FELs OF EUROPE NEWS 1|18

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Welcome to the sixth issue of the FELs OF EUROPE Newsletter, the first of 2018! We hope you will enjoy reading it and find interesting information and updates, for instance starting with a number of research highlights that show the excellence of the scientific activities at our partner FELs facilities, ranging from the infrared to the soft and hard x-ray sources. In the previous edition of the newsletter we reported about the European XFEL inauguration last September, now we are proud to present an overview of the first user run and of the impressive perspectives of increase in beamtime offer in the near future.

The last months have seen a number of important events for the FELs OF EUROPE collaboration and partners. At the last Steering Committee meeting in Trieste, in March, it was decided to extend the duration of the collaboration for further six years, until 2024. We are also glad to congratulate two of our partners that received important new support from their national funding agencies, namely the Radboud University for an expansion of the capabilities of the FELIX infrared facility and, very recently, the National Centre for Nuclear Research in Poland, for the construction of PolFEL, a THz and VUV FEL facility.

In June 2018 Stockholm University hosted the fourth FELs OF EUROPE Science@FELs conference, another very successful event of this series of conferences. As a satellite event, a première was the Forum on Advanced FEL Techniques, which focus was to bring together FEL developers and FEL users, that gave a very positive feedback wishing for more events of the same kind organized in the future. We draw your attention to the fourth FELs OF EUROPE PhotonDiag workshop, jointly organized by DESY and European XFEL on 17-19 September 2018 in Hamburg.

Finally, we want to highlight the increasing contacts and common activities between FELs OF EUROPE and other European research networks and collaborations such as CALIPSOplus, EUCALL, LASERLAB Europe and of course LEAPS, in which FELs of EUROPE represents the core of the Strategy Group on Free Electron Lasers.

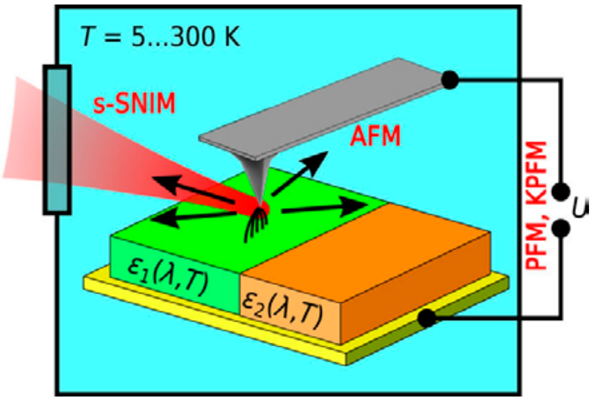
Michele Svandrlik

Near-field Nanoscale Spectral Imaging of Low-Temperature Phase Changes

The technique of scanning near-field optical microscopy (SNOM) was initially developed by transmitting or collecting optical radiation in the near field of a sample surface via a fiber optic waveguide tapered to a subwavelength diameter tip. This method though is limited to optical wavelengths compatible with fiber optic waveguides. By focusing light onto an AFM tip, the near-field component of the scattered radiation similarly provides optical information with subwavelength resolution. Here, a wavelength-independent lateral resolution of ~ 50 nm is typical, which solely depends on the apex' curvature of the AFM tip. Intriguingly, this scattering-type SNOM can be extended to the infrared spectrum, denoted as s-SNIM, where many materials and structures exhibit a distinct spectral response. A team led by Susanne Kehr and Lukas Eng from the Technische Universität Dresden has developed several s-SNIM instruments at the Free Electron Laser Facility FELBE of HZDR in Dresden, Germany. In a recent result, they have demonstrated their unique capability of spectrally resolved s-SNIM with the FELBE FEL at low temperatures (LT). This LT-s SNIM instrument is capable of measurements down to 5 K by operating in an optical bath cryostat with an ambient pressure of 100 mbar of He gas in the sample tube to facilitate efficient heat exchange with the sample and instrument. This instrument has been applied to study the spinel-type skyrmion-host GaV_4S_8, which shows a Jahn-Teller phase transition at the critical temperature of T_c = 42 K to a LT ferroelectric phase. With the FEL tuned to 31.7 µm, in the vicinity of the LO phonon resonance of the reststrahlen band of GaV_4S_8, the LT-s SNIM reveals a strong optical contrast in the lamella-shaped domain structure at a sample temperature of ~ 30 K. By these near-field measurements and by simultaneously applied complementary AFM-based techniques such as topography imaging, piezo-response force microscopy (PFM), and/or Kelvin-probe force microscopy (KPFM), the local structural properties of all ferroelectric domain types in this phase have been identified successfully. J. Michael Klopf

Original publication:

Denny Lang, Jonathan Döring, Tobias Nörenberg, Ádám Butykai, István Kézsmárki, Harald Schneider, Stephan Winnerl, Manfred Helm, Susanne C. Kehr, and Lukas M. Eng, "Infrared nanoscopy down to liquid helium temperatures", Rev. Sci. Instrum. **89**, 033702 (2018). https://doi.org/10.1063/1.5016281



Sketch of the LT s-SNIM: IR/THz radiation is focused onto the tip-sample junction inside the liquid helium (LHe) cryostat. Elastically backscattered radiation from the tip-sample system is measured and the near-field contributions extracted, which contain the local information of the sample permittivity ϵ as a function of temperature T and wavelength λ. Both the sample and tip are electrically contacted in order to enable complementary AFM-techniques such as PFM or KPFM.

First Demonstration of Soft X-ray Second Harmonic Generation at FERMI

In the optical regime, a standard technique to explore the chemistry and physics of surfaces and buried interfaces, is second harmonic generation (SHG). Interfaces are hugely important in a variety of contexts, including solar cell efficiency, catalysis, and computer chip functionality. In this three-wave mixing technique, two photons of the same energy interact with the material to generate a single photon at twice the energy. In even-ordered nonlinear processes, such as SHG, the process only occurs when no centrosymmetry exists (in the dipole approximation). This necessarily makes it interface sensitive at optical energies, but at hard x-ray energies (wavelength on the order of the spacing between atoms) SHG is a bulk probe, as each individual atom breaks inversion symmetry. Extending SHG to soft x-ray wavelengths would combine the element specificity and spectral sensitivity of x-ray spectroscopy with the interface selectivity of optical SHG.

By utilizing the EIS-TIMEX beamline of the FERMI FEL to measure the number of SH photons generated in graphite thin films, second harmonic generation at soft x-ray energies was observed for the first time (Figure 1). Moreover, the second harmonic signal was independent of film thickness, implying that the signal is interface specific (Figure 2). Additionally, by varying the x-ray energy, the effect of resonant enhancement was observed, consistent with x-ray absorption spectroscopy. Calculations indicate that the majority of the signal arises from the topmost layer of graphite, making it significantly more 'surface specific' than traditional x-ray 'surface specific' spectroscopies such as x-ray absorption and x-ray photoemission which are typically limited to nanometer specificity. In the future, using the ultrafast laser pulses at FERMI, it should be possible to study dynamics at interfaces during reactions and catalysis.

Sumana Raj, Craig Schwartz

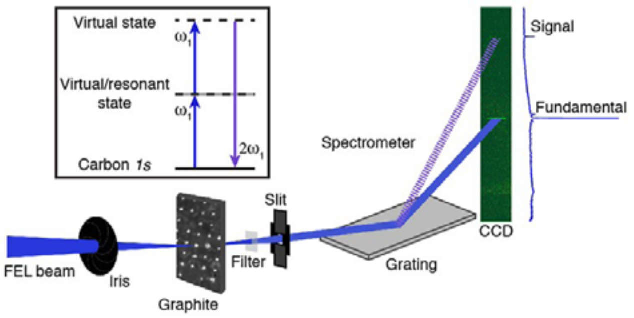


Figure 1: Experimental Design. The x-ray pulse is focused onto the graphite sample at normal incidence. The transmitted beam then reflects off a spectrometer grating, spatially resolving the second harmonic signal from the fundamental, and is detected with a CCD. Inset: A schematic energy level diagram of SHG.

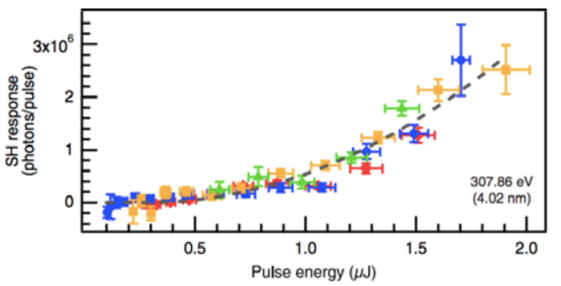


Figure 2: Second Harmonic Generation from Graphite. Second harmonic generation signal observed at 307.86 eV as a function of pulse energy. Signal is independent of film thickness, varying from 100 nm (red diamonds), to 300 nm (blue circles), to 500 nm (orange squares), to 720 nm (green triangles). This indicates the technique is surface sensitive.

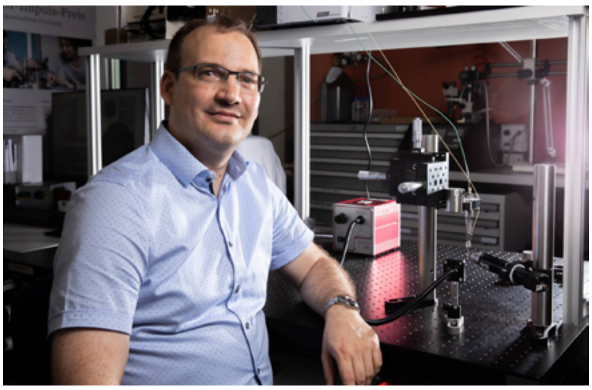
Original publication:

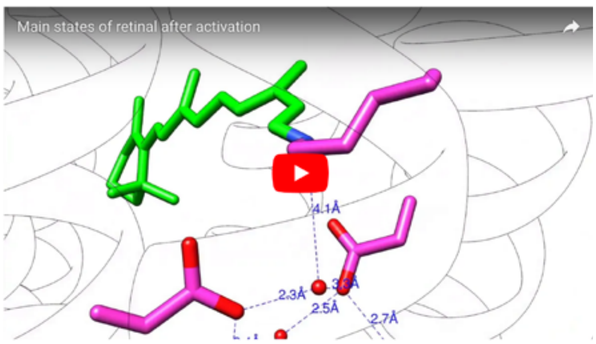
R.K. Lam, S.L. Raj, T.A. Pascal, C.D. Pemmaraju, L. Foglia, A. Simoncig, N. Fabris, P. Miotti, C.J. Hull, A.M. Rizzuto, J.W. Smith, R. Mincigrucci, C. Masciovecchio, A. Gessini, E. Allaria, G. De Ninno, B. Diviacco, E. Roussel, S. Spampinati, G. Penco, S. Di Mitri, M. Trovò, M. Danailov, S.T. Christensen, D. Sokaras, T.-C. Weng, M. Coreno, L. Poletto, W.S. Drisdell, D. Prendergast, L. Giannessi, E. Principi, D. Nordlund, R.J. Saykally, C.P. Schwartz, "Soft X-Ray Second Harmonic Generation as an Interfacial Probe", Phys. Rev. Lett. 120, 023901 (2018)
https://doi.org/ 10.1103/PhysRevLett.120.023901

Biological light sensor filmed in action

Using X-ray laser technology, a team led by researchers of the Paul Scherrer Institute PSI has recorded one of the fastest processes in biology. In doing so, they produced a molecular movie that reveals how the light sensor retinal is activated in a protein molecule. Such reactions occur in numerous organisms that use the information or energy content of light – they enable certain bacteria to produce energy through photosynthesis, initiate the process of vision in humans and animals, and regulate adaptations to the circadian rhythm. The movie shows for the first time how a protein efficiently controls the reaction of the embedded light sensor. The images, now published in the journal Science, were captured at the free-electron X-ray laser LCLS at Stanford University in California. Further investigations are planned at SwissFEL, the new free-electron X-ray laser at PSI.
https://www.psi.ch/media/biological-light-sensor-filmed-in-action

SwissFEL/PSI





The film shows the transition between the main states of retinal within the first picoseconds after activation in the binding pocket of the bacteriorhodopsin. (Video: Paul Scherrer Institute/Przemyslaw Nogly and Tobias Weinert)

Elusive oxocarbenium ions revealed and characterized by IR ion spectroscopy

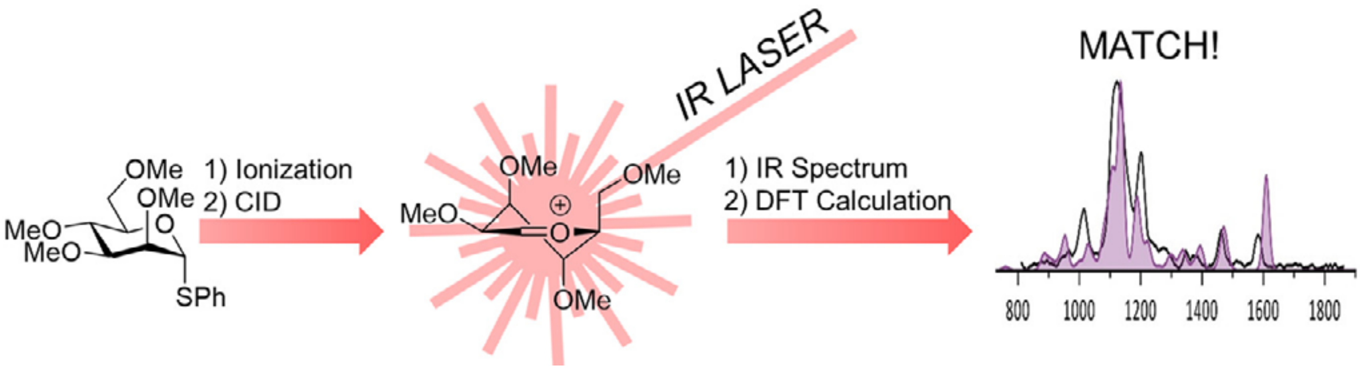
Glycosyl cations, including the elusive oxocarbenium ion, have been experimentally formed and structurally characterized for the first time by combining tandem mass spectrometry and IR ion spectroscopy using the free electron laser FELIX and quantum chemical calculations.

The stereo-selective synthesis of glycosidic bonds is a huge challenge in oligosaccharide synthesis. In these glycosylation reactions, carbohydrate building blocks are covalently linked in order to form larger oligosaccharides. The transient intermediates, the glycosyl cations are key in the mechanism and outcome of glycosylation reactions. However, due to their high reactivity and short life times, these glycosyl cations are very hard to characterize spectroscopically. Only recently, the structure of a glucose oxocarbenium ion has been shown under very harsh conditions by NMR. These conditions are, however, not compatible with all commonly used protecting groups.

The use of tandem mass spectrometry coupled with IR ion spectroscopy and quantum chemical calculations is a novel, mild and versatile approach to generate and structurally characterize elusive glycosyl cations under isolated conditions. The robustness and generality of the approach has been examined by for example testing different glycans; i.e. manno-, gluco and galactosides, and the effect of neighboring group participation on the resulting conformation of the glycosyl cation. When neighboring group participation was fully eliminated, the elusive oxocarbenium was formed. Since the IR spectra show a plethora of diagnostic features highlighting the conformational preferences of the glycosyl cation. These experiments are a first step in elucidation the glycosylation reaction mechanism and predicting its stereoselectivity.

Anouk Rijs

Original publication:
H. Elferink, M. Severijnen, J. Martens, R. Mensink, G. Berden, J. Oomens, F. Rutjes, A.M. Rijs, and T. Boltje, "Direct Experimental Characterization of Glycosyl Cations by Infrared Ion Spectroscopy", J. Am. Chem. Soc. 140, 6034 (2018)
https://doi.org/10.1021/jacs.8b01236



The figure illustrates our approach: first the glycosyl cation is formed by activating the precursor carbohydrate inside the mass spectrometer, subsequently it IR ion spectrum is recorded and compared to quantum chemical calculations to determine its exact structure.

Direct measurement of the pulse duration and frequency chirp of seeded XUV free electron laser pulses

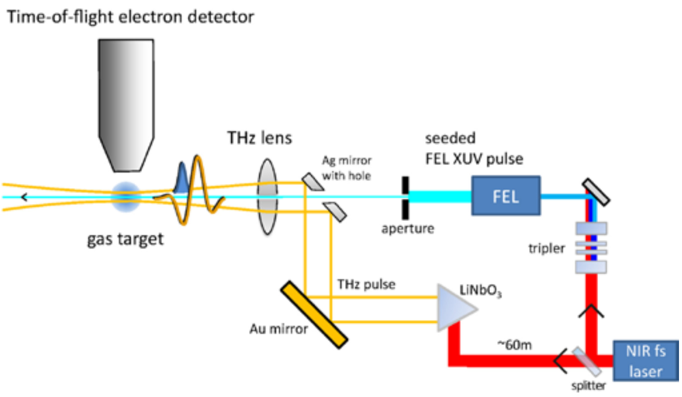
We report on a direct time-domain measurement of the temporal properties of a seeded free-electron laser pulse in the extreme ultraviolet spectral range [1]. Utilizing the oscillating electromagnetic field of terahertz radiation, a single-shot THz streak-camera [2] was applied for measuring the pulse duration and the fre quency chirp of a seeded FEL pulse. Figure 1 shows an overview. A near infrared femtosecond laser generates a synchronized Gaussian laser pulse, which is split into two pulses. One pulse is frequency tripled and injected into the FEL to seed the electron bunch inside an undulator. The other part is guided to the THz streaking diagnostic, where it is frequency down-converted to THz radiation and brought to spatio-temporal overlap with the XUV pulse inside an argon gas target. In figure 2 the temporal delay scan between the XUV and the THz pulse is presented. For each delay step, kinetic electron energy spectra are recorded and plotted vertically in false color encoding the electron signal amplitude normalized to the overall maximum. The red line connects the centers of mass of each spectrum. The ”x” at the two peak inflexion points mark the operating points $O_\pm$, where we take the streaked spectra of rms width $\sigma_\pm$ to calculate the pulse properties. From a quantum-mechanical theory discussed elsewhere [3] follows

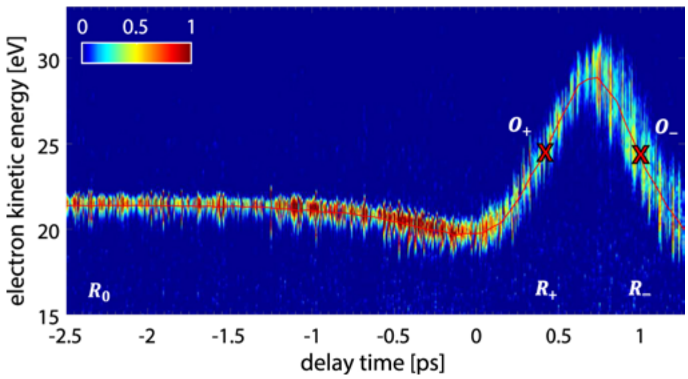
$$\tau_{XUV} = \sqrt{\frac{\left(\sigma^2_{+,decon}\right)s_- + \left(\sigma^2_{-,decon}\right)s_+}{(s_+ + s_-)s_+ s_-}} \quad (1) \qquad c = \frac{\left(\sigma^2_{+,decon}\right)\cdot s_-^2 - \left(\sigma^2_{-,decon}\right)\cdot s_+^2}{4 s_- s_+ \cdot (s_+ + s_-)\cdot \tau^2_{XUV}} \quad (2)$$

for pulse duration τ_{XUV} and chirp c of the XUV pulse with deconvoluted spectral widths $\sigma_{\pm,decon} = \sqrt{\sigma_\pm^2 - \sigma_0^2}$, the unstreaked spectral rms width $\sigma_0$0 and streaking speeds $s_\pm$, i.e. the corresponding slope at the operating points. Taking several measurements at these points, one calculates the average temporal pulse properties of the seeded FEL $\tau_{XUV,rms} = (58\pm7.5)$ *fs* and $c = (-1900\pm800)\,\frac{THz}{ps}$. The XUV pulse duration had been measured in parallel using an electron bunch based measurement method [4], which provided a similar pulse duration of (57±8) fs rms. Importantly, the single-shot capability of THz-streaking allows assessing the reproducibility of these pulse parameters. However, in this experiment only one ToF was used measuring only one of the three spectral widths σ_+,σ_- or σ_0. After a recent upgrade of the THz streaking diagnostic together three ToFs will now be able to measure all three widths simultaneously providing single-shot pulse duration and chirp measurement capability.

This research was supported by the Germany Federal Ministry for Education and Research through collaborative research projects FSP-302 (05K13GU4) and LoKoFEL (05K2016).

Armin Azima





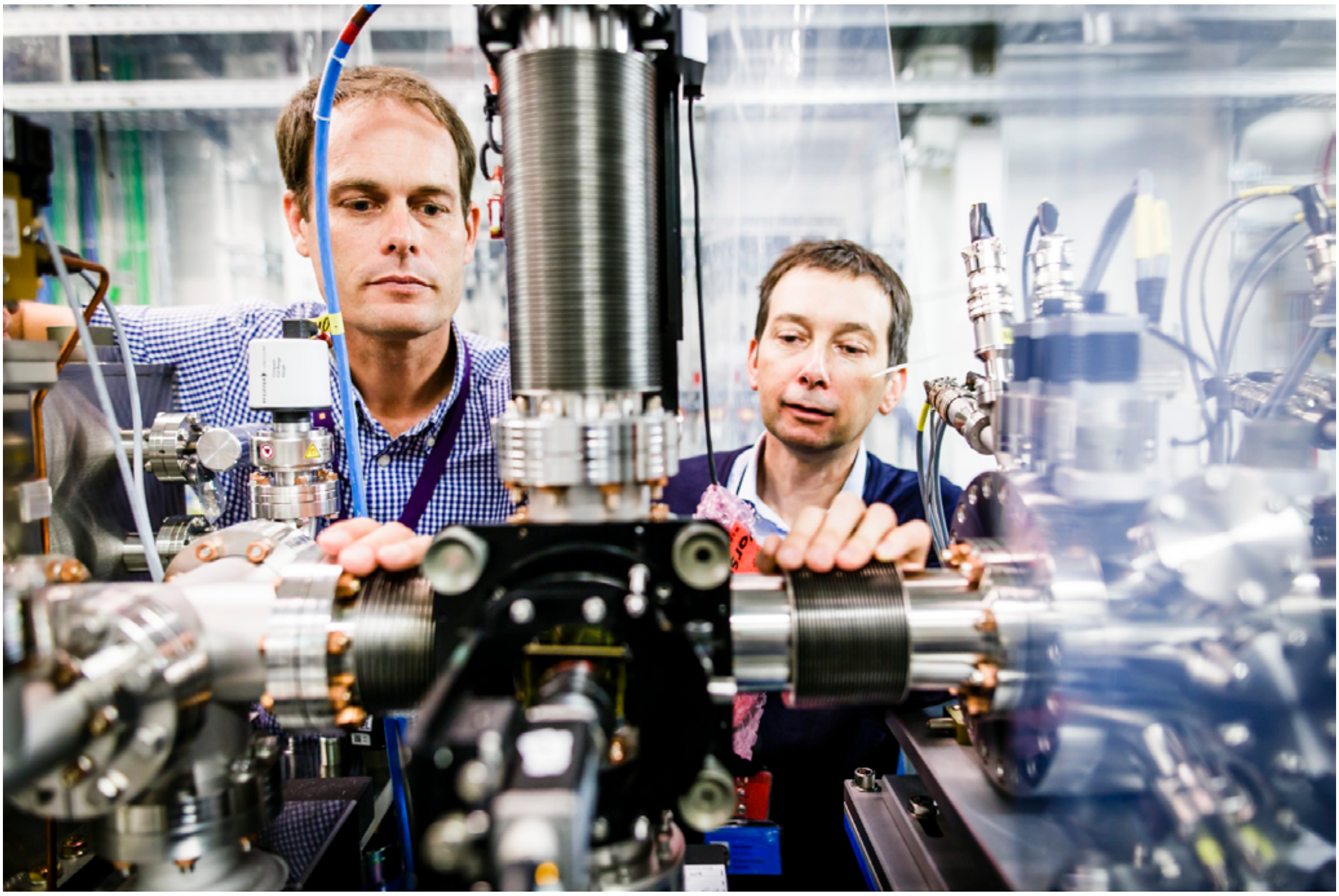
Original publication:

[1] Armin Azima, Jörn Bödewadt, Oliver Becker, Stefan Düsterer, Nagitha Ekanayake, Rosen Ivanov, Mehdi Kazemi, Leslie Lamberto Lazzarino, Christoph Lechner, Theophilos Maltezopoulos, Bastian Manschwetus,Velizar Miltchev, Jost Muller, Tim Plath, Andreas Przystawik, Marek Wieland, Ralph Assmann, Ingmar Hartl, Tim Laarmann, Jörg Rossbach, Wilfried Wurth and Markus Drescher, New J. Phys. 20, 013010 (2018)
https://doi.org/10.1088/1367-2630/aa9b4c

References:

[2] U. Frühling 2011 J. Phys. B: At. Mol. Opt. Phys. **44** 243001
[3] J. Itatani et.al. Phys. Rev. Lett. 88, 173903
[4] T. Plath et. al. Scientific Reports 7, 2431 (2017)

European XFEL increases performance during its first user run



First users at the SPB/SFX instrument in September 2017. In total, 14 user groups did research at European XFEL in the first user run, which ran from then until June 2018.

The first round of user experiments at the European XFEL has come to a close, covering a wide range of research topics. In 12-hour shifts, the European XFEL's SPB/SFX and FXE instruments facilitated the research of 14 groups on a variety of crystallographic applications, work on light-capturing compounds, and novel materials such as organic LEDs. The scientists are now analysing their data and the first papers are being prepared.

In the background, instrument scientists and technical staff continued to improve the properties of the facility. New components, including diagnostic tools and focusing optics, are being installed at the instruments to give users more flexibility in their work. Meanwhile, the commissioning team for the facility has been slowly increasing the X-ray laser's capabilities. In the past user run, the European XFEL could deliver up to 300 flashes per second, with a pulse rate of 1.1 MHz—currently the highest repetition rate at an X-ray FEL in the world. The facility also has generated laser light at all three of its light sources simultaneously, meaning that capacity for hosting experiments will increase at least threefold by mid-2019.

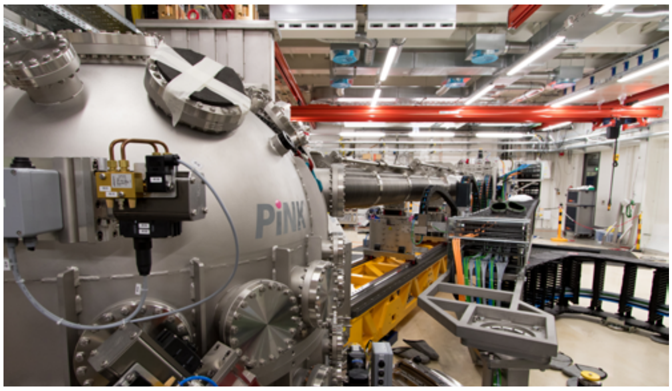
As research continues in the experiment hall, the number of member states increased to 12 when the United Kingdom officially signed the facility's convention in March. The UK contributes 38 million pounds to the construction and commissioning of the facility.

Joseph Piergrossi

European XFEL set to more than triple capacity in 2019

Since September 2017, users from around the world have made their way to Schenefeld near Hamburg, Germany, to perform experiments at the first two instruments at the facility. One of them, SPB/SFX, focuses on structural biology with an aim towards time-resolved imaging of single particles, the other one, FXE, enables ultrafast observations of chemical processes at environmental conditions. The first round of experiments ran from September 2017 to June 2018.

In May, the European XFEL became capable of producing X-ray laser light at all three of its currently installed X-ray generating undulators simultaneously. This feature is important, as it allows for the first time at an FEL to operate three instruments at once. Also in May, the call for proposals for the second round of user experiments opened—for the first time for all six scientific instruments at the facility. The new SCS and MID instruments have a strong materials-science focus, the SQS instrument will probe quantum systems inside molecules and atoms, and the HED instrument will enable studies of laser-compressed dense matter similar to that found inside planets. SQS and SCS are scheduled to have their first users in November 2018, while MID and HED will start user operation in the first half of 2018. As the scientific infrastrucSture of the facility continues to develop, scientific groups are busy making sure all components are ready to serve the users in the next rounds of experiments. Optics experts, vacuum engineers and technicians, sample specialists, and laser scientists are working hard to install the devices needed to support experiments at all six instruments—often working alongside the users who have come for early experiments. By mid-2019, all originally planned six instruments will be in user operation. In total, it is expected that the European XFEL will be able to offer more than three times more beamtime than as compared to the first user cyle.



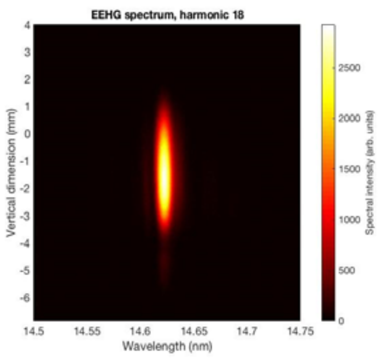
MID is one of four scientific instruments that are currently under construction at European XFEL. The first users at MID are expected to arrive in early 2019.

Joseph Piergrossi

First EUV pulses with Echo-Enabled Harmonic Generation at FERMI

Echo-Enabled Harmonic Generation (EEHG) has been proposed as an efficient method for extending external seeding techniques in Free-Electron Lasers to the few nm wavelength range. During a dedicated experiment at the FERMI FEL, the capabilities of EEHG have been demonstrated in the EUV spectral range for the first time. First measurements, done at 14 nm, show amplification of the EEHG bunching in the FEL radiator, allowing generation of very narrow bandwidth FEL pulses with energies of several tens of uJ. The successful experiment is the result of a fruitful collaboration between the FERMI team at Elettra Sincrotrone Trieste and scientists from international laboratories including SLAC, PSI, MAX IV, Soleil, DESY, LBL, ANL and Shanghai Jiao Tong University. The experiment will continue during the next months with the goal of extending the EEHG capabilities down to the soft-X-ray wavelength range.

Primož Rebernik
On behalf of EEHG@FERMI



Single shot spectrum of a typical 50 uJ FEL pulse produced at FERMI with the EEHG scheme

Movie directors with extra roles

Data storage devices based on novel materials are expected to make it possible to record information in a smaller space, at higher speed, and with greater energy efficiency than ever before. Movies shot with the the SwissFEL X-ray laser show what happens inside potential new storage media, as well as how the processes by which the material switches between two states can be optimised. https://www.psi.ch/media/movie-directors-with-extra-roles

SwissFEL/PSI

HFML-FELIX laboratory awarded National Roadmap Grant

The HFML-FELIX laboratory has been awarded a grant in the "National Roadmap for Large-Scale Research Facilities" scheme of the Netherlands Organisation for Scientific Research (NWO).

The Free-Electron Lasers for Infrared eXperiments Laboratory (FELIX) and the High Field Magnet Laboratory (HFML) are two open access research infrastructures that allow researchers to investigate matter under extreme conditions and to enter the "terra incognita" in which new effects and phenomena can be realized in molecules and materials.

This grant will enable an expansion in the capabilities of their suite of free-electron lasers and to install three dedicated research laboratories: the "Molecular ID lab", where complex mixtures can be analyzed and molecular structures can be isolated and identified swiftly and accurately, the "Condensed Matter lab" for studying the interaction of condensed and magnetic materials with intense THz radiation and a laboratory that will focus on the exploitation of the recent option to combine very high magnetic fields with intense THz radiation. The Roadmap committee recognized the societal relevance and contribution of the research facility in the important fields of health, energy and smart materials.

For additional details and images: https://www.nwo.nl/en/news-and-events/news/2018/04/national-roadmap-138-million-euros-for-ten-top-research-facilities.html

Britta Redlich

PolFEL – continuous wave FEL and THz facility in Poland

PolFEL, a THz and VUV FEL facility at the National Centre for Nuclear Research (NCBJ) in Świerk has been approved recently and will have 37.5 M€ funding in its disposal for construction of the first stage. The construction will begin in January 2019 and should end in 2022. The facility has been classified for funding under the Smart Growth Operational Program – which is complementary to the European Union Horizon 2020 Framework Programme. The decision has been taken based on the declared scientific and technological interest of numerous laboratories and universities in Poland, industrial contribution both from Poland and abroad, and an invaluable hardware contribution by STFC Daresbury Laboratory.

The PolFEL accelerator will operate in continuous wave (cw) and long pulse (lp) modes, delivering to two undulators bunches generated by superconducting injector, and accelerated by four HZDR-like cryomodules, housing in total 8 TESLA SRF cavities. The beam at energies of 120 MeV and 160 MeV in cw and lp mode respectively will be directed to the VUV undulator line while lower energy beams will drive the THz undulator.

The generated radiation in the range from 0.3 mm down to 150 nm for the first harmonic (50 nm for the third harmonic), will be delivered to experiments in a dedicated experimental hall. The expected pulse energy is at the level of 100 μJ for VUV and tens of micro-joules for the THz radiation. The maximum photon flashes repetition rate will be 100 kHz.

A part of the facility operation time will be dedicated to the machine and new accelerator component studies in collaboration with STFC Daresbury, European XFEL and DESY.

Robert Nietubyć

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polfel

Science@FELs 2018 in Stockholm

For the fourth time the Science@FELs conference was organized, this time in Stockholm in the AlbaNova University Center at Stockholm University between 24 and 27 of June. The preceding events took place in Hamburg, at PSI and in Trieste.

Science@FELs 2018 is a conference by FELs of Europe and focuses on the scientific highlights achieved during the last years at FELs and laser facilities world-wide. The conference in 2018 was co-organized by the Stockholm-Uppsala FEL center, the MAX IV Laboratory, the Lund Laser Centre, Stockholm University and Lund University.

Despite the long light Nordic nights of Stockholm combined with south European temperatures and a distracting football championship, around 160 participants joined the conference. They came to listen to talks on New developments, Imaging, Scattering, Condensed Matter Physics, Chemistry, Atomic and Molecular Physics, Bioscience and Matter under extreme conditions. In addition there were over 70 posters and a “Hot-topic session” with oral presentations on highlights from the posters. The speakers spanned the world from Stockholm, via Århus, Kiel and XFEL, FERMI, SOLEIL to LCLS and Spring-8. With Laserlab Europe being a co-organizer, one talk per session was chosen from a laser perspective, highlighting the integration in science between FEL and laser sources.

The conference started with four tutorials catching the spirit of lasers, X-ray FELs and light. Michele Svandrlik, head of FELs of Europe, and Claes-Göran Wahlström, head of Laserlab Europe,

Dr Jonas Sellberg is awarded the FELs of Europe prize on FEL Science and Application.
Photo: Sverker Werin.

Conference picture of the Science@FELs 2018 participants.
Photo by : Andre Posmitny

welcomed the audience and stressed the fruitful collaboration between lasers and FEL.

The FELs of Europe prize in recognition of recent work for scientific excellence in the area of FEL science and applications was, awarded to Dr. Jonas Sellberg from the Royal Institute of Technology (KTH) in Stockholm for “his innovative contributions by means of free electron lasers to the understanding of supercooled water”.

Ten students were supported to travel to the event in Stockholm by EUCall.

Taking advantage of the Swedish summer a Barbecue evening with Boule games, food and drinks emphasized the informal character and joyful approach to science, research and networking.

Michele Svandrlik and Wilfried Wurth welcomed everybody to Science@FELs 2020 at DESY in Hamburg in September 2020, this time with a new XFEL in operation!

The event was supported by The Swedish Research Council, Structural Dynamics AIP and the Swedish Research Council.

https://indico.maxiv.lu.se/event/476/

Per Johnsson, Mats Larsson, Anders Nilsson and Sverker Werin

Forum on Advanced FEL Techniques in Stockholm 2018, 27-28 June

The Forum, being a Satellite event to the Science@FEL conference, gathered around 40 participants in a sunny and warm Stockholm with a distracting football event ever present.

Within Science@FEL the Forum is a key action in the exploration of FEL techniques and FEL user possibilities, especially joining the forces for an even more focused future development.

The Forum focused on bringing together FEL developers and Users, aiming at improving exchanges between the two communities. Plenty of time was therefore used for discussions that were introduced by review and highlight talks where users and FEL developers presented side-by-side, dedicated to important aspects such as coherence, photon pulse manipulation, high pulse energy, polarization control, ultrashort pulses, and production of multiple colour pulses.

Discussions soon deepened in how to match the broad-range of community-dependent requirements to different techniques available by FEL developments both in the soft and hard X-ray regimes. Users pointed to the key characteristics of FEL pulses needed to fulfil experimental expectations. A large ensemble of users deal with time-resolved pump-probe experiments and are interested in relatively short pulses (down to a couple of femtoseconds) with well-synchronized and carrier-envelope stable pump-probe pulses over a large frequency range, from THz to optical and beyond. Timing, as an alternative to synchronization, is an option for some, while others see it as a work-around, difficult to conjugate to a large frequency-range of pumps, due to the need of dedicated timing tools at different frequencies.

Going towards single-particle imaging requires few-femtosecond pulses as well, but needs a large number of photons (Terawatt range) and shorter wavelengths allowing for sub-nm resolution. Studying ultra-fast phenomena goes even further, to sub-femtosecond single- or multi-pulses.

Applications dealing with warm and hot dense matter need mJ-level pulses with micrometer-size focus, while beams with stable and good degree of polarization are required for imaging magnetic domains. Finally, multiple-colour, high-repetition X-ray pulses are needed for site-selective, coincidence pump-probe experiments.

Another developing field discussed was OAM (Optical Angular Momentum) beams that can be created in FELs with helical undulators and how and if they can explored. Moving particles by light was shown (not only inspired by Scottish folk music as presented by Brian McNeil).

Users were asked to dream, what is the "dream beam"? Perhaps it cannot be created, not in a single machine, but sometimes the FEL developers come up with new surprising schemes as the FEL is among the most versatile light sources out there.

It was proposed to continue and deepen communication between users and developers both by an electronic platform, where requirements can meet FEL development ideas, and future Fora. The Forum was generously hosted by Stockholm University.

https://indico.maxiv.lu.se/event/771/

Gianluca Geloni (European XFEL), Luca Giannessi (Fermi) and Sverker Werin (MAX IV)

Photos by: Sverker Werin

Trieste FoE SC committee meeting brief summary

The Steering Committee (SC) of FELs of Europe (FoE) met in Trieste on 13 and 14 March 2018. The meeting was held at Elettra, following the LEAPS General Assembly and Coordination Board meetings. Representatives of 12 FoE partners attended the SC meeting. Claudio Masciovecchio, Head of Scientific Programs of FERMI, opened the meeting with the welcome address and gave a brief overview of the most recent scientific highlights of the facility.

At the meeting it was unanimously decided to extend the FoE collaboration, that started on 31st of May, 2012 by a second period for further 6 years. At the same time the integration of FoE activities within LEAPS, in the frame of the Strategy Group 2 – Free Electron Lasers, was extensively discussed and a first core group of members of the Strategy Group 2 was proposed and approved at the meeting. A review of the Appendix to the LEAPS Strategy 2030 document was undertaken during the meeting, allowing the delivery of a revised version of it in time for presentation few days after at the Sofia event.

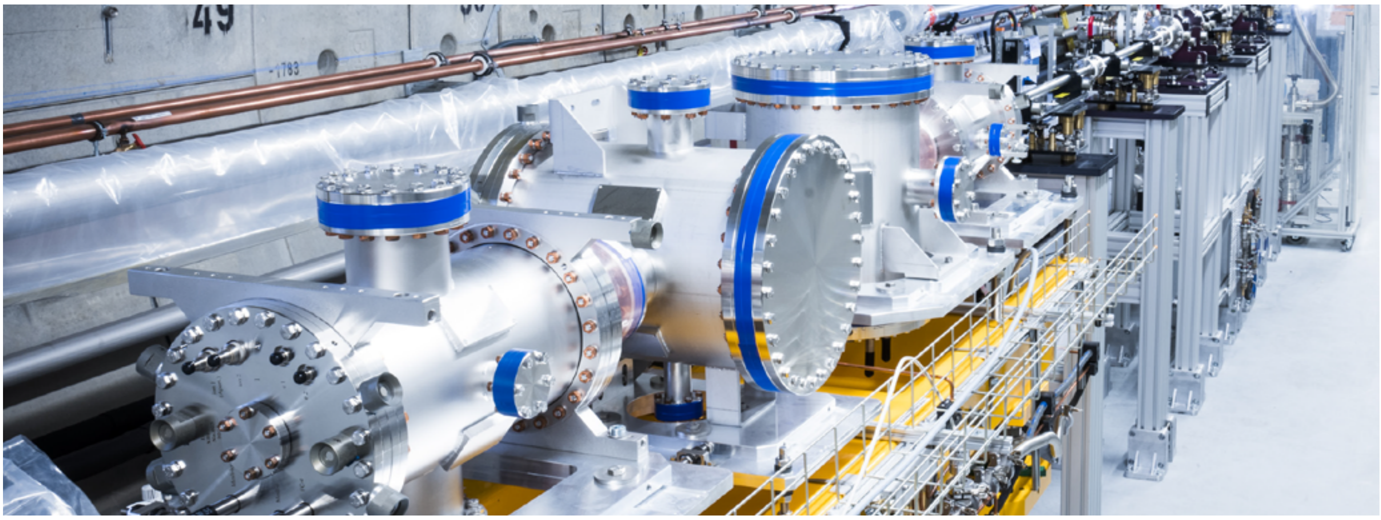
On the second day, special focus with dedicated presentations was given to a number of European initiatives and projects, as CALIPSOplus, EUCALL, Wayforlight, CompactLight, LASERLAB Europe and EUPRAXIA; possible connections and synergies with FoE were analyzed.

A report on the organization of the FoE conferences and workshops in 2018 was given, namely the SCIENCE@FEL Conference end of June in Stockholm and the Photon Diagnostics workshop mid of September in Hamburg: the organization of both events, including satellite meetings, appears to be well on track.

Finally the host and date for the next meeting of the FoE SC was agreed: it will be held at SOLEIL mid of October 2018.

Michele Svandrlik

PhotonDiag 2018 in Hamburg



The 4th FELs OF EUROPE workshop on FEL Photon Diagnostics, Instrumentation, and Beamline Design, PhotonDiag 2018, will be held in the Hamburg area on 17-19 September 2018. It is co-organized by DESY and European XFEL and will focus on topics such as photon beam diagnostic techniques, FEL optics and beam transport as well as science instruments and detectors & scientific computing for FEL experiments. The registration deadline is September 1, 2018. The scientific program is currently being finalized and detailed information is available at photondiag2018.desy.de. Welcome to Hamburg!

Jan Grünert, Elke Plönjes and Kai Tiedtke

LEAPS

LEAPS - the League of European Accelerator-based Photon Sources - is a strategic consortium initiated by the Directors of the Synchrotron Radiation and Free Electron Laser (FEL) user facilities in Europe. Its primary goal 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.

Presentation of LEAPS Strategy 2030

Dr. Caterina Biscari, Director of the ALBA Synchrotron in Spain and Vice Chair of LEAPS, League of European Accelerator-based Photon Sources, presented the LEAPS Strategy 2030 to Jean-David Malo, Director, Directorate General Research and Innovation, European Commission.

LEAPS join forces with the European Commission to strengthen Europe's leading role in science. "A world where European science is a catalyst for solving global challenges, a key driver for competitiveness and a compelling force for closer integration and peace through scientific collaboration." This is the vision of LEAPS, League of European Accelerator-based Photon Sources, on which the LEAPS Strategy 2030 is based. Director Jean-David Malo, DG Research and Innovation, received the strategy today at the Bulgarian Presidency Flagship Conference on Research Infrastructures.

– I believe science makes the world a better place and I'm very happy to be able to present this strategy today, said Dr. Caterina Biscari, Director of ALBA Synchrotron and Vice Chair of LEAPS. I'm convinced it will be a major contribution in how to develop European research infrastructures in a cost-effective and sustainable way. I look forward to the upcoming discussions with the European Commission, with our national funders and with our extensive user community on how we, by joining forces, can boost European science and innovation.

The health, prosperity, and security of European citizens today and in the future depend on meeting increasingly demanding challenges. These can be found in energy and transport, health care and food safety, and sustainable living. This demands new technology, new treatments and a better understanding of the world around us, all of which point to an increased role and reliance on highly sophisticated analytical tools like accelerator-based light sources to provide the most incisive means of measuring and unravelling atomic and molecular structures of the world around us. Europe hosts 13 synchrotron radiation facilities and six free electron laser facilities which all of them are founding members of LEAPS. They represent a multi-billion Euro investment with an annual operation budget of €700M serving more than 24 000 direct users.

- By bringing together the community of national and pan European synchrotrons and free-electron laser facilities, the LEAPS initiative should be encouraged as it aims at structuring the European landscape of Research Infrastructures, coordinating strategic investments and facilitating transnational access, emphasised Jean-David Malo.

The LEAPS Strategy 2030 shows how the members, by joining forces, will be able to deliver even better capacity and capabilities at their research infrastructures. This will be done through smart specialisation, closer co-operation, better engagement with industry and working together with the existing user communities to reach out to scientists, academic and non-academic, that may not yet know of all the tools and skills available at photon sources for solving questions from all fields of science. The strategy explains how LEAPS will address key issues of the European Long-Term Sustainability Action Plan, presents roadmaps to optimise national and European resources and also describes the how the path towards FP9 looks with a few carefully selected pilot activities under the Horizon2020 programme.

– LEAPS fully embrace the European Commission's "Open Innovation, Open Science, Open to the World" concept and with the planned activities building on our strategy we hope to make a substantial contribution in making this a reality, concludes Dr. Biscari.

The LEAPS members are: ALBA, DESY, Diamond Light Source, Elettra, ESRF, European XFEL, FELIX, HZB, HZDR, INFN, ISA, MAX IV, PSI, PTB, Solaris, Soleil. The LEAPS strategy 2030 can be downloaded here: https://www.leaps-initiative.eu/about/leaps_strategy_2030/

EUCALL holds its final annual meeting and prepares for its closeout

From 30 May to 1 June 2018, over 60 EUCALL participants met in Dolní Břežany, Czech Republic, for the project's final annual meeting at ELI-Beamlines. Over the past three years, the EU-funded project EUCALL (Horizon 2020 Grant Agreement No. 654220) has brought together experts from free-electron laser, synchrotron and high-power optical laser facilities to work on common technologies and collaborate on solutions to challenges facing their fields.

FELs of Europe is one of two networks and thirteen facilities taking part in the European Cluster of Advanced Laser Light Sources (EUCALL). Since the project funding period ends on 30 September 2018, those at the meeting spent the majority of their time strategizing the last tasks and making plans for extending the collaborations initiated through EUCALL.

Such a meeting was also a ripe time for reflection on the project's successes. EUCALL Coordinator and European XFEL Scientific Director Thomas Tschentscher opened the meeting praising the efforts of those involved and going over the project's results so far. "The partners are very pleased, highlighting a wealth of advanced results coming out of the project, as well as instruments and tools that can be used at complimentary light sources participating in EUCALL. During the next weeks we will complete any remaining tasks in EUCALL and prepare for the future of our collaboration." Many of the attendees also expressed satisfaction over what had developed through the project. "This project gave a great connection between photon science and optical lasers", said Axel Hübl, a Ph.D. student at Helmholtz-Zentrum Dresden-Rossendorf who worked on the EUCALL SIMEX work package. "EUCALL gave us the opportunity to expand our code for our pump–probe modelling so we could extend the model to perform imaging simulations."

The SIMEX simulation software, which was developed from one of EUCALL's four technical work packages, models experiments at light sources from source to detector and has been praised by the EUCALL's project reviewer as being an "invaluable" tool.

"EUCALL gave me a very good opportunity to get to know people from different communities, proposing technologies that give different perspectives to my work", said Daniele Margarone, a leading scientist at ELI-Beamlines, leader of EUCALL's HIREP project, and one of the annual meeting's organizers.

Among the most recent successes at the time of the meeting were the deployment of HIREP's high repetition sample delivery system prototypes at ESRF and the successful use of the diverse PUCCA diagnostics and timing tools at the European XFEL's FXE instrument. UFDAC, a work package offering firmware for ultrafast data acquisition and analysis needed to deal with high data throughput, is attracting attention with its benchmark 10 GB/s rate of processing data.

Present at the meeting were various researchers and instrument scientists who have begun to integrate these EUCALL technologies into their beamlines. For example, researchers working on the MicroMAX beamline at the MAX IV beamline in Sweden said they were excited to start working with HIREP technologies, and a visitor from the LCLS X-ray free-electron laser in California discussed building on the SIMEX platform for their LUME simulation program. In addition to plenary sessions and breakout working time for the technical groups, the meeting also featured talks on other international light source collaborations such as LEAPS and Laserlab-Europe and a presentation on wayforlight, a database of light source facility characteristics that was significantly expanded as a consequence of EUCALL efforts.

Participants at the third and final EUCALL Annual Meeting at ELI-Beamlines

OTHER CONTRIBUTIONS

One common theme at all talks was how the different teams could continue collaborating beyond the EUCALL end date. Attendees proposed several ideas, with a scope either within their individual work packages or extending to all project partners and beyond. Some already made plans, such as a continuation of SIMEX that will be a part of the PaNOSC photon and neutron science cloud networking project, and a Target Development Network that will help facilities collaborate on sample delivery systems such as those developed in HIREP.

"The facilities involved in EUCALL want to keep the collaboration going", ELI's Margarone said. "But that will take funding. We want to make sure what's happened in EUCALL doesn't end here."

Dozens of papers linked to EUCALL developments have been published, with at least 10 ending up in high-impact journals. EUCALL will hold two final workshops before its completion. One will take place on 1–5 July 2018 at ELI-ALPS in Szeged, Hungary, entitled Theory and Simulation of Photon–Matter Interaction, and a final workshop on 6 September 2018 in Brussels, Belgium, on Future Strategies for Research Infrastructure Operation.

Joseph Piergrossi

CURRENT AND UPCOMING CALLS FOR PROPOSALS

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

FERMI at Elettra
Deadline: 1 October 2018

For experiments at FELBE:
Deadline: 22 October 2018

For experiments at FELIX
Deadline: 15 November 2018

For experiments at FLASH:
Deadline: 1 October 2018

For experiments at SwissFEL:
Deadline: 15 September 2018

UPCOMING EVENTS

PhotonDiag 2018 Conference
https://indico.desy.de/indico/event/19622/

IMPRINT

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FELs OF EUROPE