EuroFEL NEWS 03|13

6th issue · www.eurofel.eu

8th SC meeting of the Collaboration of European FEL and SPS Facilities, 14-15 March 2013 at INFN, Frascati, Italy.

EuroFEL moves forward to AISBL

The overwhelming majority of partners have recently agreed that EuroFEL adopts the legal form of a non-profit association under Belgian law, an AISBL (association international sans but lucratif). A draft statute was discussed and revised by the facility representatives on 15 March. The European IR FEL facilities will also be members of the AISBL.

This is a very important step forward to being recognised by ESFRI (European Strategy Forum on Research Infrastructures) as so-called European distributed research infrastructure. All ESFRI projects that are not yet implemented are currently being assessed by ESFRI. EuroFEL had its interview with the Assessment Expert Group in Brussels on 14 February; the draft AISBL statute was sent to them after the discussion in Frascati. An ERIC (European Research Infrastructure Consortium) which was originally envisaged by the IRUVX-PP project as legal framework, is currently not possible with all facilities and would also take much more time, therefore it was decided to establish an AISBL as a first step. This would not exclude an ERIC in the future if it should turn out to be the more suitable structure.

Two years ago, at the end of IRUVX-PP in March 2011, the legal framework was not the main issue. It was much more important to find ways to continue the very fruitful collaboration that had been funded over six years by FP6 and FP7, and to integrate the European XFEL that was very interested to participate in the activities. Finally, on 31 May 2012, European XFEL and all previous IRUVX-PP partners signed a memorandum of understanding establishing the Collaboration of European FEL and SPS Facilities. The Steering Committee of the Collaboration has since initiated a number of joint activities (see the article on the right). *JF*

8th SC meeting

The 8th Steering Committee meeting of the Collaboration of European FEL and SPS Facilities took place at INFN on 14 March 2013 in Frascati, Italy.

Two newly established expert groups on pulse length measurement and seeding schemes bringing together experts from the Collaboration, presented first ideas for joint technical developments. These groups are also open to external experts who want to contribute to the topics.

The Steering Committee discussed also the concept of a white paper on European FEL science. It will include the science case for the complete European research infrastructure of free electron lasers comprising the European XFEL and all national FEL facilities. The white paper is planned to be published by March 2014.

Further activities planned for 2014 are the 2nd Science at FEL conference, to be organized as a satellite to the FEL conference at PSI, and an FEL school for Ph.Ds. and Postdocs at MAXLAB. CI

IN THIS ISSUE

EuroFEL
FREE ELECTRON LASERS OF EUROPE

EuroFEL is part of the ESFRI Roadmap since 2006; its preparatory phase (IRUVX-PP) prepared the establishment of the EuroFEL Consortium to link FEL & SPS facilities in Europe closer together and was funded by the European Commission under FP7 from April 2008 to March 2011. Some results were taken up in the EC funded projects Pandata & PaNdataODI. EuroFEL became partner in the EC funded cluster of research infrastructures for synergies in physics-CRISP. *info@eurofel.eu*

Seeding Experiment at FERMI @ ELETTRA

The FERMI@Elettra seeded Free Electron Laser (FEL) is based on two complementary FEL lines, FEL-1 and FEL-2. The first one, is a single stage cascaded FEL delivering light in the 65-20 nm wavelength range. This FEL is in operation since December 2010 and has reached full specifications in 2012. The FEL is now delivering light to dedicated user experiments.

The second FEL beamline, FEL-2, is a double stage cascaded FEL, based on the scheme denominated "fresh bunch injection technique" [1]. The two stages consist of two FELs, each one similar to FEL-1, where the first stage generates a short wavelength seed which is then used by the second stage to further reduce the final wavelength. The two stages are driven by the same electron beam, and are separated by a delay line which introduces a shift in the longitudinal position of the photons generated in the first stage, moving the light onto a fresh portion of the electron bunch, not yet heated by the FEL process.

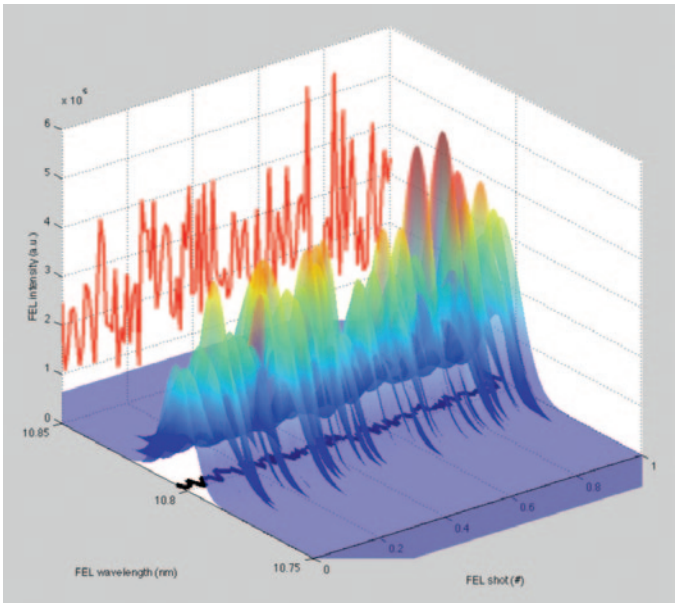
Commissioning of the FEL-2 started in October 2012. The first commissioning experiments were done at a final wavelength of 14.4 nm in planar polarization. This wavelength is the result of a harmonic conversion to the 6th harmonic (43.3 nm) in the first stage and the 3rd harmonic in the second (i.e., 18th harmonic of the seed laser). The FEL pulse energy has been optimized to increase the flux to about 20-30uJ. Further tests at the final wavelengths of 10.8 nm obtained as the 24th harmonic of the seed wavelength at the end of the two frequency conversion processes, have demonstrated that the FEL is capable of producing single mode narrow bandwidth pulses with an energy exceeding 50 uJ and shot to shot fluctuations of about 14% (rms).

The figure shows a sequence of the single shot spectra obtained from FEL-2 at 10.8 nm.

In the extreme ultraviolet, this is the first experimental demonstration of a seeded free electron laser configured in the "fresh bunch" injection mode. *LG et al.*

[1] I. Ben-Zvi, K. M. Yang, L. H. Yu, Nucl. Instruments Meth. A 318, 726 (1992).

http://www.elettra.trieste.it/lightsources/fermi/fermi-management-page.html



Sequence of consecutive spectra from FERMI FEL-2 operating at 10.8nm.

Users' Meeting in Hamburg

From the 23 – 25 January 2013, the annual users' meeting jointly organized by DESY photon science and European XFEL took place at DESY, Hamburg, with over 800 scientists in attendance and nearly 50 exhibiting companies. The high attendance record demonstrates the growing interest in this rapidly developing and exciting field, as well as the interest in the light sources FLASH and PETRA III and the European XFEL which is under construction. The first two days were dedicated to the FEL facilities. The latest developments at European XFEL and FLASH were presented as well as recent scientific results obtained at FLASH and LCLS, USA. Also important at this years' meeting was the participation of a high number of young scientists who form the next generation of experts and are important to the continuous development of this field. *CI*

5th Annual X-ray FEL Collaboration Meeting

From the 4-6 February 2013, the 5th Annual X-ray FEL Collaboration Meeting took place at the SLAC National Accelerator Laboratory in Menlo Park, California, USA. A total of 89 scientists from five X-ray laser laboratories around the world presented the status of ongoing development projects to their peers. The main purpose of this regular meeting is to initiate and foster collaborations on the technical level in the areas of electron beam dynamics, seeding techniques, x-ray optics, diagnostics, and simulations. A detailed program of the meeting and more information can be found at *https://portal.slac.stanford.edu/sites/conf_public/5xrf2013/*

The next meeting will take place in 2014, in Hamburg. *HS*

Self-Seeding: A Path to Single-Mode X-ray FELs

Typically, SASE FEL output is poorly longitudinally coherent due to start-up from shot noise. Self-seeding schemes aim at providing single-mode X-ray pulses. However, up to recently, proposed methods required major changes to the facility layout [1]. Recently, a collaboration of DESY members V. Kocharyan and E. Saldin, and European XFEL member Gianluca Geloni proposed a self-seeding concept in the hard X-ray regime with minimal and cost-effective changes to the baseline [2]. The setup size is reduced to that of a single undulator segment, and can be installed without changes to the focusing system, easily granting return to the baseline mode of operation. In its simplest configuration, the layout includes a first undulator where the SASE process takes place in the linear regime. The self-seeding setup follows, where the electron beam microbunching is washed out and a monochromatic seed is created. Finally, the seed is amplified by interaction with the electron beam in an output undulator. The self-seeding setup is composed of a weak chicane, washing out the microbunching, creating a transverse offset for the installation of a single-crystal monochromator, and acting as micron-level tunable delay line. The monochromator is composed of a single crystal, a thin diamond crystal, which acts as a bandstop filter in the frequency domain. In the time domain, the effect of the filtering corresponds to the appearance of a trailing pulse of monochromatic radiation. By tuning the chicane, the electron beam can be parked onto this pulse, which acts as seed, Fig. 1. The final output pulse is nearly Fourier limited. In early January 2012, experimental confirmation of the scheme proposed by the DESY/European XFEL collaboration was provided at the LCLS facility in Stanford, demonstrating as expected, an increase in the spectral density of the output pulse [3]. Following this experimental demonstration, scientists at the SACLA XFEL, in Japan, began to equip their facility with a single-crystal self-seeding setup. The success of self-seeding in the hard X-ray range also promoted worldwide developments of technical solutions for self-seeding in the soft X-ray range. Efforts are underway at the European XFEL and other facilities to enable the realization of self-seeding setups. The scientific community recognized the novel invention and honored the DESY/European XFEL collaboration members, together with Paul Emma for the LCLS group, with the Innovation Award on Synchrotron Radiation, Fig. 2. For the future, self-seeding schemes combined with post-saturation tapering hold the promise for a tremendous increase of the output power from XFELs [4]. Preliminary simulations for the baseline undulators of the European XFEL show that TW-level pulses can be achieved in this way. *GG, VK, ES*

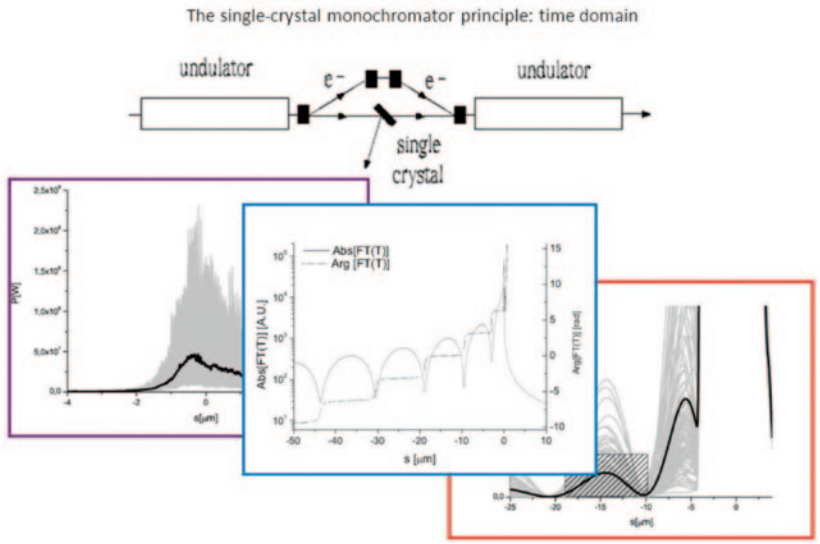


Fig. 1 – The self-seeding working principle with single-crystal monochromator.

Fig. 2 – From right to left: Vitali Kocharyan (DESY), Gianluca Geloni (European XFEL), Evgeni Saldin (DESY) and Paul Emma (LBNL) in front of the LCLS self-seeding setup.

[1] J. Feldhaus et al., Optics Comm. 140, 341 (1997)
[2] G. Geloni, V. Kocharyan, and E. Saldin, J. Modern Optics 58, 1391 (2011).
[3] J. Amann et al., Nature Photonics 6, 693 (2012).
[4] G. Geloni, V. Kocharyan, and E. Saldin, DESY Report No. 10-108, 2010.

Civil Construction of European XFEL Well Underway

In the Hamburg area, hundreds of employees from European XFEL, DESY and different construction companies continuously prepare the field for the moment, when the world's brightest light source will finally light up in 2015. In 2012, the civil construction again made good progress at all sites and all major milestones were met. The most important one was the completion of the network of tunnels, which totals nearly 5.8 kilometres in length and extends 3.4 kilometres from Hamburg-Bahrenfeld to Schenefeld in Schleswig-Holstein. After two years of tunnel boring, the event was marked by a celebration with more than 400 participants – including guests from politics and science as well as staff from collaborating companies. Installation of the technical infrastructure inside the tunnels has now begun and the civil construction crews made way for the installation teams.

At the heart of the future site in Schenefeld, more than 90% of the experiment hall is finished and the ceiling will be closed in March. Construction of walls and storeys of the shaft buildings which are built at the branching sites of the tunnels is completed at some shafts, while on-going at others. The layout of the laboratory and office building that will be placed on top of the ceiling has been planned and discussed with the scientists who will later operate the beamlines.

2012 aerial view of the Schenefeld site of XFEL.EU with the future experiment hall in the foreground.

At the DESY-Bahrenfeld site, the entrance hall, the modulator hall and the injector hall covering the access shafts to the injector building rooms are essentially finished, and with their elegant anthracite design they are the first above surface buildings visitors can spot of the future unique research facility. Up to 40 metres below, the shaft and tunnels are now being prepared for the installation of the injector hardware and the linear accelerator. This includes the walls for the many rooms of the seven-storey underground building, as well as the elevator shafts.

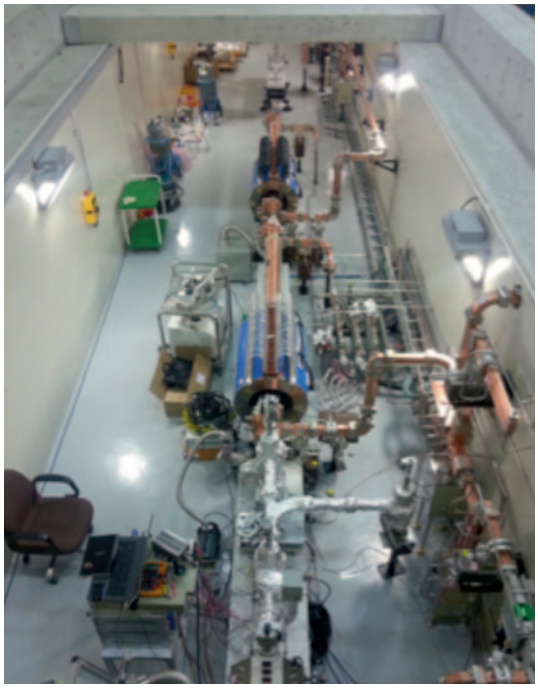
The Osdorfer Born site, which is somewhat more than half way between the injector and the experiment hall, marks the point where the linear accelerator tunnel (XTL) ends and the first two undulator tunnels begin. In 2012, work at Osdorfer Born concentrated on the construction of the underground storeys of the shaft building. The underground building is now ready for the installation of the technical infrastructure. The construction of the hall on top of the shaft is scheduled to begin in March and to be completed at the end of the year.

Despite the very complex nature of the project, costs for civil construction remained within the budget foreseen for the year. European XFEL is also optimistic that civil construction will continue to proceed according to plan in the challenging and exciting months and years to come. *AS, BE*

PAL-XFEL, South Korea

The PAL-XFEL project started in 2011 with a 4-year budget of $400M has made a big progress in ground preparation work in February 2013. The construction of the 1,110 m long building will be completed by November 2014. The budgets for the years 2011, 2012, 2013 stood at $20M, $45M, and $85M respectively. The project period has a good possibility of extending one more year due to the budget. If this happens, the accelerator construction will be finished in 2015 and the commissioning will follow. The installation of the injector test facility was completed in October 2012 and is now undergoing beam commissioning. ITF has the same configuration as the injector of the PAL-XFEL which consists of a photo-cathode RF-gun, two S-band accelerating structures, and a laser heater. A deflector S-band cavity will be installed in ITF in May to measure the slice emittance and a laser heater undulator in September 2013. ITF will be used as a test bed for the performance evaluation for diagnostics and control devices for the PAL-XFEL such as strip-line BPM, cavity BPM, screen monitor, and a beam arrival time monitor, etc. A prototype 5m long out-of-vacuum undulator

Areal view of PAL-XFEL facility.



Injector test facility at PAL-XFEL.

adopting the XFEL.EU design is being fabricated by a local company. It will be delivered to PAL in April 2013 and be measured at the undulator field measurement lab (13-m wide and 64-m long) where there are two measurement rooms with a 0.1°C temperature control capability to measure a total of 42 undulators for one and half years. The field measurement lab will be ready by March 2013 by renovating one of the existing buildings. *H-SH*

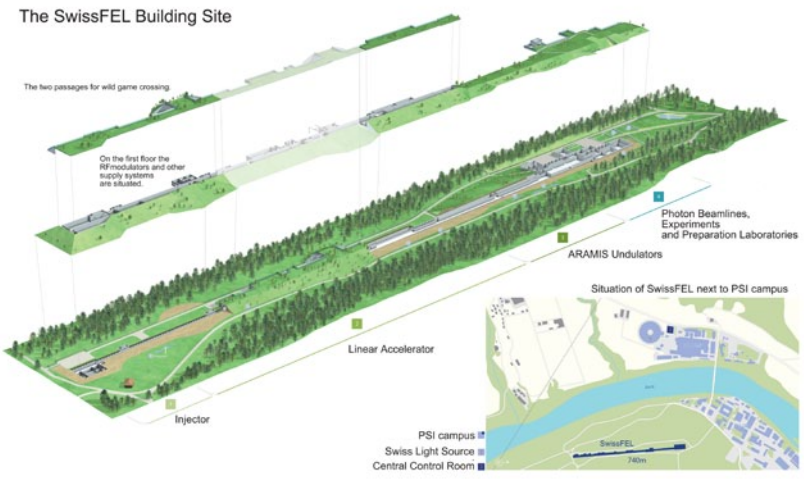
SwissFEL-Project Status

Important milestones for the realization of the new SwissFEL facility were reached in 2012. In September 2012, the Swiss Parliament approved the Federal Program for Education and Research for the 2013-16 period, which includes the mandate for PSI to build SwissFEL. On the 14th of December 2012 the budget for federal building construction was approved including the funding for the SwissFEL building. The legally valid building permit for SwissFEL arrived at the end of January 2013. Directly afterwards uprooting on the SwissFEL building site in the "Würenlinger Wald" near PSI started, and will go on until the end of March. Building site preparation and connection of PSI infrastructures to the SwissFEL site started in fall 2012 and are still ongoing.

As next milestone, the ARGE "EquiFEL Suisse", a consortium of three Swiss companies, was awarded the exclusive contract as full service general contractor for the construction of the SwissFEL Building and its technical infrastructure. Signing of the contract took place on the 7th of February 2013. First works for the SwissFEL building and its technical infrastructure will start in April 2013. At the end of 2014, the finished building will be delivered to the Paul Scherrer Institute. SwissFEL machine commissioning and commissioning of the experimental stations will follow in 2015 and 2016. The first beam is foreseen for the end of 2016.

The project is progressing well. The new SwissFEL facility will open the door to discoveries in many areas of current research that cannot be obtained using existing methods, and will also provide the basis for a vast range of technical and scientific developments.

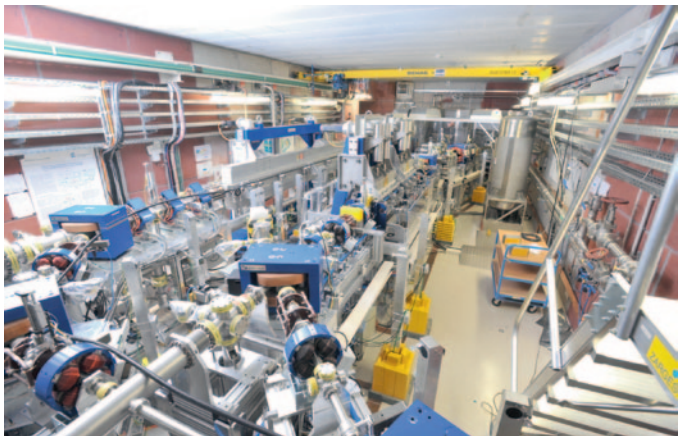
The collection of user input for the design of the initial set of instruments at the SwissFEL hard X-ray „ARAMIS" undulator beamline started in 2011 with two Scientific Workshops on hard X-Ray Instrumentation with the SwissFEL. Planning of the design of the experimental stations was continued in 2012 with 5 topical workshops focusing on the different experimental stations (ES); 1. ESA: Multi-purpose pump probe, 2. ESB: Pump-probe crystallography, 3. ESC: Coherent diffraction imaging, 4. next frontier SwissFEL instruments, and 5. SwissFEL scientific computing & data acquisition. Further workshops on pump laser and sample mounting were held in November 2012. The talks given by experts from different facilities gave an inspiring view of the existing and planned instrumentation for pump laser and sample mounting at different FEL and XFEL facilities. We are grateful for the excellent contributions which were made; more information can be found on: *http://www.psi.ch/swissfel/swissfel-workshops* *MvD*



Other FEL & SPS Facilities at a Glance

FELBE @ HZDR, Dresden, Germany

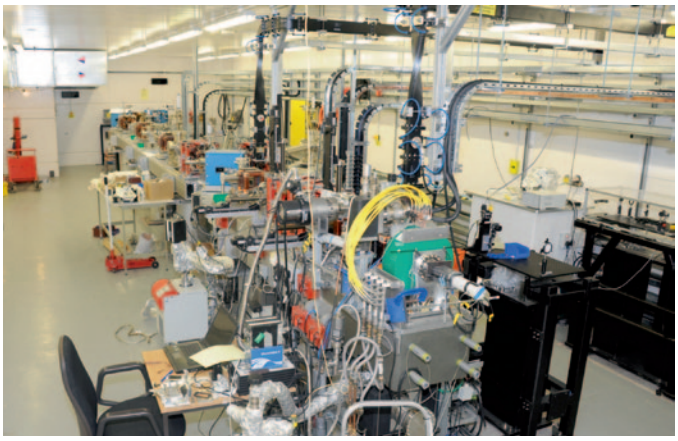
The Helmholtz-Zentrum Dresden-Rossendorf (HZDR) hosts the FELBE user facility. At FELBE two free-electron lasers based on the superconducting electron linear accelerator ELBE are in mature operation. The facility name FELBE stands for FEL@ ELBE. The two lasers deliver picosecond pulses at energies up to the µJ level in the wavelength range from 4 – 250 µm. The key feature which distinguishes FELBE from other FEL user facilities is the possibility of "quasi cw" operation (meaning a continuous train of pulses at 13 MHz repetition rate). Additionally FELBE can be operated in macrobunch mode and in 1 kHz (pulse picking) mode. The two FELs can be synchronized to a number of tabletop femtosecond and picosecond lasers, enabling two-color experiments from the near-infrared to the THz frequency range. The main techniques at FELBE are pump-probe spectroscopy and time-resolved photoluminescence. Furthermore there is a lab devoted to near-field microscopy and the possibility to perform spectroscopy in pulsed high magnetic fields up to 70 T (150 ms magnetic pulse duration). *MH*



View in the cave with the mid- and near-infrared FELBE FELs.

EBTF @ STFC, Daresbury, UK

EBTF is a new RF photoinjector facility at Daresbury Laboratory in the UK that is designed to deliver a highly stable, highly customisable, short pulse, high quality electron beam to a number of test enclosures. The new facility will deliver a capability for the cutting edge development and qualification of advanced accelerator systems, enabling industry to advance their technology development from prototypes to market ready products. The EBTF has been assembled over recent months (see photo) and the gun cavity is now being conditioned with high power RF pulses. It is anticipated that once this conditioning is complete that the first electron bunches will rapidly follow. In parallel to the assembly and commissioning a wide collaboration led by ASTeC has been designing an advanced FEL test facility named CLARA which will make use of the very high quality electron bunches from EBTF. For further information about the plans and capabilities of CLARA or about the opportunities available with EBTF please contact Prof. Jim Clarke: *jim.clarke@stfc.ac.uk*. *NP*



The new electron beam test facility at Daresbury laboratory, STFC, UK.

FERMI @ ELETTRA, Trieste, Italy

The FERMI@Elettra seeded FEL facility, close to the Elettra ring, is shown in the picture, from right to left the Linac building, the Undulator Hall and the Experimental Hall.

MAX IV @ MAXLAB, Lund, Sweden

At the top-left the start building above the laser photo gun is ready.
At the right hand side the support building for the SPF (Short Pulse Facility) experimental hall is seen. The linac tunnel stretching between the two buildings is ready and covered with earth.
In the centre of the photo, the main storage ring building is starting to grow.

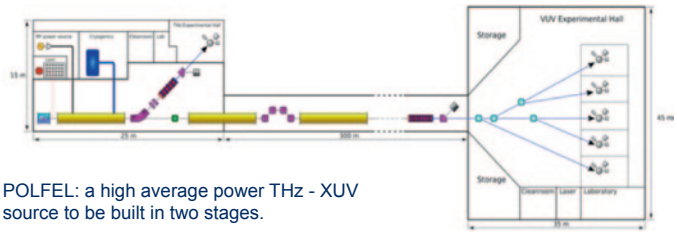
FELIX @ RU, Nijmegen, The Netherlands

The layout of the four beam lines - FLARE, FELIX-1, FELIX-2 and FELICE – of the FELIX Facility.

FLASH @ DESY, Hamburg

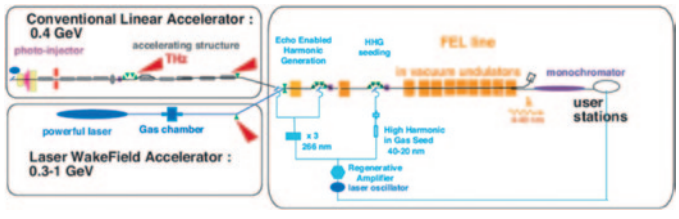
The FLASH facility at DESY in Hamburg, Germany, is currently undergoing a major upgrade to add a second undulator line (FLASH II) which together with an accompanying experimental hall, will double the number of experimental stations.

POLFEL @ NCBJ



POLFEL: a high average power THz - XUV source to be built in two stages.

LUNEX 5 @ SOLEIL, St. Aubin,France



The LUNEX5 (free electron Laser Using a New accelerator for the Exploitation of X-ray radiation of 5th generation) aims at investigating the production of short, intense, coherent pulses in the soft X-ray region.

CLIO @ CNRS, Paris, France

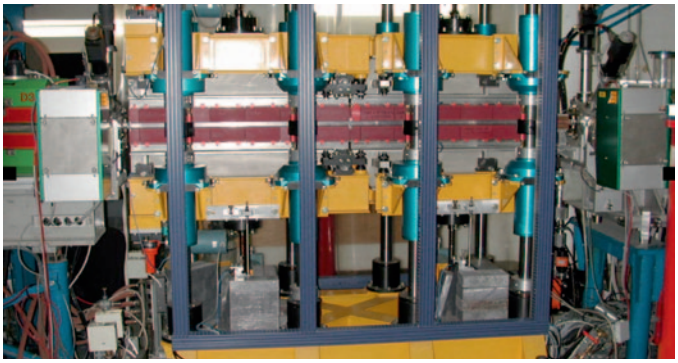


Fig 1 : Undulator of the CLIO infrared FEL (4 -120 µm). The variable gap allows to adjust continuously the wavelength by a factor of 2 at each accelerator energy, for spectroscopic measurements.

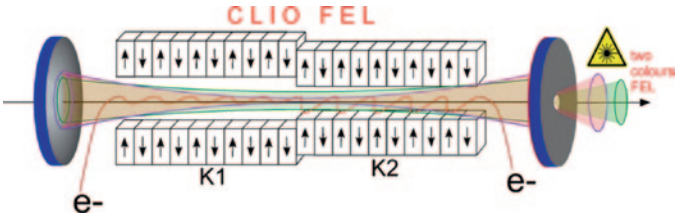
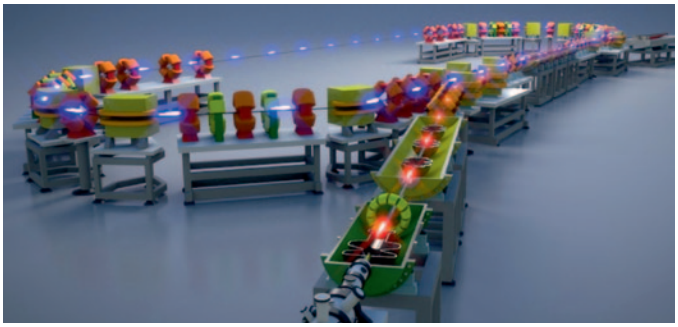


Fig 2 : The above undulator is made of 2 independently adjustable parts, allowing to produce a 2 colors FEL between 5 and 40 µm, the maximum relative separation being approximately 50%.

SPARC @ INFN, Frascati, Italy

Some members of the Steering Committee of the Collaboration of FEL and SPS facilities visiting the SPARC test facility at the Laboratori Nationali di Frascati (LNF) during the 8th SC meeting on 14th March 2013.

BERLinPro @ HZB, Berlin, Germany



BERLinPro combines the advantages of different accelerator concepts. The ERL combines the brilliant, ultrashort electron pulses of a Linac while simultaneously utilizing the high-repetition rate and high average current of the superconducting Linac.

Workshop at DESY Launches New Collaborations in MTCA Community

The first MTCA (Micro Telecommunications Computing Architecture) Workshop for Industry and Research was held from the 11-12 December 2012, with 180 participants from 15 different countries. The event was well received by industry representatives and academics alike and plans are already underway for the 2nd MTCA Workshop at DESY on 11-12 December 2013.

The primary focus of this year's workshop was to bring the fledgling MTCA community together. Many specialists in this field have already collaborated closely, but never met face-to-face before. Another important objective was to make the world of MTCA more inclusive and reach out to those with interest but no experience in the technology. Three tutorial sessions dedicated to MTCA beginners provided plenty of opportunities to ask questions about basic system set-up and configuration before a densely packed set of five sessions covered more advanced topics. Coffee breaks were held right at the industry exhibition outside the main auditorium, facilitating lively discussions of the current state-of-the-art.

The overall spirit was decidedly positive and optimistic given that major research organizations have commenced extensive programs to evaluate and test MTCA installations. Many speakers highlighted the growing need to address open questions around MTCA.4, such as coordinated EMI mitigation, pin assignment for analog and digital signal routing through the Zone3 connector and thermal management of crates and boards. The workshop laid the foundation for a more structured discussion of these and other issues at a BoF gathering which assembled like-minded participants who will now start to collaborate in search of sustainable solutions.

A one-hour tour of selected MTCA-related facilities and an evening dinner at the festively decorated DESY lunch hall rounded off the event.

All workshop material has been made available for download via the MTCA Workshop archive at: *http://mtca.desy.de* TW

UPCOMING EVENTS

SPIE Conference "Advances in X-ray Free Electron Laser Instrumentation"
15 – 18 April 2013, Clarion Congress Hotel Prague, Czech Republic
Organized by the international society for optics and photonics (SPIE)
http://spie.org/optics-optoelectronics.xml

Ultrafast X-ray Summer School 2013 (UXSS 2013)
11 – 14 June 2013, Centre for Free-Electron Laser Science (CFEL), Hamburg, Germany
The school is jointly organized by CFEL and SLAC
https://conferences.cfel.de/uxss_2013/

4th International Conference on Attosecond Physics (ATTO2013)
8 – 12 July 2013, Institut Pasteur, Paris, France
http://atto2013.celia.u-bordeaux1.fr/

2nd workshop on Intense Field, Short Wavelength Atomic and Molecular Processes (ISWAMP-2)
20 – 22 July 2013, Xi'an, China
http://iswamp2.csp.escience.cn/dct/page/65540

CORPES-13: International Workshop on Strong Correlations and Angle-Resolved Photoemission Spectroscopy
29 July – 2 August 2013, DESY, Hamburg, Germany
Workshop is hosted by European XFEL
http://corpes13.xfel.eu

The X-ray Free Electron Laser School and symposium (X-FEL 2013)
16 – 20 September 2013, Dinard, France
Organized within the framework of a French GDRI-XFEL initiative
http://xfel2013.univ-rennes1.fr/

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Images: page 1 Claudio Federici; page 2/3 Luca Gianessi, Gianluca Geloni; page 4/5 XFEL.EU, PAL-XFEL, SwissFEL; page 6/7 FELBE, ELETTRA, STFC, Perry Nordeng, FELIX, DESY, POL-FEL, M-E Couprie, CLIO, C Itambi, Edgar Weckert, BERLinPro; page 8: Thomas Walters.