

HiLumi LHC

FP7 High Luminosity Large Hadron Collider Design Study

Newsletter

From the FP7 HiLumi Design Study towards the High Luminosity LHC

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10 December 2013



The HiLumi LHC Design Study is included in the High Luminosity LHC project and is partly funded by the European Commission within the Framework Programme 7 Capacities Specific Programme, Grant Agreement 284404.

This work is part of HiLumi LHC Work Package 1: **Project Management & Technical Coordination.**

The electronic version of this HiLumi LHC Publication is available via the HiLumi LHC web site <<http://hilumilhc.web.cern.ch>> or on the CERN Document Server at the following URL:
<<http://cds.cern.ch/search?p=CERN-ACC-NOTE-2014-0003>>

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 **From the editors**

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

In this winter issue, we are celebrating this year's amazing highlights: Nobel Prize in physics for the Higgs, Prince of Asturias Award, the end of EuCARD, the start of EuCARD-2, the conclusion of the preparatory phase of TIARA and HL-LHC entering a new phase - from design study to approved project. We are happy to announce that Accelerating News has been assigned an ISSN Number and is now listed in the catalogue of the Swiss National Library.

In addition to this year's highlights, we report on TIARA's recommendations for promoting accelerator science in Europe, energy efficiency of particle accelerators, the design of a test cryostat for low beta superconducting cavities and quality assessment during SRF cavity production.

In the headlines are engaging stories on plasma wakefield, compact particle accelerators, 13.5 Tesla magnets, concept of a very large hadron collider and improvements in proton therapy.

Amongst the upcoming events, we invite you to the CLIC2014 Workshop and the Future Circular Collider Kick-off meeting.

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



We wish all Accelerating News readers a very happy festive period and plenty of success for 2014.

Image credit: Ivan Martinez (FPA)

 **EuCARD wrap-up and beyond**

by Agnes Szeberenyi (CERN) and Livia Lapadatescu (CERN)

The **EuCARD** project was launched to join forces to improve the performance of European accelerator infrastructures. After 4 years of running, the project lived up to the expectations and achieved most of its ambitious goals. The work in EuCARD has been organized around scientific networks, transnational activities and joint research activities.

The Accelerating News newsletter, the series of scientific [monographs](#) on accelerator sciences and the roadmaps towards novel frontier accelerators are just a few examples of the outcomes of networking activities under the umbrella of the project. During the lifetime of the project, an out-of-contract networking activity has been successfully launched on laser plasma acceleration, contributing and supporting the [AWAKE collaboration](#), which has gained relevant momentum since then. Two test facilities were open in EuCARD to transnational access: [HiRadMat@SPS](#) and [MICE@STFC](#). The EC funding of these TA was mostly dedicated to the support of the new users' visits and research in the facilities.

The joint research activities had the lion's share in EuCARD. The highlights of these activities include: development of an innovative Nb₃Sn magnet with a high-temperature



Some key project figures.

Image credit: EuCARD.

EVENTS

4-15 December 2013
[LCS 2013](#) - 8th International Accelerator School for Linear Colliders
 Antalya, Turkey

16-20 December 2013
[HEP 2013](#) - 5th International Workshop

on High Energy Physics in the LCH Era
Valparaíso, Chile

6 January - 14 March 2014

[JUAS school](#) - Joint Universitites Accelerator School
Archamps, France

20-31 January 2014

[USPAS](#) - US Particle Accelerator School
Knoxville, US

3-7 February 2014

[CLIC 2014](#) - Workshop on Accelerator, Detector and Physics studies
Geneva, Switzerland

10-14 February 2014

[ICTR-PHE 2014](#) - International Conference on Translational Research in Radio-Oncology and Physics for Health in Europe
Geneva, Switzerland

12-15 February 2014

[FCC Study Kickoff meeting](#)
Geneva, Switzerland

25-30 May 2014

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

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

1-5 September 2014

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

superconducting YBCO insert for the first time in Europe; a smart collimator and cryocatcher, two-beam acceleration RF technologies, the active mechanical stabilization of magnets to a fraction of nanometer, ultra-precise beam monitoring, 20 fs scale synchronization and novel high gradient RF cavities for proton linacs, etc.

As EuCARD finished on 31st July, [EuCARD-2](#) will build upon the success of [EuCARD](#) and push it into an even more innovative regime.

[Read more >>](#)

Keywords: [EuCARD](#), [EuCARD-2](#), [summary](#)



Concluding the TIARA Preparatory Phase

by *Celine Tanguy (CEA)*

Almost 3 years since the TIARA Kickoff meeting, the TIARA participants met in Daresbury to review the progress within the Work Packages (WPs) and finalise the last deliverables.

The organisational Work Packages provided details about the Infrastructure Need and Resource Comparison ([WP3](#)), the final plan of the collaborative R&D Program ([WP4](#)) and the results of the survey of market needs for trained personnel and recommendations for promoting accelerator science and technology ([WP5](#)).

From the technical Work Packages, the following achievements were highlighted (among others): ultralow (world record) vertical emittance at the Swiss Light Source ([WP6](#)), multi-MegaWatt RF systems for the Ionisation Cooling Test Facility ([WP7](#)), new C-band structures at SPARC and overview of C-band technology at other international projects ([WP8](#)), design of innovative multi-MegaWatt Irradiation Facility for complex target testing ([WP9](#)).

On this occasion, an overview of R&D Infrastructures and Accelerator Programmes in UK was given, as well as Industrial Engagement in UK Accelerator R&D. Status of the on-going work toward 14 TeV operation of LHC and R&D for High Luminosity Upgrade was also showcased.

[Governing Council](#) meetings, including the [Steering Committee](#) members, were also organised, in particular to pursue discussion toward the TIARA implementation.

[Read more >>](#)

Keywords: [TIARA](#), [Daresbury](#), [concluding meeting](#)



The final general meeting of the TIARA Preparatory Phase was hosted by STFC at Daresbury Laboratory on November 25-28. Image credit:TIARA.



From the FP7 HiLumi Design Study towards the High Luminosity LHC

by *Agnes Szeberenyi (CERN) and Livia Lapadatescu (CERN)*

To mark the approval of the High Luminosity LHC Programme by the CERN Council in June 2013, the 3rd Joint HiLumi LHC-LARP Annual Meeting was held in conjunction with the HL-LHC kick-off.

The event took place at the Daresbury Laboratory in the UK between 11-15 November 2013, with an outstanding attendance of more than 160 scientists from all over the world, including Japan, Russia and the US. Directors of major accelerator laboratories were present as invited prominent speakers.

The first part of the event covered the kick-off of the HL-LHC project, advanced as a first priority for CERN in the years to come. Following the format of the previous annual meetings, the second part of the event focused on the progress in design and R&D of the FP7 HiLumi Design Study. Plenary and work package parallel sessions were organized and focused on the work of the Parameter and Lay-Out Committee, the collaboration



Group picture from the 3rd Joint HiLumi LHC-LARP Annual Meeting 2013. Image credit: HiLumi LHC.

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

with LARP, the achievements and reports from work packages. The outcomes and recommendations of the CERN Review of LHC & Injector Upgrade Plans Workshop (RLIUP) were also reported.

The 4th Joint HiLumi Annual Meeting is planned to take place in November 2014 at KEK, the High Energy Accelerator Research Organization in Japan.

[Read more >>](#)

Keywords: Hilumi LHC, HL-LHC, RLIUP, US-LARP, Annual Meeting



E-learning: a new training opportunity for European accelerator science

by Philip Burrows (JAI, University of Oxford)

Currently around 500 students each year commence master's and PhD courses related to accelerator science and technology. TIARA Work Package 5 (WP5) proposes measures to improve training access. For science and engineering undergraduates, and high-school students, we recommend setting up an e-learning course: 'Introduction to Accelerator Science and Technology'.



Based on the surveys on education and training provision, and the market needs for accelerator scientists and engineers, TIARA WP5 ("Education & Training") has issued its final report, which includes recommendations for promoting Accelerator Science and Technologies at a European level. Among these TIARA WP5 recommends improved support for students to participate in training programmes, including accelerator schools and lab-based internships. It is believed that a prestigious European fellowship scheme for master's and PhD students would help to improve the supply of trained personnel, as well as raise the profile of the field. It is also recommended setting up an e-learning course ('Introduction to Accelerator Science and Technology') to open up training opportunities to European undergraduate science students, as well as a module suitable for high-school students and teachers. See the report 'Recommendations for promoting accelerator science and technology in Europe' for full details.

An additional recommendation by TIARA WP5 is to set up a www portal for providing a comprehensive source of information on accelerator opportunities, namely job and internship vacancies, bursaries and fellowships, and research group and personnel expertise, as well as news on conferences, workshops and training schools and access to online training materials and resources.

Image credit: Max Bradbury (JAI, University of Oxford).

[Read more >>](#)

Keywords: TIARA, education, training, recommendations

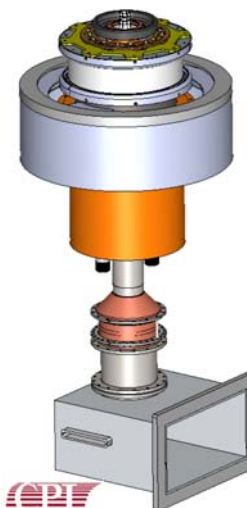


Towards energy efficient particle accelerators

by Mike Seidel (PSI) with Mathilde Chaudron (CERN)

The 2nd Workshop on Energy for Sustainable Science at Research Infrastructures was held the 23-25 October 2013 at CERN to discuss the challenges and potential solutions in energy efficiency. The workshop featured a talk from the EnEfficient network, the EuCARD-2 Work Package 3, which presented its plan to stimulate innovation in the energy efficiency of particle accelerators in the coming years.

Scarcity of resources, along with rising energy costs and climate change are ever growing concerns for the next generation of large accelerator based facilities. Indeed, the much increased performance of proposed new facilities comes together with anticipated increased power consumption. The network EnEfficient builds on this recent consciousness that accelerators have to be sustainable over the long term and socially acceptable by reducing their environmental impact and their energy consumption. It aims to federate the initiatives of research institutions and universities towards an efficient utilization of electrical power in 5 different areas: heat recovery, efficiency of Radio Frequency (RF) power generation, virtual power plant (improved adaptation to varying supply situation on grid), energy



Inductive Output Tube (IOT).
 Image credit: CPI.

IN THE HEADLINES

From **Nobelprize.org**

October 2013
The Nobel Prize in Physics 2013 to Peter Higgs, François Englert

From **Fundación Príncipe de Asturias**

October 2013
Prince of Asturias Award for Technical and Scientific Research 2013: Peter Higgs, François Englert and CERN

From **CERN Updates**

October 2013
New beam dump for a veteran accelerator

From **Symmetry**

October 2013
Why particle physics matters

From **CERN Courier**

October 2013
To the terascale: catching the plasma wakefield

From **Phys.org**

November 2013
Charged particles can be accelerated using light, leading the way for more compact particle accelerators

From **Nature**

November 2013
Physicists plan to build a bigger LHC

From **CERN Updates**

November 2013
Test magnet reaches 13.5 tesla – a new CERN record

From **Medical Physics Web**

November 2013
Proton rescanning: which works best?

storage systems and low power beam transport channels.

As one of the networking activities a workshop on efficient RF generation will be organized in the spring of 2014. The picture shows the concept design of a multi-beam Inductive Output Tube (IOT). IOTs typically reach higher efficiency than traditional klystrons particularly where klystrons need to be operated below saturation. The utilization of this technology for the accelerator of the [European Spallation Source](#) (ESS) is presently being investigated which would result in electrical power savings of 3 MW. [European](#)

Additional participants are sought and are welcome in all themes of the [EnEfficient](#) network.

[Read more >>](#)

Keywords: *EuCARD-2, energy efficiency, networks*



A versatile test cryostat for low beta superconducting cavities

by Sébastien Bousson (CNRS/IN2P3/IPN Orsay), Hervé Saugnac (CNRS/IN2P3/IPN Orsay) and Sébastien Blivet (CNRS/IN2P3/IPN Orsay)

In Work-Package 9 (WP9) of the TIARA-PP project, the IPN Orsay team (CNRS/IN2P3) has raised the challenge of designing a versatile test cryostat capable to host almost all type of fully-equipped superconducting (SC) cavities, including the wide range of low beta structures.

In the process of developing a SC accelerating cavity, the integrated test of the fully dressed cavity (i.e. equipped with its RF power coupler and cold tuning system) in the nominal condition of RF power and temperature is a key step towards the validation of the expected performances of the accelerating structure. To perform this experiment, a specific cryostat is required, adapted to the geometry and configuration of the cavity to be tested.

This type of infrastructure already exists for elliptical-type SC cavities, but not for the low beta structures due to difficulty of integrating the large variety of geometries, configurations and frequencies: quarter-wave or half-wave resonators, spoke or CH-type cavities, single-gap or multi-gap, frequencies ranging from 60 to 700 MHz...

As shown in Fig.1 with a spoke cavity or in Fig. 2 with a quarter-wave resonator, the chosen configuration of the cryostat is a top-loading, where the equipped cavity coming from the assembly in the clean room is suspended to the cryostat top-plate. The various openings located laterally or on the bottom closing plate of the cryostat allow to implement the power coupler and cold tuning system and give access to the cavity for the assembly process and to integrate the instruments. With a length of 2.7 m, a width of 1.5 m and a height of 3.4 m, the cryostat dimension is optimized to minimize the footprint in the test stand but sufficient enough to integrate a string of a SC cavity and a SC solenoid for specific tests.

[Read more >>](#)

Keywords: *TIARA, low beta Superconducting Cavity, cryostat*



Fig 1: Top-loading of the cryostat with a double spoke cavity. Image credit: TIARA.



Fig 2: Cryostat integrating a quarter-wave resonator. Image credit: TIARA.



Synergies for testing Superconducting RF cavities

by Dettlef Reschke (DESY)

Within the 36 month period of the [CRISP project](#) the main objective of WP4 is to upgrade and harmonize the SRF Accelerator Structures for ESS, ILC, LHC upgrade and the European XFEL. The activity supports an optimised surface treatment, the application of advanced test and preparation infrastructure as well as state-of-the-art diagnostics tools.

At CERN the SRF cavity test infrastructure is under upgrade to allow 2 Kelvin operation needed for the characterisation of a first cryomodule for the ESS and the CERN-SPL. The upgrade includes a new cryogenic transfer line between the cryoplant and RF test stand area with two horizontal cryomodule test places and four vertical RF test cryostats. Two of the vertical cryostats have been modified for 2K operation, which is necessary for the testing of the SPL cavities.

The industrial production of the series accelerator cavities for the European XFEL started successfully beginning of 2013. Until end October 2013, 164 series accelerator and ILC-HiGrade cavities for the European XFEL have been delivered to DESY. For many of the cavities that didn't pass the tests an additional treatment applying a chemical surface removal ("Buffered Chemical Polishing BCP") is under consideration. The development of advanced diagnostics like high resolution optical inspection and the experience of industrial cavity production and surface treatment will be extremely beneficial for any other European large scale SRF project such as ESS as well as for the preparation of the ILC.



XFEL series cavity during incoming inspection at DESY.
Image credit: DESY.



Vertical test inserts equipped with XFEL superconducting accelerator series cavities.
Image credit: DESY.

[Read more >>](#)

Keywords: CRISP, SRF, European XFEL, cryomodule cavities

LINKS

[Accelerators for Society](#)
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[LC Newslne](#)



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](#).

