

One birthday, three events and a look into the crystal ball

20 years ago the Joint Universities Accelerator School (JUAS) was founded under the patronage of CERN and a European network of 4 Universities to meet the Europe-wide demand for a foundation course on accelerator physics and associated technologies. Today JUAS joins 14 Universities and offers an intensive programme of modular courses for students and accelerator professionals. Hundreds of students have since followed this unique training and several of the former students have since become teachers themselves. On 25th April 2014 all JUAS partners will gather in Grenoble to celebrate the many successes to date. Many oPAC Fellows have participated to JUAS and benefitted from the excellent courses and our network has also actively supported the school. Happy birthday JUAS – you're looking better than ever !

Registration is now open for three upcoming oPAC events: A Topical Workshop on the „Libera’ technology will be held in Slovenia on 10 April 2014 and hosted by Instrumentation Technologies, another one on „Beam Diagnostics“ will be held in Vienna, Austria on 8/9 May 2014 and hosted by CIVIDEC, and our international oPAC School on Accelerator Optimization will be held at RHUL in London between 7-11 July 2014.

Registration for all 3 events is possible via the project website. **Take part !**

What does the future offer for accelerator research and development ? Between 12-15 February accelerator experts and high energy physicists are attending a meeting at the University of Geneva that marks the starting point of a five-year international design study called “Future Circular Collider” (FCC). It has emphasis on a hadron collider with a centre-of-mass energy of the order of 100 TeV in a new 80-100 km tunnel. This design study includes a 90-400 GeV lepton collider, seen as a potential intermediate step and also examines a lepton-hadron collider option. The scope of this meeting is to discuss the main study topics and to prepare the groundwork for the establishment of international collaborations and future studies – as already found in oPAC. In parallel CERN is hosting a meeting on plans for medical applications. Particle beam-based cancer treatment, medical diagnostics and the production of radioactive isotopes are amongst the best-known applications of particle accelerators outside of fundamental research. Research in this area requires close collaboration between universities, research centres and industry and has been an engine for cross-sector collaboration and knowledge exchange for many years. CERN is now planning to add its technologies to those needed for the development of a global system for the treatment of cancer tumours with particle beams and this promises fantastic opportunities for true interdisciplinary, collaborative research. I anticipate that many oPAC partners will join this initiative.



Carsten P. Welsch, Coordinator

Special Interest Articles

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Research Highlights

Low alpha lattice at the ALBA light source - Michele Carla

While conventional electronics stop to operate over 300 GHz lasers steps in not before 30 THz in the far infrared region, leaving an unexplored slice of the electromagnetic spectrum usually referred as the "terahertz radiation".

The lack of "good" sources at the terahertz wavelength makes it a novel and unexplored field of research. On the other hand an electron storage ring with some trick can be exploited to produce strong burst of terahertz radiation.

The synchrotron radiation collected from a bending magnet offers a rather flat spectrum from low frequencies up to x-rays, a strong enhancement in the low frequency region can be obtained by making the bunch length shorter than the wavelength we are interested in.

If this condition is fulfilled the bunch will behave like a single particle radiating coherently.

Because in a coherent emission process the emitted power is proportional to the number of emitting electrons we can obtain a rather strong radiation pulse compared to the incoherent case where the absence of a relation between the phase of the radiation emitted by different electrons make the power scale only as the square root of the emitting particle. The large number of particles taking part in the emission process (around 10^9), makes then the coherent process a winning choice. The key to obtain short electron bunch in a storage ring is to tweak the lattice in order to make all the electrons travel through the ring in the same time, in spite of their energy. This will prevent the spreading of electrons with different energy along the bunch.

Two electrons with slightly different energy, while travelling through the ring, will experience a different deflection in the magnetic fields being dispersed like in a spectrometer, thus they will travel on different path with slightly different length. Such dependencies of the path length, and then on the revolution frequencies, from the energy are known as the "momentum compaction factor" and commonly referred to as alpha, and are mainly determined by the sign of the dispersion inside the bending magnet.

In the nominal operation mode of the ALBA storage ring the bunch length is around 16 ps, too long to achieve a coherent emission in the THz region, for such reason the momentum compaction factor has to be reduced drastically near to zero. The actual Double Bend Achromat lattice does not permit to lower the momentum compaction factor in an easy way. In fact the task is made particularly challenging because ALBA is a compact machine employing integrated function bending magnets (bending magnets that also include a focusing component). Thus the common approach used in similar accelerators cannot be applied.

The integrated function dipoles and the limited strength of the quadrupoles prevent to lower the dispersion inside the bending magnets, while keeping the current lattice symmetry. In order to fulfil the requested conditions the actual symmetry has been broken, merging together near cells, and the beam energy has been lowered from 3 GeV to 2.4 GeV in order make the quadrupoles more effective. Nonetheless a complete working solution has yet to be found.

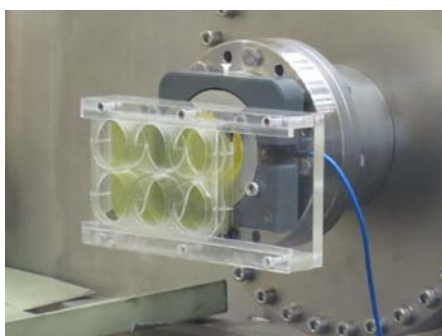


Radiobiology research at Centro Nacional de Aceleradores (CNA), Seville - Maria Cristina Battaglia

The study of the biological effects caused by ionizing irradiation is one of the big interests of the scientific community. Nowadays, new techniques are using the properties of the interaction between radiation and matter to destroy tumor cells and treat cancers. Within this context, irradiation of cells using proton beams was carried out at the “Centro Nacional de Aceleradores” (CNA) in Seville, Spain for the first time on December 2013.

This experimental activity at CNA required tailored beam diagnostics developments and experimental beam lines adaptation to make it suitable for radiobiological studies. A 3MV Tandem, installed at CNA, was utilized in order to produce the proton beam. The measurements were performed at the experimental beam line dedicated to basic nuclear physics studies and beam tracking developments.

During an experimental campaign, the homogeneity of the beam profile was achieved and the first culture of cells was irradiated by the proton beam with different doses.



Details of the setup mounted at the end of the beam line



An overview of the experimental setup used for the tests performed at the CNA

With a homogeneous irradiation of the culture’s cells, the biological effects can be analyzed. This research activity involves a wide collaboration between the University of Seville, CNA, the University of Granada, “San Cecilio” Hospital in Granada, and the GSI Helmholtz Centre for Heavy Ion Research in Germany.

Bibliography

Mareike Müller, “Physical and biological characterization of light ionizing radiation”, Diploma thesis, Technische Universität Darmstadt, December 2004

Challenges in the LHeC Interaction Region Design

– Emilia Cruz Alaniz



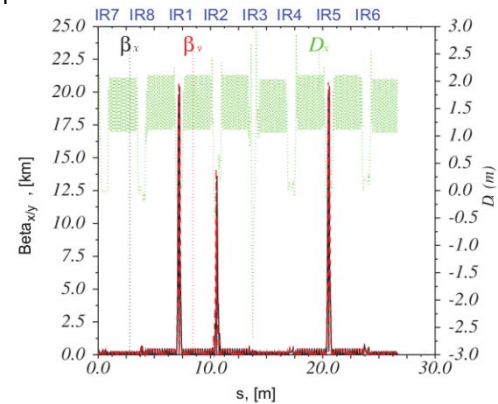
Particle Physics in the past has profited from the complementarity of different types of collisions. Thus the idea of using the machinery and energy reach of the Large Hadron Collider (LHC) to produce hadron-lepton collisions to take this type of collisions to the next level, just as the LHC has already done for proton-proton collisions.

This proposed upgrade experiment, named LHeC, will run synchronously with the LHC and will substantially extend and complete the physics research at the TeV energy scale. Providing the study of open questions in high precision QCD (Quantum Chromodynamics), new physics such as Higgs or SUSY and electron-ion physics.

The focus of this work involves the design of the interaction region, an important part of the overall design. The aim will be focused on integrating an electron beam with the LHC lattice at one of the interaction regions (IR) to interact with one of the proton beams while the other proton beam bypasses the interaction without disturbing the other IRs. An important part of this development involves reducing the beta function of the proton beam in the interaction point (β^*) to maximize the luminosity. For this purpose the implementation of a new inner triplet for the IR2 to minimize even further the beta function for one of the proton beams while having a field free hole for the non-colliding proton beam and the electron beam.

The real challenge relies on the fact that the quadrupoles on the IR2 have strength limits and the new inner triplet causes huge chromatic aberrations which limits the β^* itself to achieve the value needed for the wanted luminosity. In order to overcome this problem, the implementation of the Achromatic Telescopic Squeezing (ATS) Scheme has been proposed. This new conceptual optics scheme would provide a further reduction of the β^* while controlling the chromatic aberrations at the same time. This is achieved by producing a beta wave in the adjacent regions to the β^* with the help of the quadrupoles in

these same regions. This scheme has already been well studied for another upgrade of the LHC, the High Luminosity (HL-LHC) experiment. Therefore the task to be addressed would be to extend this beta wave in order to include the IR2 while maintaining the HL-LHC regions (IR1 and IR5) undisturbed. The first part of the problem had already been solved. The extended beta wave had been achieved without affecting the HL areas as illustrated in Figure below. However, the next step, which involved correcting the chromaticity, is yet to be solved. As expected, the new triplet was causing huge chromatic aberrations and the tune spread over a momentum of ± 0.001 crossed important



LHeC ATS collision optics for beam2 with $\beta^*=10$ cm at IP2 and $\beta^*=15$ cm at IP1 and IP5. The beta wave produced by the ATS can be observed in the adjacent regions to these interaction points.

A matching in MADX was used to correct the problem. This procedure took into account the

strength limits on the sextupoles, the reduction of the horizontal (Q_x') and the vertical chromaticity (Q_y') to a value of 2 and the reduction of the chromatic betatron amplitude function, W , in both transverse planes, below 200 in the collimation insertions IR3 and IR7. This matching procedure was done successfully. To extend this study even further, the tune was tracked for a variation of momentum of ± 0.001 , avoiding resonances up until the 10th order.

Another important part of the research included exploring two options to vary the parameters in the interaction region design: minimizing β^* and increasing L^* (distance from IP to inner triplet). The first option would have, as an obvious advantage, the increase of luminosity, while the second option would produce less synchrotron radiation from the electron beam and would be useful for the inner triplet design. More chromatic aberrations would be the expected on both cases. Cases for $L^*=10-20$ m and $\beta^*=5-10$ cm and a separate case for 20 cm were found and the natural chromaticity was tracked by putting all the sextupole families

to zero in order to track its behaviour. The case for L^* presented a linearly increase of the chromaticity while the increase for the smaller β^* case presented an exponential behaviour instead.

The case for $L^*=15$ m is being specially considered because of the advantages it gives for the quadrupole design for the inner triplet, especially of the first quadrupole. The same procedure to correct the chromaticity was followed with good results.

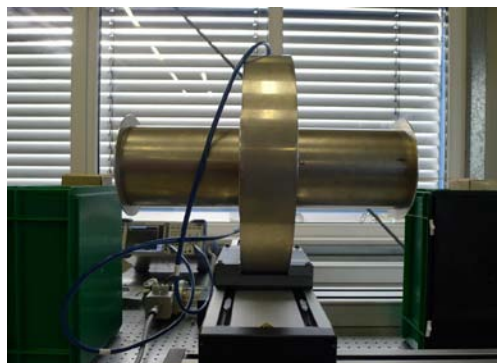
The next step of the research would be to make dynamic aperture studies to validate the ATS scheme.

The first model resonator is under test at GSI – Xiangcheng Chen

After almost one-year-long theory investigation and computer simulation, the first model resonator has been recently manufactured and delivered to GSI. This resonator will be used by oPAC fellow Xiangcheng Chen and his colleagues in order to verify the design principles of transversely sensitive resonators for particle position measurement in storage rings based on a novel concept [1].

Currently a heavy ion storage ring, the Collector Ring (CR), is being designed to operate in isochronous mode for the FAIR facility. With the high intensity and high energy secondary beams provided by FAIR, the CR will serve as a nuclear mass spectrometer particularly for short lived unstable nuclei in the regime of the nucleon drip line. Unfortunately the resolving power of the ring is subjected to the error introduced by different orbit lengths of stored ions. Therefore in order to achieve high precision, a novel position sensitive resonator is required to determine the ion paths, on which Xiangcheng is now working. The model resonator is made of AlMg3 alloy and stainless steel. It is a cylindrical cavity with beam openings on both ends, to which two beam pipes are attached. To compare with simulations, a bench top measurement is

being carried out. The resonator stands on a rail system which allows movement on a plain surface. The signals are extracted by two loop antennas on the circumference and transmitted by phase stable superflex cables to a Vector Network Analyser (VNA). For the shunt impedance measurement setup shown in Figure below, an alumina rod is inserted into the pipe and held by two supports. Both VNA and rail system are controlled by a computer, so that the measurement can be done automatically. As a next step, a bead measurement is being prepared in order to obtain the electric field distribution in the resonator.



The bench top measurement setup for the model resonator



[1] M. S. Sanjari, X. Chen, P. Hülsmann, Yu. A. Litvinov, F. Nolden, J. Piotrowski, M. Steck and Th. Stöhlker, in preparation for submission to *Rev. Sci. Instrum.*

Upcoming oPAC Events

Registration is now open for three oPAC Events:

Libera Workshop 2014, 10th April 2014, Solkan, Slovenia

Instrumentation Technologies, in collaboration with the oPAC research project, is jointly organizing the 10th Libera Workshop, which will be held on 10th April 2014 in Solkan, Slovenia.

For the first time the annual Libera community gathering will bring together experts who deal with the most demanding measurement and diagnostics tasks on a daily basis and the next generation of researchers with fresh perspectives in the field of optimization of particle accelerators, to exchange views on recent findings and the latest research approaches in their labs.

The upcoming workshop will also present a rundown of the achievements of the [Libera family instruments](#) over the years, as well as ideas for future approaches. "The Spring of New Ideas", this year's slogan, will present an overview of a decade of experience with Libera, and the fresh perspectives required to face the challenges of the future.

Registration for the Libera Workshop 2014 is now open. You are all invited to take part and learn about recent findings, product developments, and research approaches using Libera instruments. You are welcome to check our [website](#) for all updates regarding the workshop.

We look forward to receiving your online registration and meeting you in Slovenia in April.

Libera
WORKSHOP 2014

Programme:

April 9: Training sessions and Libera instrument demonstrations – get practical experience and an in-depth knowledge working on different Libera instruments (optional)

April 10 : Libera Workshop

April 11 : Satellite meetings – discuss your specific needs with Instrumentation Technologies engineers at individual sessions (with prior arrangement)

Registration:

[Register online](#) to attend the Libera Workshop.

The deadline for registration is 28th February 2014.

Contact:

For more information on Libera Workshop 2014, please contact [Ms. Teja Čadež Širca](#).



3rd oPAC Topical Workshop on Beam Diagnostics, 8th-9th May 2014, Vienna, Austria

To fully understand and optimize the properties of a beam in an accelerator, storage ring or light source, powerful beam diagnostics are essential.

This two-day international workshop will provide an overview of the current state of the art in beam instrumentation. It will discuss research and development being undertaken and ambitions to further improve the performance of existing and future facilities. It will have a focus on the latest developments in beam profile and beam loss monitoring techniques and technologies.

In addition to invited talks, there will be industry displays and many opportunities for discussions.

The workshop is hosted by [CIVIDEC Instrumentation GmbH](#) in Vienna and organized in partnership with the oPAC consortium.

The registration deadline is 28th February 2014 and participants will need to contribute €350 towards the cost of accommodation and meals provided.

To register please follow this [link](#).



oPAC Advanced School on Accelerator Optimization, 7th-11th July 2014, London, UK

This oPAC School covers accelerator optimization through beam physics studies, instrumentation R&D and charged particle beam simulations at an advanced level. It targets PhD students and Postdocs, as well as experienced researchers. The school will start with an introduction to each topic and is hence suitable also for researchers without previous experience in the field - the general teaching pace will be high to allow many advanced topics to be covered too.

The school will be hosted by [Royal Holloway University of London](#), UK and take place from 7th -11th July 2014. The registration fee of £700 covers course fee, accommodation and full board. The deadline for registration and payment is 31st May 2014.

More information and registration can be found at [Cern Indico](#).



Fellows News

Konstantin Kruchinin invited to give oral presentation at the International Symposium on Radiation from Relativistic Electrons in Periodic Structures “RREPS-13”



On 23rd – 27th September 2013, the “International Symposium on Radiation from Relativistic Electrons in Periodic Structures” **RREPS-13** took place in Lake Sevan, Armenia. The Symposium was organized by Tomsk Polytechnic University (Russia) and Institute of Applied Problems of Physics (Republic of Armenia). oPAC Fellow Konstantin Kruchinin attended as invited speaker presenting “Sub-micrometer Transverse Beam Size Diagnostics Using Optical Transition Radiation”.



Dr Pavel Karataev is the editor of the symposium proceedings which will be published this year in Journal of Physics: Conference Series.

Authors: K. Kruchinin, A. Aryshev, P. Karataev, B. Bolzon, T. Lefevre, S. Mazzoni, M. Shevelev, S. T. Boogert, L. J. Nevay, N. Terunuma and J. Urakawa

Title: Sub-micrometer transverse beam size diagnostics using optical transition radiation

Charlotte Roose: from the Lorentz force to the BEH boson

“Jeunesse et Science asbl” is a non-profit association which promotes sciences and technologies via astronomy. For that purpose, this association organizes teenager’s camps three times a year. Each camp has a specific topic. The one of this winter was “The observation”.

But, what is the link between an accelerator and an observatory? Researchers use the LHC to understand how the Universe started and what it is made of. So the topic of this camp was a good opportunity to present accelerators as an observatory of our Universe.

With that idea in mind, oPAC fellow Charlotte Roose presented a three hour introduction to particle accelerators and how they can be used to better understand astronomy to “Jeunesse et Science” camp teenagers (aged 13 to 16 years old). The presentation started

with some generalities such as the Lorentz force, the atom structure, the electron-volt. The second part was about the evolution of the accelerator design, their utilizations and the challenge of this technology. And the last part presented the colliders, CERN, and ended with the BEH boson.

Charlotte Roose was pleased with the students who actively participated in the presentation: answering quizzes, doing exercises, asking questions. They remained focused, interacting a lot despite the fact that it was the last day of the camp and their tiredness after observing three nights during the week due to the exceptionally good weather in Belgium!



oPAC Fellows visit Elementary Schools

As part of oPAC outreach activities, all oPAC Fellows are asked to visit schools. In the last few months Manuel Cargnelutti and Martina Sofranac have succeed in their task of bringing science closer to school students.

Martina Sofranac visited an Elementary school in her hometown in December. She gave a presentation to students in the third grade.

these children to believe that studying is the way to improve their future.

The war, hyperinflation and sanctions had a negative effect on Martina's childhood memories; however she believed in studying hard and eventually, with time, she realised that it was the right decision. Thanks to her grades, she had the opportunity to get many scholarships, to see part of the world and to meet interesting people.

Martina really appreciated the opportunity that the oPAC project brought her and tried to transmit her enthusiasm to the young students.

To conclude, Martina was very glad to have done this outreach activity and to have shared her life story with the school children. Many of them approached her after the presentation to thank her for her visit and she describes it as a very positive experience.

In her presentation, Martina talked about CST, oPAC and accelerators but her goal was also to encourage children to study. Since Martina comes from the same country, Montenegro, she realises how difficult it is for

The students and teachers from Italy and Slovenia, and Manuel himself enjoyed his visit.

Manuel Cargnelutti has already completed school visits in two countries. He had the chance to talk to students of different ages and in different languages.

His first visit was on 13th December 2013, to the school where he had studied in Tolmezzo, Italy.

In Nova Gorica, Slovenia, his current place of residence, students from the last year at the technical gymnasium were his second audience on 21st January 2014. This second time he presented himself, science and oPAC in English and we can see the details of his presentation under the [link](#).





Blaine Lomborg welcomes students at Cockcroft Institute

Two A-level students visited The Cockcroft Institute on 24th October 2013. oPAC Fellow Blaine Lomborg showed them his research experiments within the QUASAR Group. He explained the Halo Monitor and the Gas-Jet Monitor setup. The students were very enthusiastic and enjoyed the visit and the time spent with Blaine. Their feedback can be

summarised with their own words: “Thank you for that great opportunity to visit The Cockcroft Institute. We had such a wonderful time. It’s exciting to see where research takes place and all the equipment used. We really appreciated it, thank you.”

Manuel Cargnelutti: learning Slovene

In order to join the oPAC project, each fellow was required to move to a different country. Mobility and adaptability are essential skills for a researcher. To help the fellows adapt to the new language and culture, part of the project budget can be spent attending a language course.

Among all fellows, Manuel Cargnelutti, had probably the shortest move. The distance from the eastern region of Italy (Friuli-Venezia-Giulia), where he used to live, and the host institution in Slovenia is only around 100 km. Although this was an easy step from the distance point of view, on the other side it involves a huge change when it comes to the language: Slovene and Italian have basically nothing in common!

That’s why Manuel attended his first Slovene course in November. This turned out not to be just a language course but a really interesting experience. *Karnion*, which is a private language school in Medvode (LJ), offers individual courses, also named *supertraining programs*, which are concentrated into five days. Such an intensive course is organized in eight lessons per day, four with a mother tongue teacher and four based on a relaxed listening activity. This relaxed condition called also *alpha-state*, activates the long-term memory enabling a deeper learning based on the sounds you hear. Even though the schedule was intense, Manuel felt his brain was fresh and able to learn a lot more than with “traditional lessons”.

This didn't turn out to be a problem at work, since Instrumentation Technologies employees are quite fluent in English, some of them even in Italian. But obviously, every discussion which is not involving Manuel directly, is in Slovene. This can easily be a show stopper for personal relations, and is a pity not to take the chance to learn a new language.

After five days, he had a test to measure the level he had reached, and the result was A1. Of course such level is not yet enough to sustain a conversation, but is a starting point to improve more and more.

Definitely an experience worth doing!



Partner News

Bergoz Instrumentation News

Advances in calibration techniques help to achieve percent-level absolute charge accuracy using Turbo-ICT/BCM-RF.

The Turbo-ICT/BCM-RF is a new product that has been developed for charge measurements at XFELs, Laser Plasma Accelerators and other accelerators using ultra-short particle bunches of low charge. On-line calibration testing is possible via an optional integrated stable pulse generator (Cal-FO option). The Turbo-ICT/BCM-RF reaches 1% resolution even for pico-coulomb pulses. Absolute charge accuracy at the percent-level has been achieved by revising our existing calibration method and by establishing a new, complementary method. The first method is a time-domain calibration based on a fast pulser and oscilloscope measurements. The second is a frequency-domain method based on measurements using a network analyser and a signal

generator. The main challenge for both methods is impedance mismatches altering the signal seen by the Turbo-ICT; an important challenge for laboratory measurements which is not an issue in accelerators.



Turbo-ICT with Cal-FO option

An improved Goubau line has been set up expanding our capabilities for beam instrumentation testing up to 10GHz signals.

A Goubau line consists of a wave launcher, which creates a TEM-like electromagnetic wave, and a single enamel-coated wire in the center of these fields, which acts as a wave guide due to realistic boundary conditions. Current transformers, beam position monitors or other devices are placed around the wire and interact with the fields as they would interact with a particle beam. Our new Goubau line has been designed to create fields at frequencies starting from some 100 MHz up to about 10GHz. This frequency span allows to overlap measurements with data taken by standard measurement techniques and to expand

measurements into a previously inaccessible range. The new Goubau line is fully operational and we have started developing beam instrumentation that performs properly in the GHz range.



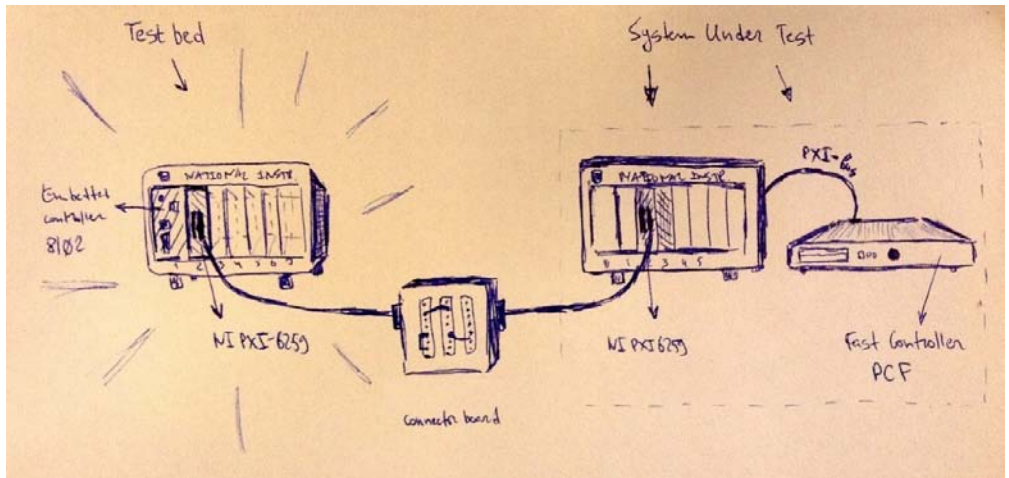
Current Transformer testing on the Goubau Line



Cosylab: TestBed Automated Test Framework by Pavel Maslov

The control systems in big physics facilities may be updated several times a year. Ideally, prior to each release, all components of the control system would be tested. One common control system component is a data acquisition (DAQ) driver which is generally tested manually according to a predefined test plan. In order to simplify this process, we have developed the TestBed suite, a test

framework that executes tests *automatically*. TestBed is a PXI chassis which contains an embedded controller running the control system on Scientific Linux and a DAQ board capable of generating and acquiring analogue and digital signals. TestBed provides an easy-to-use framework written in Python and allows for the quick development and execution of automatic test scripts.



The TestBed chassis is connected to the system under test. The network connection is not shown.

From a hardware perspective, each system under test is physically connected to TestBed with a connector board using a predefined pin configuration. Both the system under test and TestBed are connected to the network. The resulting test framework makes it

possible for the automatic tests to be executed with each new release of the control system, thus liberating human resources and ensuring complete consistency and repeatability in the testing protocol.

National Accelerator Science Open Day: Next Generation of Accelerator Researchers

The UK's inaugural National Accelerator Science Open Day was held at the Cockcroft Institute at Daresbury Sci-Tech site on the 4th December 2013 to attract physics students into accelerator science. OPAC partners CERN, the Universities of Liverpool and Manchester were represented with staffed displays informing students about their career options in the field. This was the first open day of its kind and the response from students was very positive with the event promising to become an annual attraction.



Topical Workshop on Instabilities, Impedance and Collective Effects (TWIICE) 16th and 17th of January 2014 in Synchrotron SOLEIL, France.

TWIICE, Topical Workshop on Instabilities, Impedance and Collective Effects was organized at [Synchrotron SOLEIL](#) in the series of Low Emittance Rings ([LOWeRING](#)) Workshops of the EuCARD-2 Project.

The goal of this workshop was to gather experts working on collective beam instabilities and related subjects in low emittance lepton rings such as present and future light sources, damping rings, test facilities for linear colliders, B-factories.

OPAC fellow Xavier Nuel Gavaldà was member of the organization committee of this Topical Workshop. Xavier was happy to be an active member of the local organization committee gaining experience in events management through team work. He also acted as a guide during the visit of the SOLEIL accelerator facility.

TWIICE was a success with a total of participants of 73 from **26 laboratories/universities** around the world (Europe: 19, USA: 5, ASIA: 2), collecting **35 talks**.

All potentially important collective effects that may arise and jeopardise the performance of currently running and future low emittance lepton rings have been discussed. After review talks, state of the art results both theoretical and experimental, and main work directions have been presented in 5 sessions (Impedance and Instabilities, particle scattering, two-stream instabilities, instrumentation and feedbacks, CSR instabilities).

Proceedings and session summaries are all available on the [TWIICE workshop website](#).



Participants to the TWIICE workshop

LHeC and oPAC opening up new horizons for Higgs physics and deep inelastic scattering

On 20th -21st January 2014, more than 100 particle physicists and accelerator experts, including oPAC fellows Alessandra Valloni (CERN) and Emilia Cruz Alaniz (University of Liverpool and Cockcroft Institute), discussed the next big step in high-energy deep-inelastic scattering at the “5th LHeC workshop” in Chavannes-de-Bogis, Switzerland. Among the participants were 44 scientists from CERN, 43 from other European Institutes, 14 from the United States of America, as well as 8 from Asia, South America and Africa, reflecting the large worldwide interest in the proposed powerful electron-hadron collider. With the invitation of a group of accelerator and particle physicists and of a high-level international advisory committee, chaired by emeritus DG of CERN, Herwig Schopper, to coordinate and oversee the next steps of the LHeC development, the CERN directorate established a new organisation for future energy frontier *ep* and *eA* experiments.

Inspired by the discovery of a Higgs boson and by the better than expected proton beam properties obtained at the LHC, LHeC parameter sets have been revised to boost the LHeC luminosities to levels above $10^{34} \text{ cm}^{-2}\text{s}^{-1}$, at which several tens of thousands Higgs bosons per year will be produced in *ep* scattering, allowing for precision Higgs physics and rendering the LHeC a true and unique Higgs factory.

On the particle physics side the workshop illuminated three exciting areas of LHeC research: searches for new physics including Higgs studies, precision measurements of parton distribution functions (which would also improve the analysis of the LHC experiments), and exploration of a new regime of QCD. The accelerator sessions reviewed the LHeC ERL baseline design, the recent performance optimization in light of the Higgs discovery, the LHeC integration into the High-Luminosity LHC, the design of a CERN ERL test facility, and ERL activities around the world.

The possibility, at the LHeC, of colliding electrons and ions other than protons may also motivate new studies on the accelerator part, e.g. regarding deuteron-beam production.

At the workshop, oPAC fellow Alessandra Valloni proposed a staged scenario for the construction of the CERN ERL Test Facility, with intermediate steps used for important accelerator studies and attractive applications, and aimed at an ultimate beam energy of about 1 GeV. She presented the detailed optics design of this test facility including spreaders and combiners. One possible application is controlled quench tests of superconducting magnets, for which the expected beam parameters were shown to well match the requirements.

A second oPAC fellow, Emilia Cruz Alaniz, discussed the integration of the LHeC proton optics into the HL-LHC design, in particular the chromatic correction for the case of an extended achromatic telescopic squeeze (ATS) with a b^* of 15 cm in LHC interaction points (IPs) 1 and 5, and a b^* of 10 cm in IP2 for LHeC. She examined the effects of an even smaller b^* for LHeC as well as of a longer free length between the IP and the first quadrupole, L^* , e.g. 15 m instead of 10 m. The latter leads to about 10% increase in chromaticity. Her next steps will be an exploration of the chromaticity-correction limits, dynamic aperture studies to validate the ATS scheme with 3 interaction points, and ensuring compatibility between the proton optics and the design of the electron beam line.

Several meetings, including the FCC workshop in Geneva, will now explore these exciting options further – and of course oPAC partners will stay strongly involved.



Developments on Recruitment in the Network

Grazia Scognamiglio was born in Pompei in 1987 and studied Physics at the University Federico II of Naples.

As an undergraduate student, she collaborated within the ATLAS group of Naples, developing software whose purpose is the monitoring of muons detectors of the ATLAS experiment at LHC. This work became her Bachelor's Degree Thesis, discussed in 2010.

In the same year, Grazia started a Master's course with specialization in Electronics. She implemented and tested communication protocols between FPGAs optimized for spatial applications, adapting them to the requirements of the JEM-Euso project. With

this work of thesis, she obtained a Master's Degree in 2012.

After her studies, she improved her software and hardware programming skills through many stages in private and public companies. Since January 2014, Grazia is employed as a Marie Curie Early Stage Fellow at the CNA and the University of Seville. The objective of her research is the optimization of ^{10}Be detection into an AMS apparatus, which will be performed searching for the best operation settings and designing fit modifications to the system.

Welcome to oPAC!



Vacancies

The Accelerator Division of ALBA is looking for a Linac specialist to join the RF&Linac Section.

ALBA is a 3GeV electron synchrotron Light source in operation, located in Cerdanyola del Vallés, Barcelona, Spain. The CELLS consortium is the responsible of the maintenance and operation.

ALBA accelerators include: a Linac at 100 MeV, a Booster to ramp the energy up to 3 GeV and a Storage Ring. There are seven operational beamlines. The synchrotron operates 24 hours per day, seven days a week, in periods of several weeks.

The key functions of the post are:
 Commissioning, operation and maintenance of the Linac accelerator.
 Involvement in the upgrade projects of the Linac.
 Operation of the ALBA accelerators, including shifts work and on-call, accordantly to the established schedule.

For more information:
<http://www.cells.es/Jobs/JobOffers/...>



oPAC Events

April 9 th – 11 th 2014	oPAC Libera Workshop, Instrumentation Technologies, Solkan, Slovenia
May 8 th - 9 th 2014	oPAC TW on Diagnostics, Vienna, Austria
July 7 th - 11 th 2014	oPAC School on Accelerator Optimization, London, UK

Events

April 28 th – 30 th 2014	LA ³ NET Workshop on Novel Acceleration Schemes, Dresden, Germany
May 5 th – 6 th 2014	Workshop on Advances in Low Emittance Ring Technology. Hosting Laboratory: IFIC, University of Valencia, Spain
June 15 th – 20 th 2014	IPAC 14, Dresden, Germany
Sept 1 st – 5 th 2014	LINAC 14, Geneva, Switzerland
Sept 17 th – 19 th 2014	Low Emittance Rings Workshop LER2014. Second annual meeting of EuCARD-2 WP6. Hosting laboratory: LNF-INFN, Frascati, Italy
Sept 29 th – Oct 3 rd 2014	School on Advanced Laser Applications at Accelerators, Salamanca, Spain

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NOTICE BOARD

DEADLINE FOR CONTRIBUTIONS TO THE NEXT NEWSLETTER 18th April 2014

About oPAC

The optimization of the performance of any Particle ACcelerator (oPAC) is the goal of this new network within the FP7 Marie Curie Initial Training Network (ITN) scheme. oPAC aims at developing long term collaboration and links between the involved teams across sectors and disciplinary boundaries and to thus help defining improved research and training standards.

oPAC is funded by the European Commission under Grant Agreement Number 289485



www.opac-project.eu

