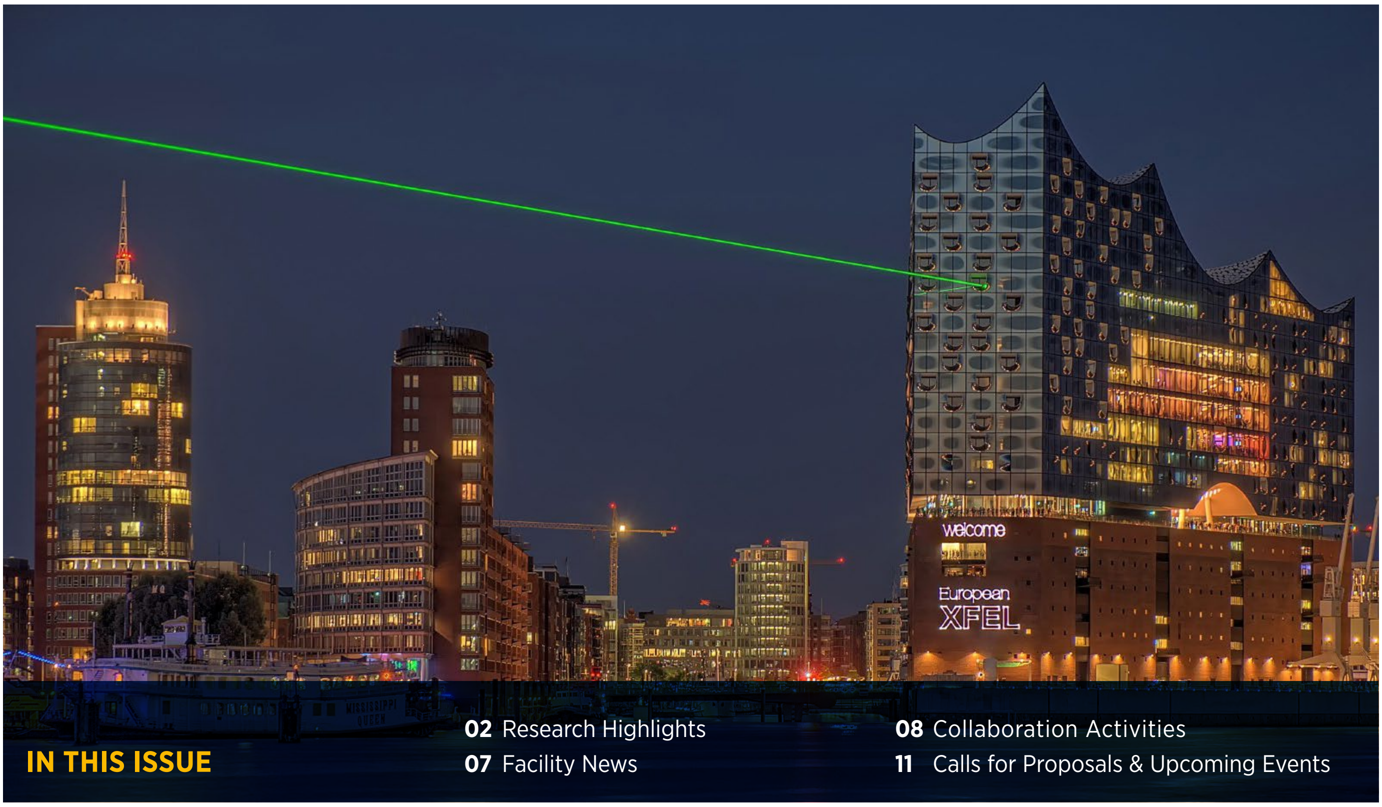
FELs OF EUROPE NEWS 2|17

5. ISSUE | www.fels-of-europe.eu



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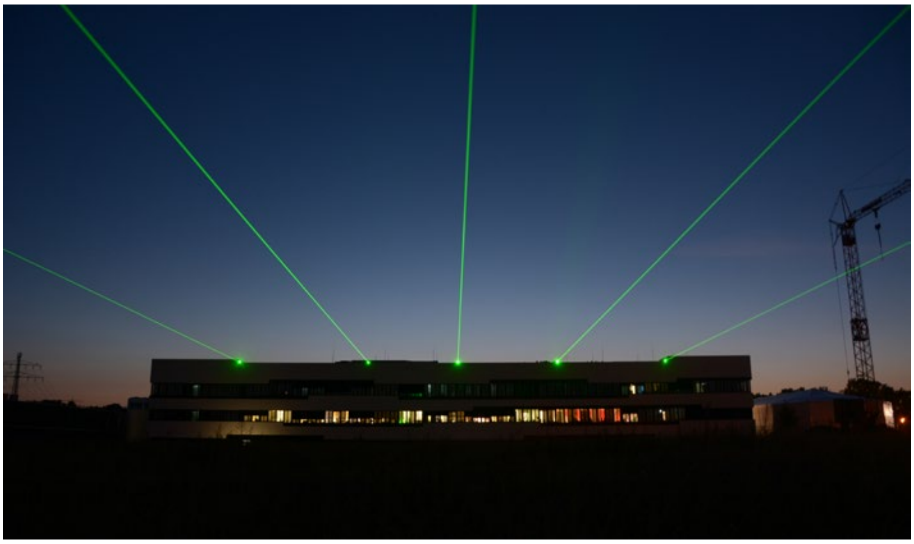
New FELs of Europe Management

As of 1st July 2017, FELs OF EUROPE has a new chair of the steering committee. The term of the chair of the collaboration, Rafael Abela from PSI in Villigen, Switzerland, ended after two years. Michele Svandrlik, the project director of the FERMI facility at Elettra, Trieste, Italy, was elected new chair. He is being assisted by two vice chairs, Britta Redlich from the FELIX Laboratory at Radboud University in Nijmegen, The Netherlands, and Serguei Molodtsov from the European XFEL in Schenefeld, Germany. Together they form the new Management Board and take care of the daily business and the overall coordination of the FELs OF EUROPE activities.

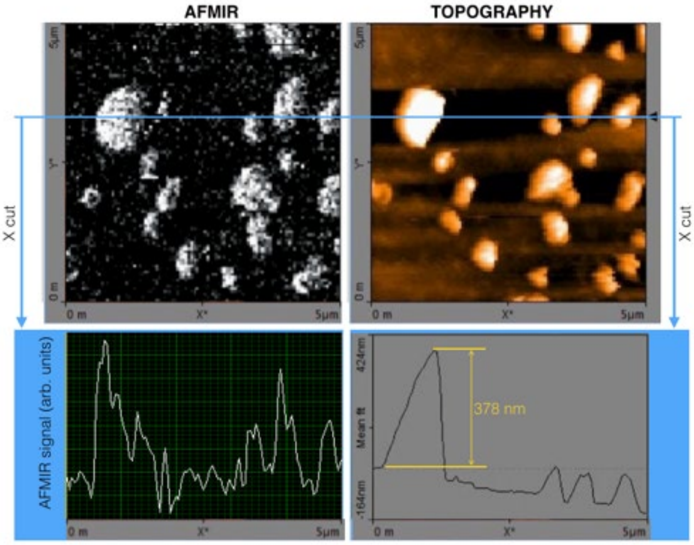
Britta Redlich



Five lasers situated on the roof of the main building in Schenefeld highlight the five underground tunnels of the European XFEL (Credit: European XFEL/Jan Tolkiehn).

Far infrared micro-spectroscopy at the infrared CLIO FEL

We have extended in the far-infrared spectral range the AFMIR method of micro-spectroscopy. This method measures directly the transient local dilatation absorption due to light absorption [1]. We extended it to far-infrared (10 to 50 µm typically) by using the combination as substrates of diamond plates with bevelled edges and the CLIO infrared FEL as a tunable source. The purpose of this extension is to establish a differential method of infrared micro-spectroscopy in order to allow the accurate detection of nanoparticles of interest for biomedical applications. We take then advantage of the presence of specific adsorption bands in far infrared in order to individually discriminate them from those of ordinary biological materials, possessing broad bands in the 2 -10 µm rang . Among these, Metal-Organic Framework (MOF) nanoparticles attracted increasing interest due to their capacity to incorporate high drug payloads, biodegradability and possibility to tailor their surface by grafting specific ligands. However, MOF particle detection in biological media without grafting or incorporating fluorescent molecules is challenging. Here we show that single MOF nanoparticles can be imaged with a spatial resolution of a few tens of nanometers[2]. Jean-Michel Ortega



AFM and AFMIR distribution of nanoparticles of various sizes "glued" on the surface. The wavenumber is 350 cm-1 and the laser power 0,3 mJ over the scanned size 5x5 µm. The AFM profile, displayed below, corresponds to X-cut along the blue line, i.e. a measurement of the height of the objects.

[1] A. Dazzi, R. Prazeres, F. Glotin, J.M. Ortega, Optics Letters, 30 (18), 2388-2390 (2005)

[2] J.-M. Ortega, F. Glotin, R. Prazeres, X. Li, R. Gref, App. Opt., 56(23), 6663-6667 (2017)

Four-wave mixing in graphene

Owing to its peculiar, linear band structure ("Dirac cone"), the two-dimensional material graphene has been predicted to exhibit strong nonlinear optical effects, especially in the infrared and THz spectral range. Yet clear experimental evidence for this behavior is scarce. Recently, researchers have demonstrated such a nonlinear process, four-wave-mixing (FWM), using the free-electron laser FELBE at HZDR in Dresden. In particular, a resonant enhancement of the FWM signal at a photon energy of 78 meV was observed in a magnetic field of 4.5 Tesla. A magnetic field splits up the band structure into so-called Landau levels, giving rise to such a resonant behavior. Manfred Helm

Original publication:
J. C. König-Otto, Yongrui Wang, Alexey Belyanin, C. Berger, W. A. de Heer, M. Orlita, A. Pashkin, H. Schneider, M. Helm, S. Winnerl: "Four-wave mixing in Landau-quantized graphene"
Nano Lett. 17, 2184 (2017)
https://doi.org/10.1021/acs.nanolett.6b04665

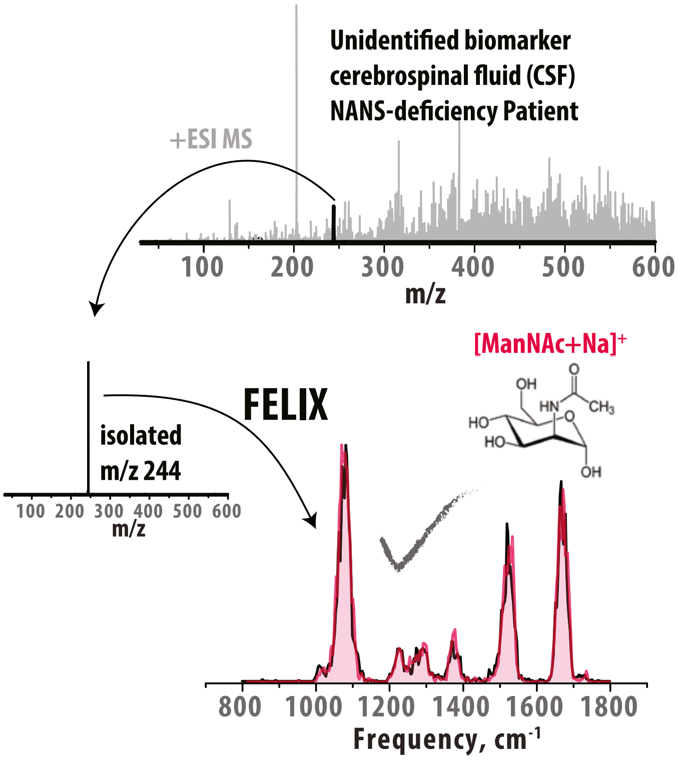
Dressed polaritons

Exciton-polaritons are quasiparticles consisting of an electron-hole pair (exciton) in a semiconductor and a photon. If the active semiconductor layer is embedded in a cavity, the exciton resonance can strongly couple to the zero-point (virtual) photons in the cavity leading to the vacuum Rabi splitting into two polariton branches. Recently, a research group from Warsaw (Poland) studied the influence of additional (real) THz photons resonant with the internal excitonic 1s-2p transition on the polaritons using the free-electron laser FELBE at HZDR in Dresden. A third polariton branch is then observed and can be regarded as evidence of a new quasi-particle: an exciton dressed with a vacuum cavity photons and THz photons at the same time. The experiments can be well explained using a quantum mechanical theory treating all three bosonic fields and the Rabi splitting caused by the external THz and the vacuum fields. Manfred Helm

Original publication:
B. Piętka, N. Bobrovska, D. Stephan, M. Teich, M. Król, S. Winnerl, A. Pashkin, R. Mirek, K. Lekenta, F. Morier-Genoud, H. Schneider, B. Deveaud, M. Helm, M. Matuszewski, J. Szczytko:
"Doubly dressed bosons – exciton-polaritons in a strong terahertz field"
Phys. Rev. Lett. 119, 077403 (2017)
https://doi.org/10.1103/PhysRevLett.119.077403

FELIX used to identify disease biomarkers and drug metabolites for the first time

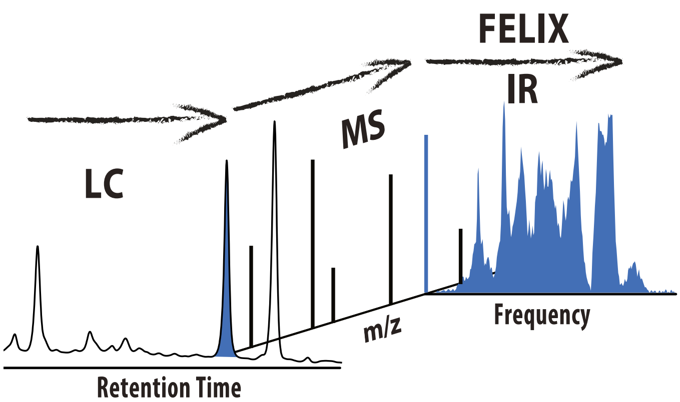
In collaboration with researchers at the Radboud University Medical Center and Janssen Pharmaceutica, scientists at the FELIX infrared free electron laser laboratory have demonstrated the first (bio)analytical application of infrared ion spectroscopy. In one study, the identification of a biomarker of an inherited metabolic disease directly from patient cerebrospinal fluid was accomplished[1]. In a second study, a workflow combining infrared ion spectroscopy using FELIX together with high performance liquid chromatography was implemented for the first time in order to identify metabolites of the lipid-lowering drug Atorvastatin (lipitor)[2]. These results are the first examples biomedical challenges being solved using FELIX. FELIX, in combination with an ion trap mass spectrometer is used to identify a disease biomarker in a cerebrospinal fluid sample from a patient with NANS-deficiency.



FELIX, in combination with an ion trap mass spectrometer is used to identify a disease biomarker in a cerebrospinal fluid sample from a patient with NANS-deficiency.

Small molecule identification is an important clinical metabolomics research – the study of all small molecules present in the human body and how there levels are affected by disease, drugs, and environmental factors. Here, we differentiate a series challenging metabolites from patient body fluids. This work demonstrates the (bio)analytical potential of IR-IS measurements using FELIX. Additionally, we look forward to the workflow demonstrated here to be applicable in a variety of other fields, including plant metabolomics, pharmacology, environmental sciences, etc.

High-performance liquid chromatography is one of the most important modern tools for the analysis of complex samples in analytical chemistry. For the first time, this technique has been combined with ion spectroscopy using FELIX. This workflow is now demonstrated by identifying isomers of metabolites of the drug atorvastatin (lipitor).



Identification of isomeric molecules in complex mixtures has been accomplished using the combination of liquid chromatography/mass spectrometry/infrared spectroscopy.

The results demonstrate the direct applicability of infrared ion spectroscopy in combination with routine analytical techniques and its promising role for the identification of small molecules buried in complex mixtures. As well, it has been shown that currently existing experimental protocols at FELIX allow the measurement of an IR spectrum from only a few nanograms of sample.

Jonathan Martens

References:
[1] Martens J, et al. *Molecular identification in metabolomics using infrared ion spectroscopy.* **Scientific Reports** 7, 3363, (2017). http://www.nature.com/articles/s41598-017-03387-4
[2] Martens J, Koppen V, Berden G, Cuyckens F, Oomens J. *Combined Liquid Chromatography-Infrared Ion Spectroscopy for Identification of Regioisomeric Drug Metabolites.* **Analytical Chemistry** 89, 4359-4362 (2017). http://pubs.acs.org/doi/abs/10.1021/acs.analchem.7b00577

Temporal pulse length and profile of the seeded free-electron laser FERMI

The pulse duration is a crucial parameter for FEL users: it determines the intensity (energy per unit area per unit time), thus the onset of non-linear processes, and it defines the time-scale of transient processes than can be studied. In other words, it sets two quintessential boundaries of cutting-edge science that can be performed at FELs. FERMI is the first running seeded FEL in the world, and these measurements are a case study [published in P. Finetti *et al.,* Phys. Rev. X, 7, 021043 (2017)].

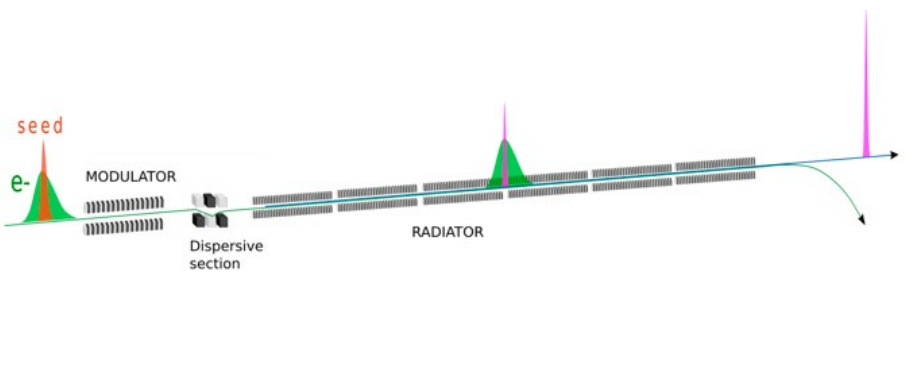
In a seeded HGHG (high gain harmonic generation) FEL such as FERMI, the lasing process is started by the interaction of an external laser, called the seed, with the electron bunch; the coupling between electrons and seed is dictated by a parameter known as "dispersive section strength" or R_{56}. Throughout the process of seed-to-FEL pulse conversion (Fig. 1), a memory of the seed laser pulse properties is retained. In particular, the FEL pulse duration τ_{FEL} is a simple function of the seed pulse duration τ_{seed} and of the harmonic n. Under conditions of low seed power and low R_{56}, $\tau_{FEL} = \tau_{seed}/n^{1/2}$; for seed power and R_{56} values that maximize the FEL emission while retaining a Gaussian profile (in the time and wavelength domain) one finds $\tau_{FEL}=7\tau_{seed}/(6n^{1/3})$. Higher seed laser power and/or R_{56} lead to saturation effects and broadening of the temporal structure, up to the point where multiple peaks start to be observed.

The experimental measurements of τ_{FEL} were carried out on FERMI beamlines LDM and DiProI, by cross-correlation with an optical pulse relating directly to the seed laser. On LDM this pulse was the standard IR (infrared) made available to users for pump and probe experiments, and the cross-correlation signal was from photoelectron sidebands, i.e., satellite peaks observed in photoemission spectra (of He atoms) in the presence of an intense IR field; these sidebands are described in terms of absorption or stimulated emission of IR photons. On beam-line DiProI, the optical pulse came from a NOPA (non-collinear parametric amplifier) pumped by the FERMI IR, and the cross-correlation signal from the transient transmission change in a Si_3N_4 membrane. The FEL pulse is strongly tilted with respect to the membrane, and this geometry establishes a linear relation between time and position of arrival of each portion of the pulse.

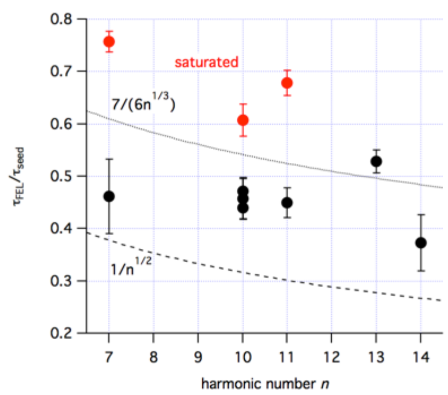
The measurements of the FEL pulse duration were carried out by varying several machine parameters such as τ_{seed}, the seed laser power, or R_{56}. As well, two modes of operation of the seed were used: THG (third harmonic generation) and OPA (optical parametric amplifier); the latter allows for continuous-tuning of the wavelength. Two nominally equivalent FEL sources were characterized: FEL-1 and the first stage of FEL-2, which is a shorter replica of FEL-1 used to seed the high-energy stage of the FEL-2 source. The results are summarized in Fig. 2: for optimum machine settings (black markers) the normalized pulse duration (τ_{FEL}/τ_{seed}) lies between the limits $7/(6n^{1/3})$ and $1/n^{1/2}$. By increasing the seed laser power and/or R_{56} (red markers), the pulse stretches above the $7/(6n^{1/3})$ limit. Comparison between the temporal and spectral profile shows that the pulses are not Fourier Transform limited. This fact is attributed to the seed laser quality, particularly to the chirp of the seed laser that is transferred to the FEL.

In summary we have measured the FEL temporal structure as a function of the machine parameters with two different techniques. The results are consistent with one another and with the theory of the FEL pulse length.

P. Finetti



Schematic diagram of HGHG seeded FEL: The electron bunch interacts with an external laser in the modulator, and a spatial modulation at the seed laser wavelength and higher harmonics ensues in the dispersive section; a set of radiators at harmonic n amplify the coherent light emitted by the electron bunch.



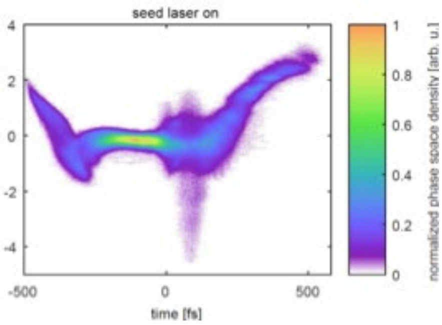
Measured normalized pulse duration as a function of the harmonic number n, and theoretical limiting functions at low gain ($1/n^{1/2}$) and near saturation $7/(6n^{1/3})$.

Profiling FLASH electron bunches on a femtosecond scale

The success of FELs, having a transformative impact on science with X-rays, relies on the capability of analyzing and controlling ultra-relativistic electron beams on femtosecond timescales. One major challenge is to extract tomographic electron slice parameters for each bunch instead of projected electron beam properties.
A unique way to longitudinally resolve slice parameters of electron bunches is a transverse-deflecting cavity in which a radio-frequency (rf) field deflects the electrons depending on their position in the bunch. In combination with a dipole spectrometer, it gives access to the longitudinal phase-space distribution of the electron bunch (see Fig. 1). The slice energy spread determined this way is a superposition of the electron beam slice energy spread and several contributions from the measurement apparatus (Panfosky-Wenzel heating, geometric beamsize on observation screen). When the impact of collective effects on the phase-space distribution of the electron bunch can be neglected, the transverse slice emittance can be extracted from the measured energy spread profile.

The emittance profile is the missing ingredient for the prediction of the FEL performance as a function of intra-bunch coordinate. Using the measured energy spread profile and current profile, the gain length of the FEL process can be determined with the semi-analytical Ming-Xie formalism. Some regions of the electron bunch exhibit small gain lengths and are thus better suited for FEL lasing than others, since their emittance is smaller.

The seeding experiment sFLASH at FLASH offers the unique opportunity to use the seed laser pulse as a local probe to start the FEL process and excite confined regions to lase. When measuring



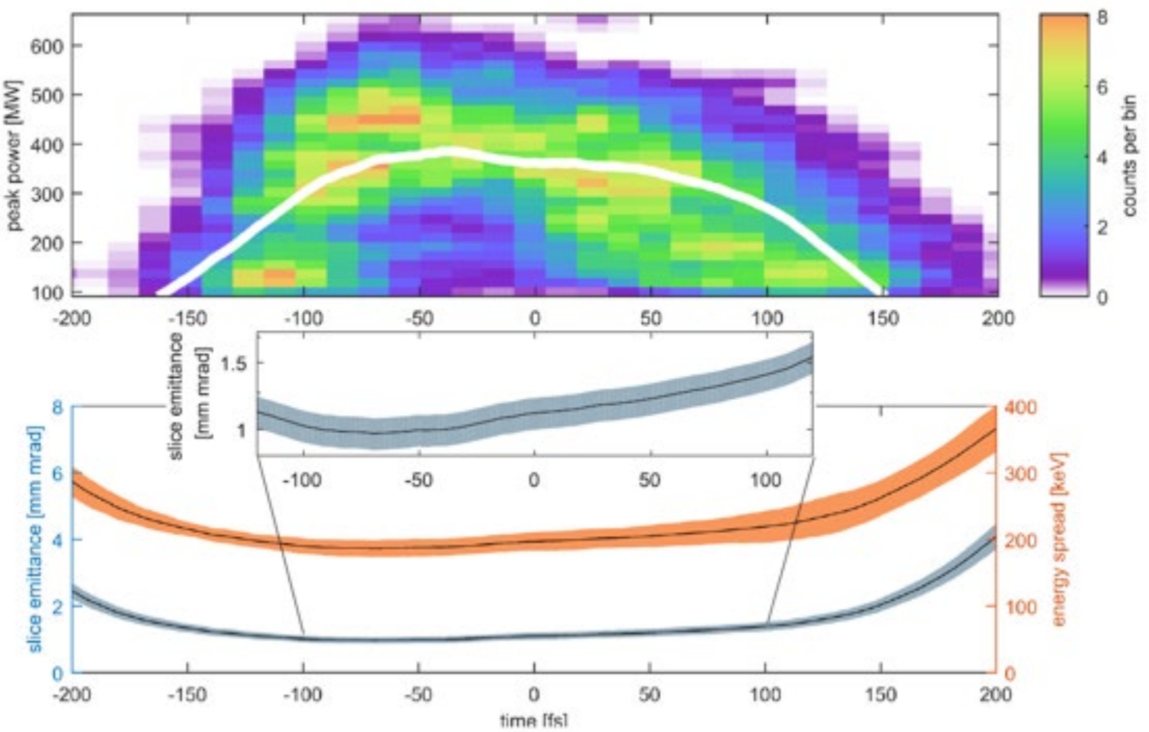
Measured longitudinal phase space distributions of a seeded electron bunch.

the longitudinal phase-space distribution of seeded electron bunches, the power profile of the seeded FEL pulse can be extracted from the energy drop of the electrons without affecting the photons. With a scan of the relative time delay between seed laser pulse and electron bunch, the achievable peak power can be measured as a function of the intra-bunch coordinate and is well in agreement with the prediction of the Ming-Xie formalism from the extracted emittance profile (see Fig. 2).

This method is currently prepared to give on-line information on the emittance profile of the electron beam and will enable a quick optimization of the emittance profile and thus lasing performance.

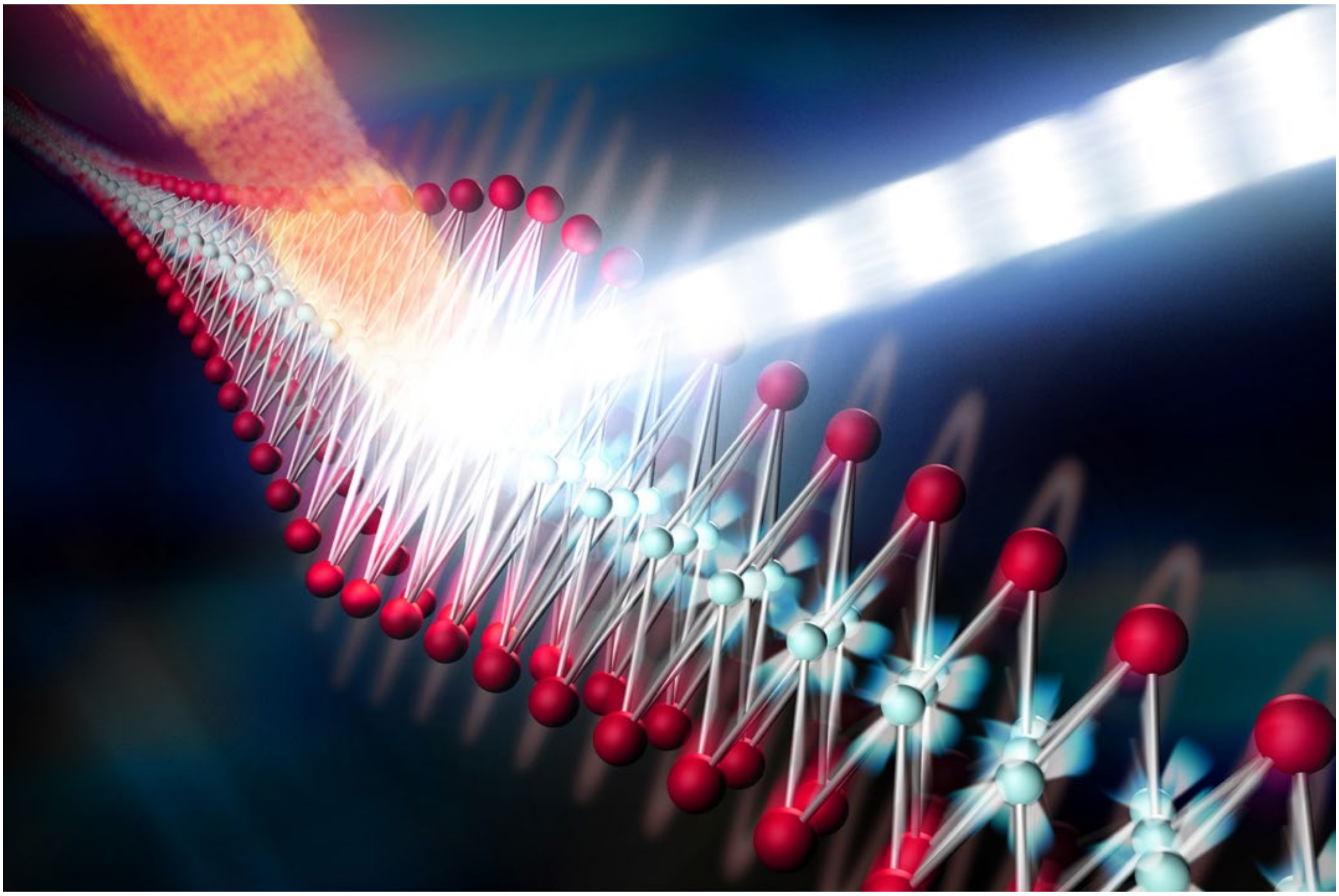
Tim Plath, Christoph Lechner, Jörn Bödewadt

Reference:
“Mapping few-femtosecond slices of ultra-relativistic electron bunches”, T. Plath, C. Lechner, V. Miltchev, Ph. Amstutz, N. Ekanayake, L. L. Lazzarino, Th. Maltezopoulos, J. Bödewadt, T. Laarmann, J. Roßbach, Scientific Reports 7, doi: 10.1038/s41598-017-02184-3



The upper panel shows a 2-dimensional histogram of the measured peak power of the seeded FEL pulses and their position with respect to the charge center of the electron bunch derived from measurements as shown in Fig. 1. The white line shows the prediction of the Ming-Xie model using the slice emittance shown in the lower panel. This work was taken from the given reference.

Scientists get first direct look at how electrons 'dance' with vibrating atoms



By Greg Stewart/SLAC National Accelerator Laboratory

Scientists at the SLAC National Accelerator Laboratory and Stanford University - one of the leading authors, Simon Gerber, has in the meantime relocated to PSI - have made the first direct measurements, and by far the most precise ones, of how electrons move in sync with atomic vibrations rippling through an quantum material, in the present study an unconventional superconductor, as if they were "dancing" to the same beat.

The atomic vibrations are called phonons and the measured electron-phonon coupling, for certain electron "orbitals", was 10 times stronger than standard theory had predicted – making it strong enough to potentially play a role in unconventional superconductivity, which allows materials to conduct electricity with no loss at unexpectedly high temperatures.

The approach developed enables a direct and highly precise way to study a wide range of "emergent" materials whose surprising properties arise from the collective behaviour of fundamental particles, such as electrons. The new approach investigates these materials through high-precision experiments alone, rather than relying on assumptions based on theory.

The experiments were carried out with SLAC's Linac Coherent Light Source (LCLS) X-ray free-electron laser, combined with time- and angle-resolved photoemission spectroscopy (trARPES) on the Stanford campus. A thick, atomically uniform iron selenide film was hit with infrared laser light to excite its 5 terahertz atomic vibrations. The team then measured the material's phonon and electron behaviour in two separate experiments. One of the studies leading authors, Simon Gerber, earlier a postdoctoral researcher in Prof. Zhi-Xun Shen's group at SLAC and Stanford University, led the LCLS measurements; he has since joined the SwissFEL team at PSI as a staff scientist. Mirjam van Daalen / Simon Gerber

(Text based on SLAC press release) / Press release PSI

Original Publication

Femtosecond electron-phonon lock-in via photoemission and x-ray free-electron laser

S. Gerber, S.-L. Yang, D. Zhu, H. Soifer, J. A. Sobota, S. Rebec, J. J. Lee, T. Jia, B. Moritz, C. Jia, A. Gauthier, Y. Li, D. Leuenberger, Y. Zhang, L. Chaix, W. Li, H. Jang, J.-S. Lee, M. Yi, G. L. Dakovski, S. Song, J. M. Glownia, S. Nelson, K. W. Kim, Y.-D. Chuang, Z. Hussain, R. G. Moore, T. P. Devereaux, W.-S. Lee, P. S. Kirchmann, Z.-X. Shen

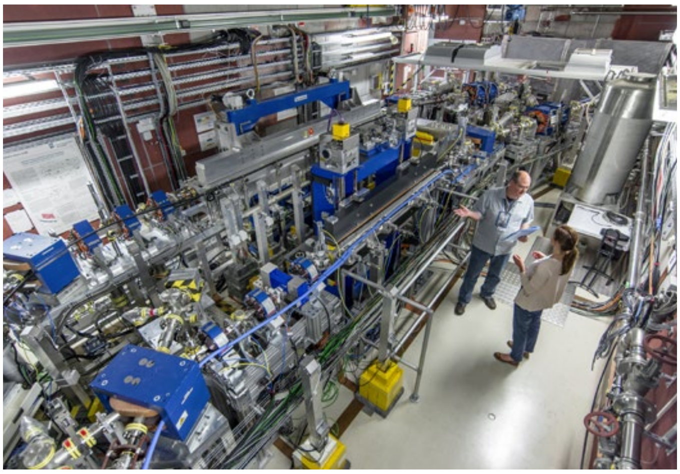
Science 7 July 2017
DOI: 10.1126/science.aak9946
http://science.sciencemag.org/content/357/6346/71

New U37 Undulator Shines Bright at FELBE

FELBE, the FEL Facility at HZDR in Dresden, Germany, operates two oscillator-based FELs lasing across the mid IR and far IR/THz spectrum and has recently commissioned the new U37 undulator on one of the two FELs driven by the ELBE accelerator. Installation of the new undulator began in February 2017, followed by first lasing on May 3, and first User beam on June 29. Regular User Operations for both FELs have resumed starting in late July.

The new U37 undulator replaces the predecessor U27 undulator, providing several performance improvements that will benefit scientists investigating materials and structures in the mid IR. In particular, the range of K_{rms} is much greater for the new undulator, and thus enables a significantly wider spectral tuning range for a given electron beam setting. Users can now perform "gap scans" covering ~ 10 μm of wavelength tuning, a marked improvement over the ~ 2 μm tuning rage of the U27 undulator that has been replaced. This is crucial for Users that need to study the spectral response of materials and nanostructures. For example, in the s-SNOM Lab (scattering-Scanning Nearfield Optical Microscopy) at FELBE, the wider tuning range of the U37 will dramatically enhance the capability for imaging the resonant coupling of embedded defects and novel structures with subwavelength resolution. Furthermore, the magnetic design of the new U37 delivers higher gain and therefore increased power over the full spectral tuning range (5 – 38 μm), which has likewise been increased at the long wavelength end where the U37 now has substantial overlaps with the U100 far IR FEL (20 – 250 μm).

Operationally, the improved performance and increased range of K_{rms} allows for the full spectral range of the U37 to be covered by



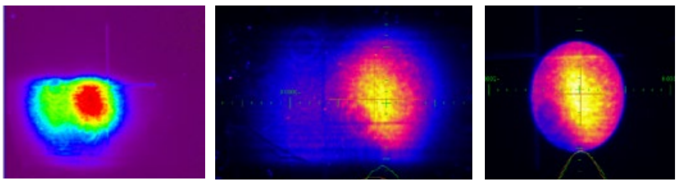
The new U37 mid IR FEL (right) and U100 THz FEL (left). ©Detlev Müller

a smaller set of electron beam settings. This reduces the time required for setting up the machine to accommodate the needs of the diverse FELBE User community.

The FELBE Facility includes 8 User Labs extensively equipped with optical and electronic instrumentation, as well as synchronized tabletop lasers and THz sources. Additionally, LHe optical cryostats and high field magnets (8 T static and 70 T pulsed) are available for low-temperature and high field studies. The ultrashort pulses of the FELBE FELs are ideal for probing dynamics with excellent signal-to-noise due to the high rep. rate (13 MHz), and at up to 5 μJ/pulse, it is also possible to measure nonlinear processes. Beamtime proposals are accepted twice a year. Information on the submission process and detailed operational parameters are available at (www.hzdr.de/FELBE). J. Michael Klopf

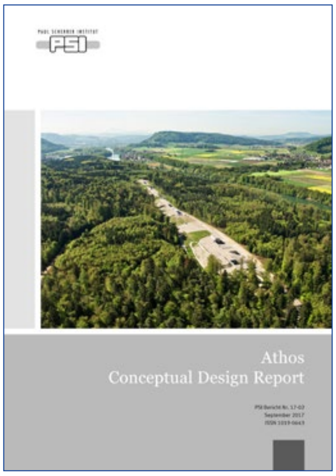
First light in SwissFEL Experimental Station Bernina

Friday, October 20th, 2017, we brought the first light (wavelength 1.2 nm) into the experimental hutch of Bernina. The beam passed the Alvra endstation, went through the diagnostic devices and hit the diagnostic screen in front of the refocussing KB-system of Bernina. The left picture shows the pink beam on the last diagnostic screen of the beamline. The middle at the entrance of Bernina-hutch, 133 m downstream of the undulator. The right picture shows the beam centered in the alignment iris in front of the KB-system (read more). Rolf Follath



ATHOS Conceptual Design Report (CDR)

The ATHOS Conceptual Design Report has recently been completed and describes the ATHOS project in detail. The CDR starts with a summary of the characteristics of the ATHOS undulator line. Especially the design parameters of the different ATHOS operation modes are explained and illustrated by simulation results. The core part of the report is a description of all key components, i.e. from the electron bunch extraction kicker down to the ATHOS experimental stations (read more). Romain Ganter



The European XFEL is go!

The world's most powerful X-ray laser is ready for user operation. On 1 September, European XFEL celebrated its official inauguration and the start of user operation. The weeks and months leading up to this important occasion have been marked by a flurry of activity and progress as scientists and engineers in Schenefeld and Hamburg work to ensure everything is ready for the arrival of the first users mid-September.

After more than a decade of planning and construction, European XFEL staff and their DESY colleagues were successful in generating the first laser light in the underground tunnels on 2 May 2017. This first beam had a wavelength of 0.8 nm and a repetition rate of one pulse per second. When the facility is up to speed, the final repetition rate will be 27 000 X-ray pulses per second.

Several weeks later, on 23 June, the X-ray laser beam was successfully guided via the mirrors and optical components of the first beamline (SASE1) in the underground tunnels, into the experiment hall in Schenefeld. The photon beam had a photon energy of 8.3 keV. After a short break to celebrate this important milestone, staff began commissioning the first two instruments which share the SASE1 beamline—FXE (Femtosecond X-Ray Experiments), for the research of extremely fast processes and coordinated by leading scientist Christian Bressler, and the SPB/SFX (Single Particles, Clusters, and Biomolecules / Serial Femtosecond Crystallography) instrument, for studying biomolecules and biological structures and coordinated by leading scientist Adrian Mancuso.

First tests of the X-ray beam properties produced the first diffraction patterns the same day. Powder diffraction patterns recorded at FXE show individual pulses of X-ray laser light scattering off sprayed silicon powder, illustrating the high level of synchronization of different components of the facility. At the SPB/SFX instrument, the first fringe and slit experiments demonstrated the high coherence of the X-ray laser beam. At the end of June, the European XFEL Council announced that the facility had successfully complied with the predefined requirements for the start of the operation phase. These requirements, laid down eight years ago, stated that the pulses of the X-ray laser beam must have a wavelength of maximally two Ångströms (0.2 nm), reach a typically high intensity and remain stable in order to qualify for the transition to the operation phase. In addition, the two experiment stations (FXE and SPB/SFX) of the first beamline should be sufficiently equipped so that first scientific experiments can be carried out. As of 1 July, the European XFEL is officially operational.

In July, the Large Pixel Detector (LPD), developed by European XFEL together with the Rutherford Appleton Laboratory in Oxford, UK, was successfully installed and commissioned. This unique piece of equipment will record images at a frequency of 4.5 MHz—fast enough to keep up with the 27 000 pulses per second of the X-ray beam, essential for recording "molecular movies". Commissioning on both instruments continues in the run up to user arrival.

Following a call for proposals earlier in the year, the first fourteen user groups have now been invited to European XFEL for experiment runs in September to December this year. The FXE and SPB/SFX instruments will run user experiments from Fridays to Tuesdays each week with Wednesdays and Thursdays reserved for maintenance and experiment set-up. The two instruments will share the beamtime, one taking the day shift and the other working during the night shift, before switching during the next run. The number of user hours will be steadily increased so that full operational capacity of 4000 hours per year will be reached in 2019.

Rosemary Wilson

COLLABORATION ACTIVITIES

Science at FELs conference 2018 in Stockholm

The upcoming Science@FEL conference 2018 will be held in Stockholm, Sweden 25-27 June. It is co-organized by the MAX IV Laboratory, the Stockholm-Uppsala Centre for FEL research and the Lund Laser Center. The scientific program is currently being finalized and all information will in due time be available at: http://indico.maxiv.lu.se/e/science-at-fels-2018

Welcome to Stockholm!
Per Johnsson, Mats Larsson, Anders Nilsson, Sverker Werin

SCIENCE @ FELs
Stockholm 2018

PhotonDiag 2017 at SLAC National Accelerator Laboratory

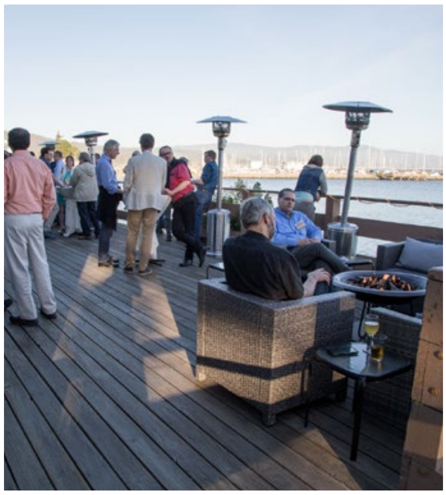
Free electron lasers (FEL) for the soft and hard X-ray range are fourth generation light sources capable of producing high brightness light pulses, ten billion times more intense than those emitted by synchrotrons, and of very short duration, with a wavelength in the extreme ultraviolet to hard X-rays. A central area of research and development is focused on characterizing these exceptional photon sources in all beam parameters and transporting them to the experimental stations for users.

The Workshop series on FEL Photon Diagnostics, Instrumentation, and Beamline Design, PhotonDiag, is organized regularly as an activity of the Collaboration of European FEL and SPS Facilities (FELs of Europe). To extend the collaboration activities beyond Europe, for the first time, LCLS, the Linac Coherent Light Source of SLAC National Accelerator Laboratory, organized and hosted, in collaboration with Fels of Europe, the third edition of the workshop series, PhotonDiag 2017. The three-day international event has taken place from May 1-3, 2017 on the SLAC campus. The PhotonDiag 2017 is a follow-up of the PhotonDiag 2015 organized by Elettra - Sincrotrone Trieste (Trieste) and the one in 2010 at DESY, Hamburg.

Scientists and engineers, over 100 participants from all around the world, gathered together to discuss photon diagnostics and beamline design for free electron lasers. The invited speakers comprised many pioneers in the development of photon diagnostics and beamline design for free electron lasers as well as a number of new faces. For the first time, a beamline scientist's round table brought together instrument scientists and engineers to discuss efficient strategies for user operations at the different facilities as well as options to collaborate even more closely.

Again, a Journal of Synchrotron Radiation special issue will be published in connection with the PhotonDiag and, for the first time, FELs of Europe awarded a dedicated prize, the "FELs of Europe Award on Photon Transport and Diagnostics" to Diling Zhu, LCLS.

Elke Ploenjes-Palm



Photos: SLAC National Accelerator Laboratory

FELs of Europe Award on Photon Transport and Diagnostics for Diling Zhu

The LCLS physicist Diling Zhu was awarded the “FELs of Europe Award on Photon Transport and Diagnostics” 2017. Diling Zhu, a staff scientist in the Hard X-ray Department at the Linac Coherent Light Source, SLAC National Accelerator Laboratory, is the program lead on R&D at LCLS.

The award was presented for the first time in connection with the international PhotonDiag 2017 workshop, which took place from May 1-3, 2017. The workshop, which is the third in a series, was jointly organized by the Fels of Europe Collaboration and the SLAC National Accelerator Laboratory in Menlo Park, California.

The award is given to researchers on the occasion of the PhotonDiag workshop and comprises of a certificate, a monetary sum of 1000 Euros and the opportunity to give a presentation of the work at the conference. With this prize, the FELs of Europe Collaboration recognizes outstanding contributions in the fields of free electron laser photon diagnostics, photon transport and beamline developments, as well as FEL instrumentation.

This year´s award acknowledges Diling Zhu’s broad excellence in developing new hard x-ray FEL tools such as techniques in thin crystal multiplexing, a crystal-based split-and-delay unit, a timing tool and a thin-crystal single shot spectrometer for LCLS. The sum of his work since the start of LCLS operations has greatly increased diagnostics capabilities as well as developed improved beam transport capabilities, pushing the frontiers of FEL science.

Elke Ploenjes-Palm

FEL’s of Europe Steering Committee Meeting at European XFEL in Hamburg

The Steering Committee of FELs of Europe (FoE) met in Hamburg on 19 and 20 of April 2017. The first day the meeting was hosted by the European XFEL at the Schenefeld premises, the second day by DESY at FLASH. The new European XFEL Director General, Robert Feidenhans’l, welcomed the members of the Steering Committee and presented exciting news on the progress of XFEL, which expects to host the early user experiments in autumn this year. The Steering Committee members had the opportunity to visit the XFEL experimental hall and user laboratories, getting an impressive overview of the different instruments just a few days before the first lasing, and the new FLASH-2 experimental hall.

Several strategic aspects of the FoE collaboration have been addressed during the meeting, chaired by Rafael Abela. The latest developments of the LEAPS (League of European Accelerator-based Photon Sources) initiative were presented by Caroline Hahn and the possible interactions between FoE and LEAPS were discussed, as well as different possible schemes for FELs of Europe to become a legal entity. The plans for the POLFEL Test Facility and the progress of CalipsoPlus and EUCALL were presented. The Steering Committee was also informed on the status of the organization of the Photon Diagnostics workshop (SLAC, May 2017) and of the Science@FELs conference (Stockholm, June 2018).

Michele Svandrlik

It's beamtime! European XFEL officially inaugurated

Speakers at the inaugruation of the European XFEL cut the ribbon in front of the hutches for the SPB/SFX and FXE instruments, officially opening the facility.

"It's beamtime!" declared Deutsche Welle journalist Zulfikar Abbany as he opened the official inauguration ceremony of European XFEL at 2pm on 1 September in front of 800 invited guests. After more than a decade of planning, development and construction, the world's most powerful X-ray laser can finally be handed over to the eagerly awaiting user community to do what it was designed to do.

Science ministers and other high ranking representatives from across Europe including German research minister Prof. Dr. Johanna Wanka, the Russian Prof. Dr. Andrei Fursenko, Swiss state secretary for research Dr. Mauro Dell'Ambrogio, Polish deputy science minister Prof. Dr. Łukasz Szumowski, and French research minister Prof. Dr. Frédérique Vidal joined European XFEL staff and management board to mark the occasion on the European XFEL research campus in Schenefeld. The speakers stressed the importance of the facility for Europe and the world of science. "The establishment of the European XFEL has created a unique cutting-edge research facility, which promises groundbreaking insights into the nanocosmos" said Wanka." The foundations for tomorrow's innovations are laid by today's basic research." Amidst much applause, the first users were welcomed on stage by the distinguished guests and presented with a symbolic golden access card to commemorate the occasion. The celebratory event also included the first official viewing of a new tunnel flight film and a musical medley representing all 12 partner countries. Elsewhere on site the guests were able to see two laser light installations including one illustrating a pump-probe experiment.

Down in the underground experiment hutches, Wanka and her guests took a closer look at the first two instruments and talked to the leading scientists before starting the first experiment in the SPB/SFX (Single Particles, Clusters, and Biomolecules and Serial Femtosecond Crystallography) instrument hutch. SPB/SFX and FXE (Femtosecond X-Ray Experiments) will be the first two instruments available for experiments from mid-September. FXE will enable the study of fast reactions and be able to record molecular movies, while the instrument SPB/SFX was developed for investigating the structure and transformation of biomolecules and other biological particles, such as viruses and cell components.

For additional details and images: www.xfel.eu

Rosemary Wilson

CALIPSOplus

On May 1, 2017 the new EU funded infrastructure project CALIPSOplus started under the coordination of HZDR. This Integrating Activity will run for four years, i.e. until April 30, 2021. In accordance with the tradition, a major focus of the project will be on the provision of access to synchrotrons and free-electrons lasers for users from EU member states, associated states and, to some extent, also from Third countries, along with the necessary financial support to cover their travel expenses (Trans-national Access).

Among the members of the FELs-of-Europe community, FELBE, FELIX, CLIO, FERMI, SwissFEL, EU-XFEL, FLASH and SPARC will be able to offer such support. Perspectively TARLA might be able to join as well towards the end of the project.

The trans-national access activities will be complemented by several networking activities and two joint research activities. The total funding amounts to nearly 10 million Euros.

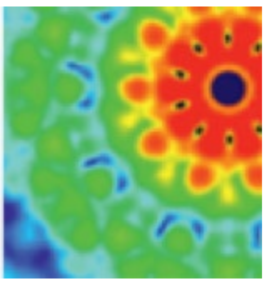
The kick-off meeting (see photograph) took place on May 18/19th, 2017 in the beautiful city of Dresden/Germany. More information can be found on www.calipsoplus.eu.

Manfred Helm

European Synchrotron and FEL user organisation (ESUO)

The European Synchrotron and FEL Users Organization (ESUO) was established in 2010 [1,2] and its most important aims are to be the platform of all European synchrotron and free electron laser users and to facilitate transnational access to European accelerator-based light sources. The ESUO represents about 30.000 users of the European synchrotrons and FEL light sources. At present 29 European countries (including Turkey and Israel) are ESUO members and represented by their delegates. The general missions of ESUO are to coordinate the synchrotron and FEL radiation user activities in Europe and to provide support to the users in order to get access to synchrotron and FEL beamlines in Europe. ESUO promotes that SR and FEL access should be provided solely on the basis of scientific merit, and that an integrated approach throughout Europe to the use of SR and FEL sources shall be pursued. This transnational interconnection of users and facilities is a strong prerequisite for future development of the European infrastructure of photon science. Considering this mission ESUO has initiated several lobby action in order to promote continuation of TNA in framework of HORIZON2020 finally realized by CALIPSOplus project [3].

Ulli Pietsch



[1] Pietsch U. & Cooper M.J. (2010) J. Synchrotron Rad. 17, 428–429
[2] http://wayforlight.eu/ESUO; http://www.ESUO.org]
[3] Barrier E. et al. J. Synchrotron Rad. (2014). 21, 638–639

EUCALL completes Mid Term Review and 2nd Annual Meeting

"Project has delivered exceptional results"

In June 2017, the European Cluster of Advanced Laser Light Sources (EUCALL) completed its Mid Term Review in Brussels, during which the EUCALL coordinator team and work package leaders presented the project's progress and achievements to the EU project officer and an external reviewer.

The review recognised that EUCALL has fully achieved its objectives and milestones for the first funding period and is creating a wealth of advanced results, instruments, and tools. The review specifically emphasized and supported EUCALL's compiled spreadsheet of "Instrumentation at Advanced Laser Light Sources", which contains characteristics of instruments at synchrotron, FEL and optical laser facilities. The spreadsheet was described as an "invaluable document", especially when the collected data will be transferred to the public www.wayforlight.eu database for users of facilities in the EUCALL community to identify the most suitable instruments/beamlines for a defined experiment.

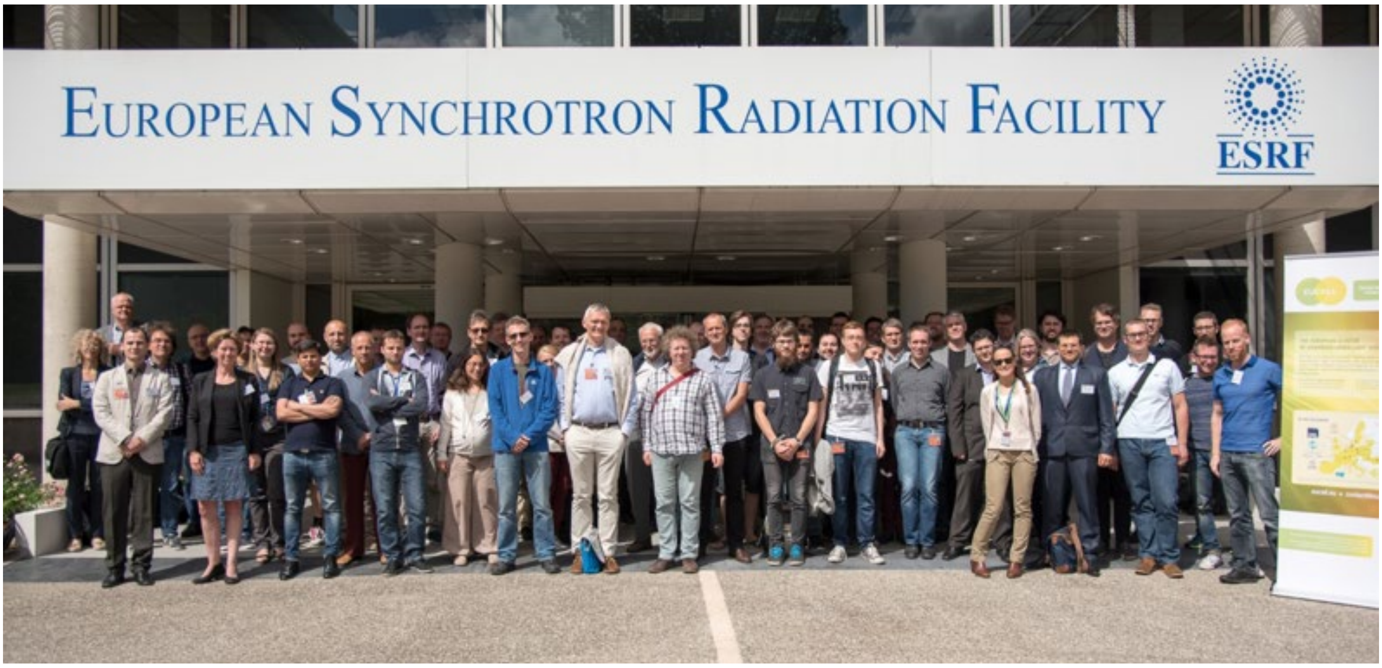
The development of EUCALL's SIMEX tool was also highlighted as a significant result. SIMEX is a new open-source simulation platform for users and facility operators to simulate experiments "from source to detector" at advanced light sources. It includes software developed and put together in one package for the simulation of experiments at the different light sources. SIMEX currently supports simulations of coherent diffractive imaging, as well as of imaging and scattering experiments on laser-excited or compressed matter. SIMEX is publicly available for download at www.github.com/eucall-software/simex_platform.

The reviewer also identified EUCALL's networking activities around newer concepts and approaches to be of great value for structuring an emerging community. EUCALL is organising one workshop on "Biology at Advanced Laser Light Sources" (30 Nov/ 1 Dec 2017 at European XFEL). The focus on biology applications was selected since these are currently of very high relevance to all of the participating facilities. The workshop will allow understanding of what the synergies between the different sub-groups are, as well as how to identify and develop them and later to extend these synergies into other communities. A second workshop on "High Impact Science at Advanced Laser Light Sources" – to be held at DESY in spring 2018 – will address urgent scientific and societal challenges and how EUCALL's facilities could contribute to solving these. A further topic deals with building a network for target delivery at high–repetition-rate laser facilities. Full details of EUCALL's upcoming workshops can be found at www.eucall.eu/events.

Also in June, EUCALL held its 2nd Annual Meeting at ESRF in Grenoble. Sixty-six project participants gathered to present and discuss the project progress and status. A plenary session addressed photon beam characteristics and applications of FEL, synchrotron, and various optical laser driven x-ray beams and one session was dedicated to discuss possible collaboration after the EUCALL project ends in September 2018. In the open discussion that followed, the participants unanimously agreed to continue EUCALL's cooperation in the future.

Graham Appleby

EUCALL has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654220.



EUCALL's project participants gathered at the Annual Meeting 2017 at ESRF.

OTHER CONTRIBUTIONS

FEL prize and Young Scientist FEL Award 2017

The prestigious international FEL prize 2017 goes to Bruce Carlsten, Dinh Nguyen and Richard Sheffield, from Los Alamos National Laboratory (Los Alamos, NM – USA), for their pioneering work on the first practical realisation of an RF photo-injector and for the first theoretical model of the emittance compensation concept. For the application of this device to the demonstration of self-amplified spontaneous emission and for their advanced studies to regenerative amplifier free electron lasers. These contributions have been recognized as keys for the success of present X-ray FELs.

Eugenio Ferrari, now at École Polytechnique Fédérale de Lausanne and Eléonore Roussel, now at Soleil, both former collaborators of the FERMI team at Elettra-Sincrotrone Trieste, are the winners of the 2017 Young Scientist FEL Award. The motivations included the contributions of these two young scientists to the commissioning of FERMI FEL-2, the investigation of the FEL polarization properties, the implementation of innovative schemes for the generation of multi-color pulses in seeded FELs, and studies of the interplay between the microbunching instability and the properties of the FEL light.

These awards were assigned during the 2017 International Free Electron Laser conference held in Santa FE (NM, USA) in August.

Luca Gianessi

CURRENT AND UPCOMING CALLS FOR PROPOSALS

www.fels-of-europe.eu/user_area/call_for_proposals

UPCOMING EVENTS

Science at FELs conference Stockholm
25-27 June 2018
http://indico.maxiv.lu.se/e/science-at-fels-2018

League of European Accelerator Based Photon Sources LEAPS

In 2015 the directors of the Synchrotron Radiation and Free Electron Laser user facilities in Europe initiated the strategic consortium LEAPS. The primary goal of LEAPS (the League of European Accelerator-based Photon Sources) is to actively and constructively ensure and promote the quality and impact of the fundamental, applied and industrial research carried out at their respective facility to the greater benefit of European science and society. On November 13th LEAPS will present its future programme to European and national politicians and stakeholders in Brussels. FELs of Europe is strongly involved and contributes to the LEAPS consortium by its experience and activities. www.leaps-initiative.eu.

Ute Krell

13 November 2017: League of European Accelerator based Photon Sources (LEAPS) launch event Brussels

How super-microscopes are changing the face of European science Brussels – 16 organisatons representing 19 light sources facilites across Europe gathered to launch the LEAPS initiative and signed an agreement to strengthen their collaboraration. LEAPS, the League of European Accelerator-based Photon Sources, aims to offer a step change in European cooperation.
www.fels-of-europe.eu

Representatives of the FEL's of Europe collaboration present at the LEAPS launch.

IMPRINT

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FELs OF EUROPE is an initiative of the ESFRI projects EuroFEL and European XFEL. It is a collaboration of all free electron laser (FEL) facilities in Europe, with the goal to meet the technological and scientific challenges of these novel and rapidly developing technologies and to provide a worldwide unique, pan-European research infrastructure that enables exploiting the full scientific potential of these unique accelerator based short-pulse light sources. More info at: www.fels-of-europe.eu

FELS OF EUROPE