

# EuCARD-2

Enhanced European Coordination for Accelerator Research & Development

## Newsletter

# Accelerating News Issue 10

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<<http://cds.cern.ch/search?p=CERN-ACC-NOTE-2014-0067>>

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## EVENTS

**15-20 June 2014**  
**IPAC'14** - International Particle Accelerator Conference  
Dresden, Germany

**2-9 July 2014**  
**ICHEP'14** - 37<sup>th</sup> International

## Acc From the editors

By Agnes Szeberenyi (CERN), Céline Tanguy (CEA) and Thomas Hind (CERN)

In this summer issue, we look at recent events within EuCARD-2 including the workshop on accelerators for ADS and the first annual meeting which was followed by a workshop on accelerator magnets in High Temperature Superconductors. We also say goodbye in this issue to our long term editor, Celine and wish her all the best for her future endeavors.

Good news about the development of MgB2 superconductors and ERC grants for supporting alternative accelerators technologies are highlighted as well as the development of a Fast Ramped Superconducting magnet within CRISP. We also update you on TIARA-PP extension and the call for application to the ICTF at Rutherford Appleton Laboratory. Of interest for the High Luminosity LHC, we also report on materials for next generation collimators and concept of a crab cavity RF system.

In the headlines, you will learn about the US Particle Physics Project Prioritization Panel's report and novel methods for eye proton therapy, among other interesting stories.

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

## EuC<sup>2</sup> EuCARD-2 Highlights from Hamburg

by Thomas Hind (CERN)

Over 140 accelerator specialists from all over the world came together recently at the DESY laboratory in Hamburg for the 1<sup>st</sup> annual meeting for EuCARD-2 and the 1<sup>st</sup> Workshop on Accelerator Magnets in High Temperature Superconductors (HTS), which took place on 19-23 May.

The meeting saw presentations from speakers from each work package, including reports from the networks, which organised over 15 workshops on the topics of catalysing innovation, energy efficiency, accelerator applications, extreme beams, low emittance rings and novel accelerators. There were also updates from the technical work packages, including reports that a Surface Analysis/Preparation Installation (SAPI) has been constructed and commissioned for carrying out research on metal photocathode materials, on completed irradiation tests on ions and protons at GSI and RCC-KI and on the demonstration and characterisation of spatial and temporal synchronisation of laser and electron beams.

The 1st Workshop on Accelerator Magnets in HTS was an invite-only event organised as part of WP10 and included researchers from elsewhere in the world. It was the first in a series of planned workshops dedicated to High Temperature Superconductors, focusing on the construction and design of an HTS-dipole capable of boosting the field of an accelerator dipole from 15T to about 20T.

[Read more >>](#)

Keywords: EuCARD-2, Annual Meeting, Highlights

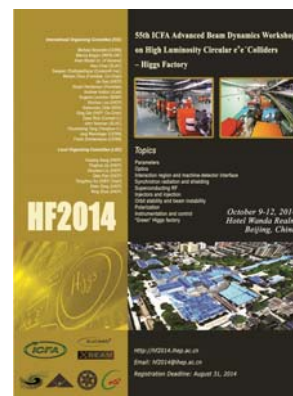


Fig1. The 55th ICFA Advanced Beam Dynamics Workshop on High Luminosity Circular e+e- Colliders - Higgs Factory kicks off in Beijing from 9-12 October. Image Credit: HF2014



Fig 1. Group photos from the recent meeting in Hamburg. Image Credit: EuCARD-2

Conference on High Energy Physics  
Valencia, Spain

13-15 August 2014

SAP'14 - 12<sup>th</sup> Symposium on Accelerator Physics  
Lanzhou University, China

24-28 August 2014

ECRIS'14 - 21<sup>st</sup> International Workshop on ECR ion sources  
Nizhny Novgorod, Russia

25-29 August 2014

FEL'14 - Free Electron Laser Conference  
Basel, Switzerland

31 Aug.-12 Sept. 2014

CAS - Introduction to Accelerator Physics  
Prague, Czech Republic

1-5 September 2014

LINAC'14 - 27<sup>th</sup> Linear Accelerator Conference  
Geneva, Switzerland

15-19 September 2014

IBIC'14 - 3<sup>rd</sup> International Beam Instrumentation Conference  
Monterey, US

6-9 October 2014

GANIL-SPIRAL2 Week 2014  
6<sup>th</sup> edition  
Caen, France

6-9 October 2014

RuPAC-2014 - XXIV Russian Particle Accelerators Conference  
Obninsk, Russia

9-12 October 2014

HF2014 - 55TH ICFA Advanced Beam Dynamics Workshop on Higgs Factory  
Beijing, China

13-17 October 2014

PCaPAC'14 - 10th International Workshop on Personal Computers and Particle Accelerator Controls  
Karlsruhe, Germany

13-17 October 2014

FAIR 2014 - Conference on Science and Technology for FAIR 2014  
Worms, Germany

10-14 Nov. 2014

HB2014 - 54<sup>th</sup> ICFA Advanced Beam Dynamics Workshop on High-Intensity and High-Brightness Hadron Beams  
East Lansing, United States

5-14 Nov. 2014



## World-record current in the MgB<sub>2</sub> superconductor

by Thomas Hind (CERN) and Amalia Ballarino (CERN)

Members of the CERN Superconductors team have achieved a world-record current in a Magnesium Diboride (MgB<sub>2</sub>) superconductor.

A current of 20kA was transferred at 24K in an MgB<sub>2</sub> electrical transfer line developed at CERN. The line consists of two cables, each 20m long, made from MgB<sub>2</sub> round wires and connected in series, with the cooling provided by a forced flow of helium gas. After operation at nominal current, a series of quench tests at 20 kA and a complete thermal cycle from room temperature to nominal operation temperature were successfully performed.

MgB<sub>2</sub>'s superconducting properties were discovered in 2001, but conductor technology only existed in the form of tape at the time. Round wire was not available when the project started, but had to be developed. The cables and associated technologies were designed and tested at CERN, with the superconducting wire the result of a joint R&D effort between CERN and Columbus Superconductors in Genova, Italy.

The project is part of the FP7 Hi-Lumi LHC Design Study, which aims to move the power converters supplying current to the superconducting magnets either to the surface or to radiation free underground areas and to use high temperature superconducting transmission lines to connect them.

These cables have further uses outside of particle physics, and their use has been proposed for innovative transmission lines used for long-distance transport of green power. The test results show that the MgB<sub>2</sub> cables can be operated at and above the temperature of liquid hydrogen and that the basic related technology is now proven.

[Read more >>](#)

Keywords: HiLumi LHC, World Record, Current, Superconducting, MgB<sub>2</sub>



Fig 1. The 20-metre long electrical transmission line containing the two 20 kA MgB<sub>2</sub> cables.

Image credit: CERN



Fig 2. Members of the CERN Superconductors and Superconducting Devices team in front of the test station. Image Credit: CERN



## News about Tiara

by Céline Tanguy (CEA)

The TIARA preparatory phase has been extended for one year, until December 31<sup>st</sup> 2014. The reason for this extension is to pursue the work toward the implementation of a cluster of accelerator R&D infrastructures and related accelerator R&D centres named "Test Infrastructure and Accelerator Research Area (TIARA)".

The main purpose of TIARA is to play a coordinating role, to exchange expertise and information concerning the "Accelerator Research Area", and to facilitate collaborative R&D programmes in the field of Accelerator Science and Technology in Europe. The means and structures required to bring about these objectives have been developed through the TIARA Preparatory Phase (TIARA-PP).

The TIARA-PP project has started on January 1<sup>st</sup> 2011 and includes 11 participant institutes from 8 countries. Co-funded by the European Union 7th Framework Programme, it is divided into 9 Work Packages (WPs). The first 5 WPs are dedicated to organizational issues, while the other 4 WPs deal with technical aspects. Numerous achievements (most of them already highlighted in *Accelerating News*), can be found via the [TIARA-PP website](#).

[Read more >>](#)

Keywords: TIARA, preparatory phase, implementation



Fig 1. Initiated within TIARA-PP, the Accelerators for Society website and tri fold-brochure invite you to discover how accelerators benefit Society. Image Credit: Accelerators for Society



## Novel Materials for Multi TeV Beam Collimation

by Alessandro Bertarelli (CERN) and Stefano Redaelli (CERN)

JAS course on Beam Loss and Machine Protection  
Newport Beach, US

17-21 Nov. 2014  
Joint HiLumi LHC- LARP Meeting  
KEK, Japan

23-29 Nov. 2014  
CAS - Plasma Wake Acceleration  
Geneva, Switzerland



**Collimators must be capable of handling impacts of intense and HEP pulses and operating safely over an extended range of temperatures and pressures, in harsh radiation environments, while minimizing the perturbations to the circulating beam through impedance effects. These challenges are even more demanding with the increase of stored beam energy in future machines. No existing material can meet all the beam collimation challenges at the same time.**

A far-reaching R&D program was launched at CERN by the LHC collimation project with support from EuCARD2 and HiLumi LHC. In EuCARD2, the goal is to develop and test without and with beam, novel materials with high shock resistance and excellent thermal conductivity, replacing or complementing presently used collimator materials. In HiLumi, the impact of new materials on the collimation system performance is studied. Simulations of beam loss and energy deposition are used to define collimation requirements for the HL LHC. So far, the novel materials showing the most promising features are Copper-Diamond and Molybdenum Carbide – Graphite (MoGR) composites. The latter has recently achieved outstanding properties, combining an extremely low coefficient of thermal expansion in the temperature range from Room Temperature (RT) to more than 2000°C and a world record-breaking thermal conductivity of about 800 W/mK at RT. MoGR has a density of 2.6 g/cm<sup>3</sup>.

These novel materials must undergo a qualification with beam before being deployed in particle accelerators. The collimation material R&D activity has strong synergy with other domains of science where thermal shock resistance and high temperature operability are needed: braking systems for high-end automobiles and aerospace, thermal management in high power electronics, hot parts for gas turbines and space components requiring extreme geometrical stability are but a few examples of potential applications.

[Read more >>](#)

Keywords: EuCARD-2, HL-LHC, materials, collimators



Fig 1. Molybdenum Graphite sample. Image Credit: CERN



Fig 2. Close up of Molybdenum Graphite sample at nanometre scale. Image Credit: CERN



## Call for Applications to ICTF

by Thomas Hind (CERN)

**Applications are now being invited for access to the Ionisation Cooling Test Facility (ICTF) based at the Rutherford Appleton Laboratory, including the MICE experiment.**

Financial support offered includes provisions for travel and subsistence expenses and access to the beam free of charge, and is designed to aid the presence of researchers at RAL in equipment delivery and data taking and analysis in support of muon cooling experiments, including the MICE experiment. It will also support external users of the beam for tests of particle physics detectors in a low-energy beam and proponents of new cooling experiments to undertake studies, installations and eventually data taking.

A typical experiment is expected to last for about 2 beam-weeks and require the presence of up to 6 external users.

The deadline for applications is the 11th of September 2014, with the applications panel meeting a week later, on the 18th of September.

[Read more >>](#)

Keywords: ICTF, MICE, Call for Applications, RAL



Fig 1. Detector systems which EuCARD-2 has been supporting access to. Image credit: Stephen Kill (RAL)



Fig 2. MICE Spectrometer Solenoid Magnet being installed to the beam-line. Image Credit: Stephen Kill (RAL)



## Crab Cavity RF System

by Thomas Hind (CERN) and Rama Calaga (CERN)



## IN THE HEADLINES

From

[medicalphysicsweb.org](http://medicalphysicsweb.org)  
June 2014

[Range verification for eye proton therapy](#)

From *CERN Courier*

May 2014

[ESS: neutron beams at the high-intensity frontier](#)

From *BNL Newsroom*

May 2014

[Proposed plan for the future of particle physics](#)

From *interactions.org*

May 2014

[CEBAF Beam Goes Over the Hump: Highest Energy Beam Ever Delivered at Jefferson Lab](#)

From *Symmetry*

May 2014

[Building artificial body parts with particle beams](#)

From *DESY informs*

March 2014

[Accelerator - stonewashed](#)

**As part of the HL-LHC upgrade, a conceptual RF system layout for a local crab crossing scheme has been presented.**

Four cavities, grouped into pairs, on each side of the collision point (IP) per beam are required to produce the transverse kick to correct the geometric effects at the collision point. A two-cavity configuration also allows for good sectorization of the cavities, both for spare policy and maintenance.

Each cavity will have an independent powering system for precise control and reliable operation of the cavities. The input power coupler will use a single coaxial disk window to separate the cavity vacuum and the air side. These powering systems are assumed to use two 40kW LEP type Tetrodes modified to 400MHz to deliver the specified 80kW to cope with beam and cavity transients with some additional margin.

The cavity controls consists of a fast loop to ensure a rapid response time (around 1 microsecond) and a central (slow) control loop, which performs the task of field and phase control in the cavity.

A proof of principle test will be carried out in the SPS as a pre-requisite before an installation in the LHC.

Due to the limited space available in the interaction region, a detailed study is underway to determine the best option to fulfil the RF requirements in a cost effective manner.

[Read more >>](#)

Keywords: *HL-LHC, Crab Cavity, RF, WP4*

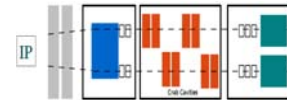


Fig 1. Schematic of the crab cavity layout on one side (not to scale) Image Credit: Rama Calaga (CERN)



Fig 2. 400 MHz Tetrode Amplifier. Image Credit: Eric Montesinos (CERN)

## Acc Development of a Fast Ramped Superconducting Dipole Magnet

by Hans Müller (GSI) and Pasquale Fabbriatore (INFN)

**Fast ramped magnets are an essential component of heavy-ion synchrotrons. Future developments ask for higher rigidity of the beams leading to stronger magnetic fields of the magnets and therefore to superconductivity. A superconducting fast ramped dipole magnet is now being developed in frame of the CRISP project.**

The magnet is based on the DISCORAP dipole built and tested by INFN as a prototype for the planned SIS300 synchrotron of FAIR in Darmstadt, Germany. The magnet has a main field of 4.5 T and the ramp rate is 1 T/s, which is orders of magnitude higher than any used currently. Its length is about 5 m and the inner diameter of the coil is 100 mm. The magnet is of so-called cos(theta) design, where the shape of the coil determines the field. This requires a high precision in the manufacturing of such a coil and the surrounding collar, which takes the magnetic forces. To increase the acceptance the magnet is wound curved making manufacturing difficult. Another challenge to be addressed is to minimize the AC-losses of the conductor due to ramping. For this, dedicated new superconductors with small NbTi filaments of only about 3 μm diameter had been developed. Another issue to be considered is fatigue, which requires high strength austenitic steel for the coil support. The collared coil being built now is a first step towards a complete magnet and establishes technologies to be used for further developments in the field of fast ramped superconducting magnets.

[Read more >>](#)

Keywords: *CRISP, FRS, Magnets*



Fig.1. One curved dipole coil of the CRISP project after curing and impregnation of the coil ends. Image Credit: Pasquale Fabbriatore (INFN)



## Workshop on Accelerators for ADS

by Alessandra Lombardi (CERN)

### A workshop on accelerators for Accelerator Driven Systems took place on 20-21 March 2014.

The workshop counted 42 registered participants and 30 contributions. The main European projects were represented with representatives from MYRRHA, Linac4/SPL, ESS, Saraf and SPIRAL2/IPHI.

An accelerator for ADS should provide a beam of protons with energies above 800 MeV and a beam power between a few and 10-15 MW. Beam losses should be controlled to minimize the irradiation of the accelerator and of the environment, but the most important quality of an ADS accelerator is its reliability. The number of beam trips should be minimised and the limitation comes mainly from thermal stress in the fuel structure. As a guideline, MYRRHA requirements are not more than 100 trips per day lasting between 0.1 sec and 3 seconds and no more than 10 trips per trimester lasting more than 3 seconds. The energy efficiency, the size of the accelerator and its cost are also important parameters. In the end, the solution chosen among LINAC, Cyclotron or Fixed Field Alternating Gradient Accelerator (FFAG) will be the one best fulfilling all these requirements.

During the workshop several synergies were identified between Max and Eucard2 AccApplic, amongst which are reliability issues, the dynamics in the low energy beam transport and neutralisation effects and the concept of a virtual Accelerator.

[Read more >>](#)

*Keywords: Accelerator Applications, MYRRHA, ADS*



Fig 1. MYRRHA Layout: injector building to the left, the long straight for acceleration and the reactor building to the right. Image Credit: MYRRHA - SCK CEN



### ERC Grants Supporting Alternative Accelerator Technologies

by Victor Malka (CNRS-ENSTA-Ecole Polytechnique), Marie Emmanuelle Couprie (SOLEIL), Ralph Assmann (DESY) and Thomas Hind (CERN)

#### ERC grants are currently being used to support development of alternative accelerator technologies.

The X-Five project, funded by an ERC Grant, is aiming to produce compact, tuneable and ultra bright X ray beams. This is possible thanks to the tremendous progress on manipulating the collective electron motion in plasma mediums, which makes laser plasma accelerators a technology option for new approaches.

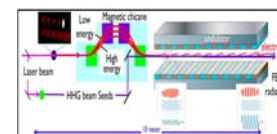


Fig 1. Diagram showing principle of compact Free Electron Laser based on Laser Wakefield Accelerator. Image Credit: Victor Malka (CNRS-ENSTA-Ecole Polytechnique)

X-ray Free Electron Lasers (XFEL) provide intense coherent femtosecond pulses for multidisciplinary investigations of matter. In parallel, electron beams generated from laser plasma acceleration offer a few femtosecond short bunches with high peak currents. The COXINEL ERC Advanced Grant aims to handle the present energy spread (~1 %) and divergence (mrad) of plasma-generated beams by a proper longitudinal and transverse manipulation in the beam transport to the undulator. It should then be possible to demonstrate FEL amplification, as a qualification of these novel beams.

The goal of the AXISIS grant is to trace and understand chemical and biological processes which take place in just quintillionths of a second, with full atomic detail. The project involves the establishing of a new facility, which will be based at DESY. The attosecond source will be based on a novel, laser-driven particle accelerator technology, which will emit X-ray radiation with much shorter pulses than is possible today. This technology can revolutionise the understanding of structure and function at the atomic level and unravel fundamental processes in chemistry and biology.

*Keywords: ERC, Grants, Free Electron Laser, COXINEL*

#### LINKS

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LC Newslines



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](#).

