34}$ $cm^{-2}m^{-1}$ in CLIC, the cross section of the colliding particle beams at the interaction point will be in the order of the nanometre. Quadrupole magnets are used as focusing elements to keep the beam size small along the full accelerator length and to focus the beams to the collision point**



A CLIC Main Beam Quad prototype on two stabilisation actuators.
Image credit: CERN

Mechanical vibrations transmitted to the quadrupoles will however create small dynamic displacements of the magnets, resulting in a gradual increase of the beam size along the accelerator and jitter of the beam at the interaction point.

Vibration stabilisation systems were developed and successfully tested both at CERN and at LAPP Annecy under EuCARD WP9 framework. The level of vibrations of the quadrupoles is decreased by the systems to values smaller than a nanometre. The calculated gain in luminosity obtained by this vibration reduction is significant. The magnets are placed on vibration isolating supports based on piezo-electrical actuators that will reduce the vibrations measured by seismometers placed on the ground and on the magnet. The same actuating support makes it also possible to make very precise adjustments to the magnet. A precision of a quarter of a nanometre was already demonstrated on a prototype.

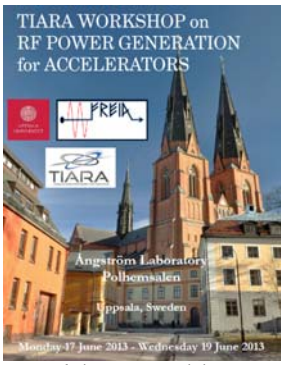
During 2013, new full scale prototypes will be constructed in order to move from a laboratory set-up to an accelerator component, integrated with other technical systems. Improved vibrations sensors are being developed.

***Read more >>***
*Keywords: EuCARD, CLIC, magnets*

## Uppsala University and TIARA highlighting RF power generation for accelerators

*by Tord Ekelöf and Celine Tanguy (CEA)*

**The 2nd industry workshop sponsored by TIARA took place on 17-19 June at the Ångström Laboratory in Uppsala University. The event, dedicated to novel concepts for RF power generation for accelerators, was also the occasion to inaugurate the hall of FREIA (Facility for Research Instrumentation and Accelerator Development) Laboratory.**




Poster of the TIARA workshop on RF power generation for accelerators. Image credit: Uppsala University.

For the 3-days workshop, about 90 experienced researchers and leading companies in the field of RF power generation and related technologies gathered to explore the technical challenges emerging from the design of new accelerators and to match them with state-of-the-art industrial solutions for RF power generation.

An overview of the main types of accelerator projects and their different RF power generation schemes was first presented, followed by sessions focussed on electron tube devices, solid-state amplifiers and phase-stability and timing.

Inauguration of the FREIA hall in Ångström Laboratory with Eva Åkesson, vice chancellor of Uppsala University, Tord Ekelöf, director of FREIA department, Mats Lindroos, head of the ESS Accelerator Division, and Roy Aleksan, TIARA-PP coordinator. Image credit: Uppsala University.

On 18 June the conference participants attended the inauguration of the new FREIA laboratory in Uppsala, intended for research and development of RF power generation, distribution and control for superconducting and normal conducting accelerating cavities for future accelerators. It is the key infrastructure required for developing the superconducting accelerating technology needed for future very high intensity proton accelerators, new free electron lasers and other emerging accelerator projects

***Read more >>***
*Keywords: TIARA, industry, RF power generation*

## Visions for the future of particle accelerators

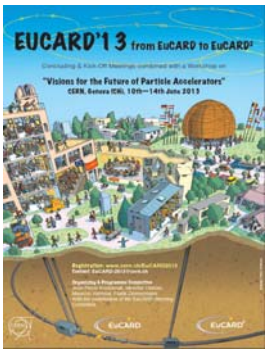
*by Agnes Szeberenyi (CERN)*

**The recently held EuCARD'13 event at CERN was combined with a workshop on the "Visions for the Future of Particle Accelerators", which targeted to discuss the challenges for the next 50 years of research and development in accelerator physics.**

The ambitions of accelerator-based sciences and applications far exceed the present accelerator possibilities. The natural time constant of accelerator technologies or projects is in the 20 to 30 years. Hence prospective studies require a vision over a 50 year period, to become liberated from today's project considerations.

This 2-day workshop aimed at identifying the ultimate limits of concepts and technologies presently used or contemplated and at investigating possible future avenues requiring generic accelerator R&D. Two round tables on the role of EC projects and on the role of industry complemented the scientific perspectives.

Jean-Pierre Koutchouk, Maurizio Vretenar and Frank Zimmermann as the workshop organizers will report on the outcomes of the event in the next, Autumn Issue.




Poster of **EuCARD'13** event at CERN was combined with a workshop on the "Visions for the Future of Particle Accelerators". Image credits: EuCARD

***Read more >>***

*Keywords: EuCARD, particle physics*

## The update of EU Strategy for particle physics adopted by CERN Council

*by Celine Tanguy (CEA)*

**Six years after its first definition in 2006, the European strategy for particle physics was updated so as to take into account the progress made so far and the evolution of the global particle physics landscape**.

The Strategy Statement paper, produced by the European Strategy Group (ESG) assisted by an ad-hoc Preparatory Group, was approved on 30 May 2013 by the CERN Council in a special meeting hosted by the European Commission in Brussels. This document is completed by the Deliberation Paper describing the rationale behind the Strategy Statements and some suggestions on organisational matters.

European Strategy Update

On the occasion of the update of the European strategy for Particle Physics, a brochure demonstrating the social benefits of European research in particle physics was released. Image credit: CERN.

***Read more >>***

*Keywords: CERN Council, strategy for particle physics*

## LINKS

APS newsletter
ICFA newsletter
LC Newsline

This accelerator newsletter is sponsored by the following projects co-funded by the European Commission within the Framework Programme 7 Capacities Specific Programme: EuCARD, EuCARD-2, TIARA and HiLumi LHC.