

EuCARD-2

Enhanced European Coordination for Accelerator Research & Development

Newsletter

Accelerating News Issue 9

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et al

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<http://cds.cern.ch/search?p=CERN-ACC-NOTE-2014-0018>



NEWS

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Acc **From the editors**
Agnes Szeberenyi (CERN), Celine Tanguy (CEA)

In this spring issue, we look at new developments on High Temperature Superconductors for future accelerator magnets and the "crab-kissing" concept for maximizing the quality of the physics data which will be delivered by the High Luminosity LHC. We update you about successful achievements at the Swiss Light Source and at Rutherford Appleton Laboratory.

We find out about modern hadron therapy Gantry developments and progress towards the construction of a new synchrotron light source in Jordan. Finally, we report on the FCC study Kick-off meeting and the conference ICTR-PHE 2014, both held in Geneva.

In the headlines we've collected stories on the approval of HL-LHC project by the CERN Council and the successful end of EuCARD. We learn about a new office for medical research at CERN. Recent approaches for siting the FCC in a 270-km tunnel in the US and a light-source free-electron laser driven by CLIC technology are also highlighted.

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



The logo of the Future Circular Collider (FCC) study symbolizes three colliders sharing a common tunnel. The FCC study [public website](#) is now available. Image credit: FCC

EuC² **New video introducing EuCARD-2**
by Agnes Szeberenyi (CERN)

Watch the recently launched video that gives a short introduction to the EuCARD-2 project and its mission to develop particle accelerators of the 21st century.

The project gives the opportunity for a new generation of scientists to be trained in an advanced technological and international environment. "We want to develop a new generation of accelerators that allow not only scientists to profit, but also society – in medicine and industry," says project coordinator Maurizio Vretenar of CERN.

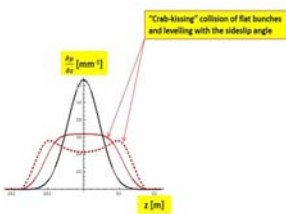


Maurizio Vretenar presents the EuCARD-2 project. Image credit: EuCARD-2, CERN

[Read more >>](#)
 Keywords: EuCARD-2, video, compact accelerators, SM18, ICTF

HiL **Pile-up management at HL-LHC and Crab-Kissing**
by Stephane Fartoukh (CERN) with Agnes Szeberenyi (CERN)

The HiLumi LHC Design Study investigates novel technologies and concepts to extend the discovery potential of the LHC. The overall scheme targets an integrated luminosity higher by a factor of 10 with respect to the LHC, but without compromising on the quality of the data delivered, both in terms of total number of interactions per bunch crossing (pile-up), but also their line density along the luminous region. A novel collision scheme might lead the way to succeed.



EVENTS

23-28 April 2014

[ICFA mini-Workshop](#) on Electromagnetic wake fields and impedances in particle accelerators
Erice, Sicily

7-14 May 2014

[CAS](#) - CERN Accelerator School on Power Converters
Baden, Switzerland

12-16 May 2014

[AWLC14](#) - Americas Workshop on Linear Colliders 2014
Batavia, United States

19-23 May 2014

[First EuCARD2 annual meeting](#)
Hamburg, Germany

25-30 May 2014

[CAARI 2014](#) - 23rd International Conference on the Application of Accelerators in Research and Industry
San Antonio, US

26-28 May 2014

[First Future Hadron Collider workshop](#)
Geneva, Switzerland

02-06 June 2014

[TIPP 2014](#) - Technology and Instrumentation in Particle Physics
Amsterdam, Netherlands

15-20 June 2014

[IPAC'14](#) - International Particle Accelerator Conference
Dresden, Germany

24-28 August 2014

[ECRIS'14](#) - 21st 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](#) - 27th Linear Accelerator Conference
Geneva, Switzerland

This so-called crab-kissing scheme is complementary to the baseline crab-crossing scheme already in use. It assumes, however, that additional crab-cavities are installed in order to achieve a bunch rotation in the plane perpendicular to the crossing plane (the so-called parallel separation plane). In this way the two beams collide with a side-slip angle in one of the two transverse planes, for levelling the collision time and therefore the luminosity, while mitigating the interaction rate at the centre of the luminous region, and therefore spreading out the events more efficiently over the luminous region.

Assuming a double harmonic radio-frequency system for the HL-LHC, as already planned for other purposes, the longitudinal bunch distribution can be made more uniform. Then combined with the crab-kissing scheme, a pile up density of only 0.5-0.6 event /mm is within reach for the HL-LHC, which would definitely maximise the efficiency of the new detector and might even be partly used to further increase peak and integrated luminosity of the HL-LHC

The connection between pile-up density and crab-cavity via the crab-kissing scheme, gives an additional boost to this very challenging RF device which remains a keystone of the HL-LHC project. First beam dynamics analysis were reported at the [6th crab-cavity workshop CC13](#), validating the soundness of the proposal, in particular in terms of beam-beam effect.

[Read more >>](#)

Keywords: *HiLumi LHC, crab-crossing, luminosity*

Crab-kissing collision to level the luminosity and strongly mitigate the pile-up density at HL-LHC.
Image credit: S. Fartoukh (CERN)

RF drive system for MICE installed at the ICTF



by Kevin Ronald, (University of Strathclyde), Andrew Moss (Daresbury Lab), Tim Stanley (Rutherford Appleton Lab) for the MICE Collaboration

Ionisation cooling is required to reduce the emittance of a muon beam rapidly for application in future accelerators for neutrino factories and muon colliders. The first RF power amplifier, developed under TIARA Work Package 7, by Daresbury Laboratory working with the Rutherford Appleton Laboratory (RAL), the University of Strathclyde and Imperial College has been installed and tested at the Ionisation cooling Test Facility (ICTF).

The first of the four compact amplifiers for the Muon Ionisation Cooling Experiment (MICE), which recently achieved the required performance of 2MW peak power in 1ms pulses at 1Hz has [now been installed](#) in the Ionisation Cooling Test Facility at RAL. This required the establishment of all necessary services in the limited space available for the RF power stations. The amplifier has been tested to the limits of the available RF loads and exhibited the same performance characteristics as achieved in the tests previously conducted at Daresbury. This is a major step in preparing the infrastructure for MICE. Through synergy with a US NSF-MRI programme at [Mississippi](#), the components required for the [distribution network](#) developed under the TIARA project have been procured, and some parts used in the recent tests. The support of [TIARA](#), the UK [STFC](#), the US NSF and [e2v technologies](#) is gratefully acknowledged.

[Read more >>](#)

Keywords: *TIARA, ionisation cooling, MICE*



Fig. 1: Installation of the triode amplifier, visible are (a) the 3" feedline from the preamplifier on the mezzanine above, (b) the preamplifier test load, (c) the final stage amplifier assembly and (d) the 6" output line from the final stage.
Image credit: TIARA/MICE.

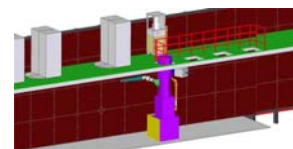


Fig 2: Engineering model illustrating the test installation of the 1st Amplifier system in the RF power station at the ICTF, the preamplifier tetrode (a), SSPA and Source are on the mezzanine with the power supplies (b), the tall triode final stage (c) is installed between the main floor and the mezzanine.
Image credit: TIARA/MICE.



Explore accelerator applications with EuCARD-2

by Rob Edgecock (HUD)

15-19 September 2014

[IBIC'14](#) - 3rd International Beam Instrumentation Conference
 Monterey, US

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

5-14 Nov. 2014

[JAS](#) - 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

Work Package 4 ([AccApplic](#)) of the EuCARD2 project is a Network investigating existing and possible new applications of particle accelerators. The aim is to find applications that could benefit from accelerators and techniques developed for research activities, particularly in Particle Physics.

More than 30,000 accelerators are in use around the World for applications in the areas of healthcare, the environment, industry, energy and security. Together, these are responsible for nearly \$0.5T/year of economic activity. Although the accelerators used for many of these applications are very well suited to the task, there are cases in which improvements in performance are possible or work is required to reduce the size or cost of the accelerator or there are particular problems to be solved. The AccApplic Network will be studying these cases.

As a Network, the main method of doing this will be to bring together experts to discuss the problems and possible solutions in workshops. The purpose is to initiate collaborations to further address the problems. The first such workshop, on [Modern Hadron Therapy Gantry Developments](#), has already taken place and the [summarizing report](#) is now available. The next two are upcoming, on [Accelerators for Accelerator Driven Systems](#) and [Neutron Production and BNCT](#). Further workshops on muon production for energy, materials and security applications and accelerators for flue gas, water and food treatment are also planned.

If you would like to participate in the Network or have suggestions for other workshops, please contact the coordinator, [Rob Edgecock](#).

[Read more >>](#)

Keywords: EuCARD-2, accelerator applications, hadron therapy



Spot scanning gantry ([Gantry 2](#)), which was designed specifically to enable treatment of moving tumours with scanned beams. Image credit: PSI.

Acc First pre-series sextupole for the SESAME storage ring

by [Attilio Milanese \(CERN\)](#)

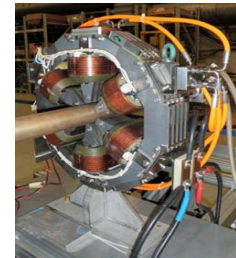
In November 2013, CERN has completed the first assembly of a pre-series sextupole for the [SESAME](#) storage ring, within the [CESSAMag](#) European project. This is indeed the first magnet for the new synchrotron light source in construction in Jordan.

The magnetic design of the sextupole has been finalized at CERN on the basis of the initial proposal of SESAME. The compact magnet is actually multi-purpose, incorporating – on top of the main sextupolar field – three correctors, namely the horizontal / vertical dipole and a skew quadrupole. Since the aperture (75 mm diameter) is comparable to the length (iron length 100 mm), the optimization of the pole tip geometry was carried out directly in 3D. A peculiar feature from the magnetic viewpoint is the unconventional choice of avoiding any end pole chamfering, while still minimizing the first allowed harmonic. This was obtained by introducing a careful bias in the 2D design, that cancels out in 3D due to edge effects. This simplifies the manufacture without compromising on the field quality. Indeed a magnetic measurement on the pre-series confirmed the simulations, with a first allowed harmonics of $0.4 \cdot 10^{-4}$ at a reference radius of 24 mm.

This pre-series sextupole validates the design and opens the way for the 64 units needed for the SESAME storage ring. Contracts for the main components are on-going in Europe, whereas for the final assembly and testing options in Cyprus and Pakistan are currently being finalized.

[Read more >>](#)

Keywords: SESAME, CESSAMag, sextupole



First SESAME sextupole pre-series undergoing magnetic measurements in the ISR tunnel at CERN. The electric and hydraulic connections are in test configuration. Image credit: CERN

IN THE HEADLINES

From CERN Courier
January 2014
[HiLumi LHC design study moves towards HL-LHC](#)

From CERN Courier
January 2014
[EuCARD comes to a successful end](#)

From CERN Courier
January 2014
[Workshop looks towards High-Luminosity LHC](#)

From Phys.org
February 2014
[Why bigger accelerators are better in particle physics](#)

From medicalphysicsweb
February 2014
[CERN intensifies medical physics research](#)

From physicsworld.com
February 2014
[Rebirth of the SSC?](#)

From CERN updates
March 2014
[Some CLIC with your free-electron laser?](#)



Upgrade of the Swiss Light Source for R&D on ultralow vertical emittance

by *Andreas Streun (PSI), Yannis Papaphilippou (CERN), Marica Biagini (INFN)*

A high resolution beam size monitor has been commissioned at the SLS for verification of vertical emittance values below 1 pm.

The SLS Vertical Emittance Tuning (SVET) Work Package within the TIARA preparatory phase was a collaboration between PSI, CERN, INFN and MAX IV Lab on instruments and methods for establishing an R&D infrastructure on vertical emittance reduction at the SLS storage ring of PSI. The final report was issued at the end of 2013.

Methods have been established to reduce the vertical emittance through re-alignment of the storage ring lattice and through systematic and random optimization of the optics. Values down to 1 pm have been achieved, and values of about 1.5 pm can be set routinely.

A new monitor was built for measurements of very small beam size and has been tested down to a level of 4 μm to date, corresponding to a vertical emittance of about 1.1 pm for the present SLS optics. The measurement is based on an image of vertically polarized synchrotron radiation, see figure beside.

The monitor beam line extends out of the storage ring tunnel in order to provide a large magnification factor and to allow the optical end station to be accessed during operation. A core component of the monitor is a toroidal mirror for wavelength independent focusing, in use since 2014. In 2013 an intermediate configuration composed from a planar mirror and a lens was used.

Monitor fine tuning is in progress, and a new emittance reduction campaign is scheduled. Further studies on intra-beam scattering effects are planned as an application of the ultralow vertical emittance beam.

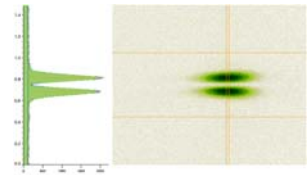


Image of vertical polarized synchrotron light: for an ideal beam of zero emittance, the image would show complete extinction of light in the midplane. Finite midplane intensity allows one to determine the beam size from the "valley to peak" intensity ratio of the image profile.
Image credits: TIARA/ Andreas Streun (PSI)

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Keywords: TIARA, WP6, SLS, vertical emittance reduction



CERN prepares for Future Circular Collider Study

by *Michael Benedikt and Frank Zimmermann (CERN)*

More than 350 world experts in accelerators and particle physics, including several laboratory directors, came together at the University of Geneva for 4 days from 12 to 15 February 2014, to launch a future circular collider (FCC) study, based on a new 80 to 100-km circular tunnel.

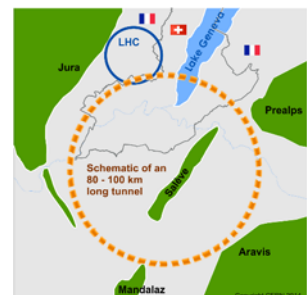
The FCC study scope comprises a frontier 100-TeV proton (and heavy-ion) collider [formerly called VHE-LHC], a high-luminosity e+e- (H, Z, W, and t̄t̄) factory as potential intermediate step [formerly called TLEP], and also a hadron-lepton collider option [formerly called VLHeC]. The goal of the study is to deliver a Conceptual Design Report (CDR) together with a cost review at the time of the next European Strategy Update (2018).

The goals of the kick-off meeting were to introduce the FCC study, to discuss study scope and organization, as well to prepare and to establish global collaborations.

After two days of plenary sessions, which surveyed the physics case, scope, plan, international situation and design starting points of the FCC, seven parallel sessions provided space for feedback, numerous additional presentations and lively international discussions. Worldwide collaboration in all areas –



Participants of the Future Circular Collider kick-off Meeting, University of Geneva, Switzerland
Image credits: CERN.



physics, experiments and accelerators – was found to be essential to reach the level for a CDR by 2018. Key R&D areas for the FCC, such as superconducting high-field magnets and Superconducting Radio-Frequency systems (SRF), are of general interest and relevant for many other applications. Significant R&D investments in these areas have been made over the past decade(s) and are still in progress, for example, in the framework of the LHC and High-Luminosity LHC.

Sketch of a future 80 to 100-km long tunnel in the Geneva area, allowing for a 100-TeV energy-frontier proton collider and also, as possible intermediate step, a high-luminosity e+e- Higgs factory. Image credits: CERN.

Institutes around the world are now invited to join the global FCC effort and to submit non-committing written “expressions of interest” with regard to specific contributions by the end of May 2014.

[Read more >>](#)

Keywords: FCC, kick-off

EuC² A step towards Next Generation Magnets

by Luca Bottura (CERN)

The Future Magnets, Work Package 10 of EuCARD-2 is exploring the use of High Temperature Superconductors (HTS) materials in future accelerator magnets: YBCO and BSCCO. Both YBCO and BSCCO were found to have not only a high critical temperature, but also a very high critical field, exceeding 100 T. This is what makes them especially interesting for high field accelerator magnet applications.



A Roebel cable prototype, inserted in a sample holder and ready for test at low temperature and high field in the CERN FRESCA test facility. Image credit: J. Fleiter, CERN

Following an evaluation performed by the EuCARD2 WP10 team, and the associated laboratories in the US and Japan, it was decided that the European program would focus on YBCO tapes, assembled in Roebel bars or, as an option, stacked tapes. YBCO is a material produced by one of the industrial partners of EuCARD-2 (Bruker HTS), and has potential for use both in very high field applications beyond the scope of WP10, such as Nuclear Magnetic Resonance magnets, as well as power applications such as Fault Current Limiters or high current power transmission cables. Accelerator magnets require high current, and the Roebel bar is a way devised by KIT to assemble multiple YBCO tapes in a high current transposed conductor. Samples of such conductors were already tested at CERN at cryogenic conditions (4.2 K) and intense field (10 T), showing the desired high current carrying capability. The EuCARD2 WP10 will produce samples of YBCO Roebel bars in the coming months.

As for the alternate material, EuCARD2 makes a significant contribution by providing the precursor powders necessary for the production of the BSCCO-2212 superconducting wire.

The question for the coil cross section is yet open for both Roebel bars and Rutherford cables; the magnet geometry for making the optimal use of the current carrying capacity of the superconductor, and respecting the engineering limits of the materials, is not necessarily the same.

[Read more >>](#)

Keywords: EuCARD-2, Future Magnets, HTS, YBCO,

LINKS

- [Accelerators for Society APS newsletter](#)
- [ICFA newsletter](#)
- [LC Newslne](#)

Acc Latest developments in medical physics research

by Livia Lapadatescu (CERN)

Researchers from around the world gathered in Geneva to discuss the latest developments in cancer diagnosis and treatment during ICTR-PHE 2014 (International Conference on Translational Research in Radio-Oncology and Physics for Health in Europe), held between 10 and 14 February.



The 5-day conference covered a variety of topics from radiobiology, nuclear medicine, detectors and imaging, to host

ICTR-PHE 2014 took place in the

and tumour immunity, radio-therapeutic control of tumours, and clinical trials in hadron therapy. The involvement of CERN in medical physics research was highlighted in the talk by Steve Myers, recently appointed Head of CERN's Medical Application Programme, and in the public lecture by Ugo Amaldi: *Physics is beautiful and useful*.

International Conference Centre in Geneva (CICG)
Image credits: ICTR-PHE 2014.

The development of compact and cost-effective accelerators for medical applications, the production of isotopes for research, and the establishment of BioLEIR at CERN were also addressed during the conference. Converting [LEIR](#) (The Low Energy Ion Ring) into a biomedical experimental facility will help investigate the effect of different ions on cancer cells, test innovative particle detectors and perform accurate nuclear fragmentation studies. The ISOLDE facility will provide beams to produce radioisotopes for medical applications, in the framework of the CERN MEDICIS project.

The need of uniting different disciplines: physics, chemistry, biology, medicine and even computer science (which could help in analyzing large databases) to develop better treatment and diagnosis for cancer was highlighted throughout the conference. Rendez-vous in 2016 for the next edition of ICTR-PHE.

[Read more >>](#)

Keywords: ICTR-PHE 2014, cancer therapy, accelerators, medical applications



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](#).

