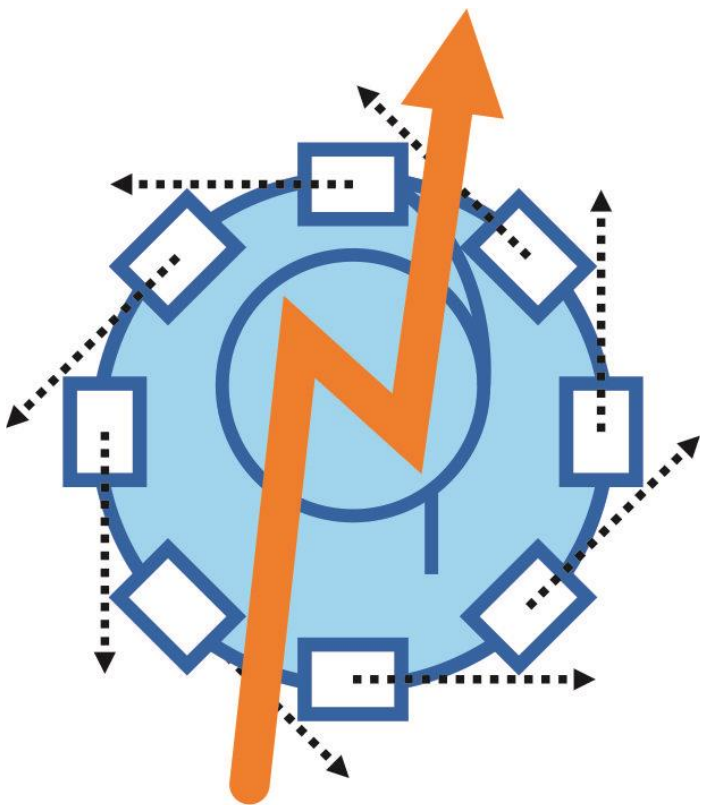
ECM31 Satellite Meeting

"Progress in instrumentation for X-ray diffraction and CryoEM"



Organisers:

Krzysztof Woźniak, Ullrich Pietsch, Michele Cianci

Oviedo (Spain), 22 /08/ 2018

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The Organisers are very grateful to the following companies which sponsor our satellite meeting:

Organisers:

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Welcome to ECM31 Satellite Meeting:
“Progress in instrumentation for X-ray diffraction and CryoEM”

Dear Participants, Dear Colleagues and Friends,

Awareness of the challenging new experimental techniques today is crucial for scientific successes tomorrow providing a solid basis for new breakthroughs. Major crystallographic and other topical conferences are usually focused on new ideas, new results and new theoretical advances for data interpretation, while less attention is paid to the latest advances in experimental hardware developments such as, for example, photon sources, the “pencil” of the most of crystallographically motivated experiments. Although many countries in the EU made or making investments in large-scale research infrastructures, most of the users are less informed about these new developments and the respective new challenges. This is particularly the case considering 4th generation synchrotron sources, FELs and even advanced laboratory sources and CryoEM.

This satellite meeting will present an overview of a wide range of new laboratory instrumentation available from different companies, as well as new developments at several large scale facilities. The meeting will cover information on the newest laboratory instruments from Bruker and Rigaku as well as on new instrumental solutions such as the Lyncean Compact Light Source (CLS) and newest X-ray sources and optics which may bring world-class structural and analytical synchrotron type capabilities back to our labs. One of the sessions is focused on new photon sources to be installed at major European synchrotrons as well as X-ray Free Electron Laser facilities including ESRF, DESY, MAXIV, and the Swiss and European X-FELs. The organizers are also particularly proud to advertise some of the first experimental results taken at European X-FEL. The program of this satellite will also be complemented by news from the neutron ISIS facility and from the cryo-EM equipment producers to provide a forum to discuss the future of instrumentation for X-ray, neutron diffraction and CryoEM.

On behalf of the Organising Committee, it is our great pleasure to invite you to participate in our satellite meeting entitled “Progress in Instrumentation for X-ray Diffraction and CryoEM” which will take place on the opening day of ECM31 (*i.e*. on 22-nd of Aug. 2018) before the ECM opening session. The lectures will be focused on new instrumental solutions and complemented by some spectacular examples of applications. We hope that this broad overview of new instrumental capabilities will help participants to design their own research in the incoming years and you will find this meeting to be interesting and useful.

We would like to thank our sponsors: Rigaku Oxford Diffraction, JEOL and Bruker Bruker AXS GmbH for supporting this event.

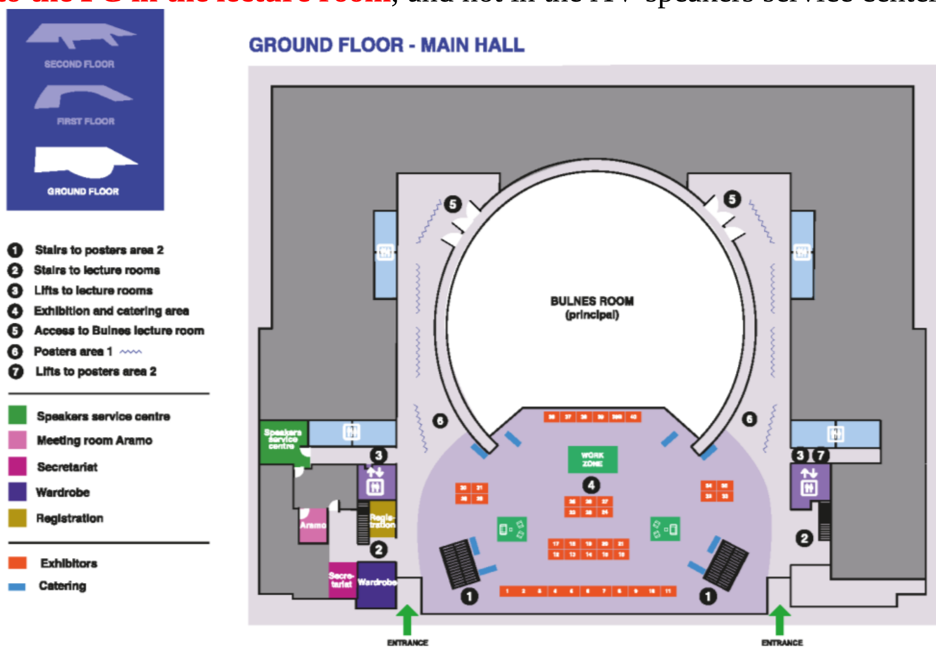
Looking forward to meeting you at our Satellite.

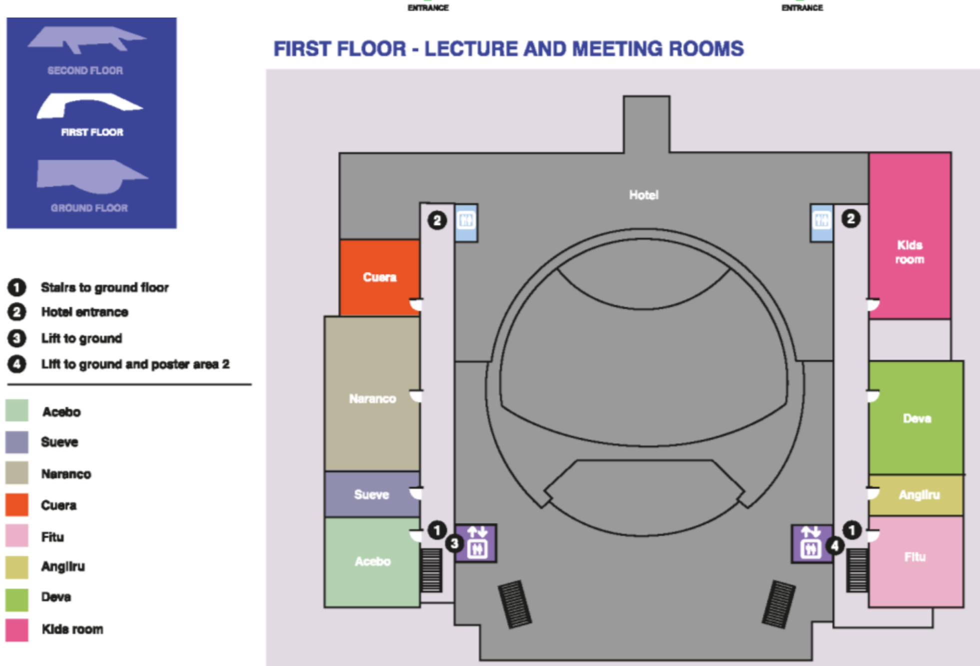
Krzysztof Woźniak, **Ullrich Pietsch and Michele Cianci**

Venue:

The ECM31 Satellite Meeting: "Progress in instrumentation for X-ray diffraction and CryoEM" will take place at the Palace of Exhibitions and Congresses (PEC) of Oviedo, in **Room Acebo**:
https://ecm31.ecanews.org/en/interactive-programme-1.php
Catering for the satellite (coffee breaks and lunch) will be served in room Cuera.
These rooms are located on the first floor, left. You can have a look at the plans of the venue here: https://ecm31.ecanews.org/en/floor-plans-of-the-venue.php

Information for speakers: https://ecm31.ecanews.org/en/av-information-for-speakers.php
Please remember that all the satellite presentations will be uploaded before sessions directly to the PC in the lecture room, and not in the AV speakers service center.





Satellite Programme

Nu	Time	Speaker	Company	Title
	8 55 - 9 00	Opening		
1	9 00 - 9 30	Holger Ott	Bruker AXS GmbH	Recent Advances in In-House Source and Detector Technology
2	9 30 - 10 00	Matthias Mayer	Rigaku Oxford Diffraction	Progress in single-crystal area detector diffractometry – the Rigaku perspective
3	10 00 - 10 30	Klaus Achterhold	Tech. Univ. of Munich	The Munich Compact Light Source - Brilliant, monochromatic, tunable X-rays for the laboratory
4	10 30 – 10 50	Julius Hållstedt	Excillum AB	MetalJet Source for High-End Diffraction and SAXS in the Home Laboratory
	10 50 – 11 15	**COFFEE BREAK**		
5	11 15 - 11 45	Oliver Seeck	DESY	PETRA IV: The ultimate high energy X-ray microscope
6	11 45 - 12 15	Thomas Ursby	MAXIV	Serial Crystallography at a 4th Generation Synchrotron Radiation Source: MicroMAX at the MAX IV Laboratory
7	12 15 - 12 45	Robert McGreevy	ISIS	ISIS instrumentation: three decades of continuous improvement.
	12 45 - 13 35	**LUNCH**		
8	13 35 - 14 05	Thomas Tschentscher	Eur. XFEL	First experiment results from European XFEL
9	14 05 – 14 35	Luc Patthey	Swiss FEL, Paul Scherrer Institut	X-ray diffraction and ultra-fast science by SwissFEL: recent achievements and future plans
10	14 35 - 15 05	Maria Weikum	EuPRAXIA at DESY	EuPRAXIA – a Compact, Cost-Efficient XFEL Source
	15 05 - 15 30	**COFFEE BREAK**		
11	15 30 – 16 00	Gordon Leonard	ESRF	Facilities and Instrumentation for Structural Biology at the ESRF
12	16 00 – 16 30	Alevtyna Yakushevska	Thermo Fisher Scientific	The role of Cryo-electron microscopy in structural biology after the “resolution revolution”
13	16 30 – 17 00	Guillaume Brunetti	JEOL (EUROPE) SAS	New structural biology solution: CRYO ARM

1

Recent Advances in In-House Source and Detector Technology

Holger Ott

Bruker AXS GmbH, Oestliche Rheinbrueckenstr. 49, 76187 Karlsruhe, Germany

The performance of home-lab X-ray systems for crystallography has increased substantially in the last decade. However, high performance usually comes with a dilemma: high investment costs for the instrument and high maintenance costs for the X-ray source. Two new products for the home laboratory address these problems: the IμS DIAMOND - the brightest micro-focus sealed tube and the PHOTON III detector with simultaneous photon-counting and integrating X-ray detection (Mixed Mode Detection)

The new air-cooled IμS DIAMOND microfocus sealed tube source uses a unique anode technology, diamond hybrid, to produces intensities similar to modern microfocus rotating anodes. The anode consists of a diamond substrate coated with copper. Properties of diamond, such as high thermal conductivity, low thermal expansion and extreme hardness make it an ideal substrate allowing not only higher power loading but greater long-term stability of the source.

The PHOTON III is a new CPAD (charge-integrating pixel array detector) which utilizes a mixed-mode approach for data collection. The weak reflections are measured in photon-counting mode and the strong reflections are measured in integrating mode. This allows the PHOTON III to have the ultra-sensitivity to collect very weak reflections while not suffering from charge sharing or non-linearity effects common to other photon-counting detectors.

Bruker's D8 QUEST and D8 VENTURE, both take advantage of these improvements in source and detector technology leading to a new level of performance without increasing operational costs. Experimental data illustrating the hardware advances will be discussed.

2

Progress single-crystal area detector diffractometry – the Rigaku perspective

Mathias Meyer

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In the last 30 years area detector single-crystal diffractometry has witnessed a tremendous progress. Affordable area detector solutions first based on IP systems, then using CCD detectors and later HPAD and CMOS detectors made these systems possible. Parallel data acquisition with 'large' area detectors is key, but the true progress is brought on by new generations of in-house X-ray sources. The sources changed from 'large focus, low brilliance', to 'micro-focus, high brilliance'. This 'high brilliance' solution allowed the use of smaller and smaller samples while still providing good data quality shorter time intervals. Comparing the effective intensity yield for 0.2-0.3mm samples over the last 30 years we have seen an increase of 3 orders of magnitude. For smaller samples this increase is even more dramatic. This has enabled 'interactive' crystallography. Connectivity can be solved within minutes, even seconds. High quality data sets at present are collected in a matter of a few minutes to a few hours. Extremely small samples on the order of a micron in size are accessible for in-house service crystallography.

The talk will highlight the outcome of this exciting journey from the Rigaku perspective.

3

The Munich Compact Light Source
Brilliant, monochromatic, tunable X-rays for the laboratory

K. Achterhold[1], M. Dierolf[1], B. Günther[1,2], Roderick Loewen[3], Martin Gifford[3], F. Pfeiffer[1,4,5]

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[2]Max-Planck-Institute of Quantum Optics, Germany
[3]Lyncean Technologies Inc., Fremont, USA
[4]Department of Diagnostic and Interventional Radiology, Technical University of Munich, Germany;
[5]Institute for Advanced Study, Technical University of Munich, Germany

For many experiments with X-rays a brilliant beam, i.e. a high number of photons in a small solid angle, a small source size and a small energy bandwidth, is needed. It is also desirable for many applications to be able to change the monochromatic energy of the beam.

Since Röntgen discovered X-rays while experimenting with a Crookes tube, the development of X-ray sources aim for higher brilliance. But a strong heating of the anode by the impinging electrons limit its power. The performance could be increased by two orders of magnitude by increasing the heated area using a rotating anode. This is still the state of the art in many research laboratories, in non-destructive material testing and in clinics and medical practices for X-ray diagnosis and therapy.

Since 50 years, synchrotron radiation is used as a brilliant source of X-rays, first parasitically, at first generation synchrotrons build for high energy physics experiments. Since 40 years, synchrotrons where built exclusively for this purpose. In order to generate synchrotron radiation in the Angstrom wavelength range, electrons of some GeV energy are required. This leads to synchrotron rings several hundred meters in diameter, superconducting magnets to keep the electrons on their orbit and many hundred million euros for the planning, construction and operation of such a facility. Highly brilliant synchrotron radiation makes many experiments possible. But, the measurement time must be applied for and often weeks or months pass between request and beamtime.

Therefore, an X-ray source of high brilliance at a moderate price and constant availability in the laboratory is highly desirable. The Munich Compact Light Source, MuCLS, produces X-rays by inverse Compton scattering of infrared photons at relativistic electrons of up to 45 MeV energy [1,2]. At MuCLS, this provides quasi-monochromatic X-ray radiation of about 4% bandwidth between 15keV and 35keV and up to 3e10 photons per second. The electron energy is so low that a small storage ring and conventional magnets are sufficient to store the electron bunches. MuCLS has a footprint of about 5m x 2m. The beam divergence is limited to 4 mrad by apertures. The brilliant beam of MuCLS serves a near experimental hutch for microbeam radiation therapy [3], (dynamic) propagation-based phase contrast imaging [4] and high-resolution micro-CT. In a second hutch, 16m apart, the beam crosssection of 6.2cm x 7.4cm is large enough for imaging of whole small animals. Here the beam is used for grating-based phase-contrast imaging [5] and vector radiography [6]. The presentation describes the properties of MuCLS and presents some results we derived in the last 2.5 years.

References

[1] Elena Eggl, Martin Dierolf, Klaus Achterhold, Christoph Jud, Benedikt Günther, Eva Braig, Bernhard Gleich and Franz Pfeiffer, The Munich Compact Light Source: initial performance measures, J. Synchrotron Rad. (2016) 23

[2] The MuCLS machine was developed and constructed by Lyncean Technologies Inc.; www.lyceantech.com

[3] Karin Burger, Katarina Ilicic, Martin Dierolf, Benedikt Günther, Dietrich W. M. Walsh, Ernst Schmid, Elena Eggl, Klaus Achterhold, Bernhard Gleich, Stephanie E. Combs, Michael Molls, Thomas E. Schmid, Franz Pfeiffer, Jan J. Wilkens, Increased cell survival and cytogenetic integrity by spatial dose redistribution at a compact synchrotron X-ray source, PLOS ONE 12 (10), 2017, e0186005

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Acknowledgements

We acknowledge financial support through the DFG Cluster of Excellence Munich-Centre for Advanced Photonics (MAP), the Center of Advanced Laser Applications (CALA) , the DFG Gottfried Wilhelm Leibniz program and the European Research Council (ERC, H2020, AdG695045). We acknowledge support through the TUM Institute for Advanced Study, funded by the German Excellence Initiative and the European Union Seventh Framework Program under grant agreement no 291763 and co-funded by the European Union. This work was carried out with the support of the Karlsruhe Nano Micro Facility (KNMF, www.knmf.kit.edu), a Helmholtz Research Infrastructure at Karlsruhe Institute of Technology (KIT). The Compact Light Source development was supported in part by grants R44- GM074437 from NIGMS and R43-RR025730 from NCRR.

4

MetalJet Source for High-End Diffraction and SAXS in the Home Laboratory

Emil Espes, Julius Hållstedt, Ulf Lundström, Björn A. M. Hansson, Oscar Hemberg, Mikael Otendal, Tomi Tuohimaa and Per Takman

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High-end X-ray diffraction techniques such as small molecule crystallography, macromolecular crystallography, non-ambient crystallography and small-angle X-ray scattering rely heavily on the X-ray source brightness for resolution and exposure time. As boundaries of technology are pushed forward samples are becoming smaller, weaker diffracting and less stable which put additional requirements on ever brighter sources. With bright enough compact sources, time resolved studies can be achieved even in the home laboratory. Traditional solid or rotating anode x-ray tubes are typically limited in brightness by when the e-beam power density melts the anode.The liquid-metal-jet technology (MetalJet) has overcome this limitation by using an anode that is already in the molten state thus e-beam power loading above several megawatts per mm are now feasible. Over a decade ago the first prototypes of liquid-metal-jet x-ray sources were demonstrated. These immediately demonstrated unprecedented brightness in the range of one order of magnitude above current state-of-the art sources [1-2]. Over the last years, the liquid-metal-jet technology has developed from prototypes into fully operational and stable X-ray tubes running in more than 50 labs over the world. Singel Crystal Diffraction (SCD) and Small-angle X-ray Scattering (SAXS) have been identified as key applications for the x-ray tube technology, since these applications benefit greatly from small spot-sizes, high-brightness in combination with a need for stable output. To achieve a platform addressing the needs of the most demanding crystallographers, multiple users and system manufacturers has since installed the MetalJet X-ray source into their SCD and SAXS set-ups with successful results [3, 4].

This contribution reviews the evolvement of the MetalJet technology specifically in terms of stability, lifetime, flux and brightness and its applicability for pushing boundaries of high end SCD and SAXS supported by recent user data. We also present recent possibilities to achieve cost effective solutions attainable for a wider application range.

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5

PETRA IV: The ultimate high energy X-ray microscope

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The PETRA IV project aims at upgrading the synchrotron radiation source PETRA III at DESY to the ultra-low emittance source PETRA IV. Being diffraction limited up to hard X-ray energies of about 10 keV, PETRA IV will be ideally suited for 3D X-ray microscopy of biological, chemical, and physical processes under realistic conditions at length scales from atomic dimensions to millimeters and time scales down to the sub-nanosecond regime. PETRA IV will enable groundbreaking studies in many fields of science, such as in health, energy, earth and environment, transport and information.

6

Serial Crystallography at a 4th Generation Synchrotron RadiationSource: MicroMAX at the MAX IV Laboratory

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The MAX IV Laboratory operates the first multi-bend achromat storage ring providing excellent possibilities for studies using synchrotron radiation for diffraction, scattering, imaging and spectroscopy. This contribution will concentrate on the recently funded MicroMAX beamline for serial crystallography and the macromolecular crystallography facilities at MAX IV but will also describe the status of the facility and highlight some instrumentation development at other beamlines.

The MAX IV linac is used as a full energy injector for two storage rings, the 3 GeV ring and a smaller 1.5 GeV ring. The linac also feeds a short pulse facility for time resolved studies. Together with tailored beamline designs this gives high quality performance for a wide range of applications.

The recently funded MicroMAX beamline will be a serial crystallography facility characterized by high performance and flexibility. The goal is to give optimal performance for collecting optimal data from small and weakly diffracting crystals. This will allow interrogation of the most scientifically rewarding and challenging projects and expand experimental possibilities, including the opportunity to collect time-resolved data with resolution down to the microsecond timescale. Inspired by the recent rapid advancements in serial crystallography, MicroMAX will make it possible to benefit from this profusion of new techniques whilst still permitting traditional single crystal oscillation data collection, when this is deemed the best method.

MicroMAX will benefit from the unique performance of the first multi-bend achromat storage ring [1]. The X-ray beam will be tuneable in both size (1-10 μm) and energy (5-30 keV) whilst offering either a highly monochromatic or a wide bandpass beam, with maximum 1013 and 1015 photons/second respectively in the two modes. The experimental setup will be highly flexible to allow switching between a variety of different sample delivery systems. Additionally, there will be a high-precision rotation axis goniometer. The experimental setup will utilise a hybrid pixel detector capable of recording data in the microsecond range. The experiment control will be based on the same system developed for BioMAX. The computing and analysis infrastructure will be dimensioned to handle the exceptionally large data volume produced by the experiments foreseen at MicroMAX.

MicroMAX will be the second macromolecular crystallography beamline at MAX IV after the phase one BioMAX beamline, now in user operation. BioMAX is a near microfocus, state-of-the-art-beamline that offers excellent performance for most MX experiments. BioMAX will also be used for the development of sample delivery systems and serial crystallography methodologies with the aim of also allowing scientifically relevant experiments. These developments will be performed in collaboration with other research groups and facilities.

MicroMAX is planned for user operations in 2022. The project is funded by the Novo Nordisk Foundation.

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7

ISIS instrumentation: three decades of continuous improvement

Robert McGreevy
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In contrast to photon or electron sources, the source brightness from neutron sources has not really increased for 50 years since the construction of the Institut Laue Langevin in Grenoble. Most of the technical improvements, which mean that neutrons remain a valuable (though less common) scientific probe, have therefore been through instrumentation. In this talk I will describe the continuous development of instrumentation at ISIS over more than 30 years, including Target Station 2 where (for particular techniques) design optimisation could achieve higher performance from a lower power source. I will also discuss some possibilities for the future.

8

First experiment results from European XFEL

Thomas Tschentscher

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Accelerator-based generation of radiation in the extreme-violet to hard x-ray regimes and using free-electron laser (FEL) schemes has been successfully developed over the last decade. Extremely intense, ultrashort, and coherent XUV and x-ray pulses at performances exceeding predictions are now routinely provided by several facilities around the globe. In current fundamental research applications this radiation is applied to solve the structure of complex bio-matter, to study ultrafast chemical processes, or to disentangle electronic state dynamics of complex materials.

Hard x-ray free-electron lasers (FEL) enable to combine the well-known powers of x-rays with new features of FEL radiation thereby opening access to ultrafast, meaning femto- to nanosecond time scales, irreversible reactions and processes, and non-linear x-ray spectroscopy. European XFEL is an international large-scale user facility for research using x-ray FEL radiation. User operation started in 2017 after about 8 years of construction. European XFEL will greatly enhance the opportunities for x-ray FEL research by providing researchers with FEL radiation in the x-ray range from 0.25 to 25 keV at initially six science instruments, each dedicated to a specific area of application [1,2].

The facility layout offers a high flexibility in selecting x-ray beam parameters and the superconducting accelerator technology allows accelerating 27.000 electron bunches per second, thereby providing high average brilliance, dedicated pulse delivery to several instruments quasi-simultaneously, but also an increased spatial and temporal stability through the application of feedback schemes. Commissioning with beam started in January 2017 resulting in lasing at hard x-rays end of May 2017. The user program was launched in 2017 and currently proposals of the third call are reviewed. The first user experiments took place in September 2018, already producing publishable results. The talk provides a summary of the start of operation of European XFEL and gives a glance on first experiment results.

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9

X-ray diffraction and ultra-fast science by SwissFEL: recent achievements and future plans

<u>Luc Patthey</u>

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https://www.psi.ch/swissfel/

https://www.psi.ch/lap/

The new X-Ray Free Electron Laser (SwissFEL) facility at PSI delivers fsec photon pulses of coherent x-rays in the wavelength range 0.1 to 7 nm, with extremely high peak brightness. These characteristics provide opportunities for new experiments in crystallography, chemistry, solid state physics, biology and materials science. The first pilot experiments by Aramis hard x-ray FEL branch took place in December 2017 with two dedicated end-stations. The *Alvra* end-station is focused on using time resolved x-ray spectroscopy (XAS/XES) to investigate femtosecond chemical processes and time-resolved x-ray diffraction for serial femtosecond crystallography (SFX) experiments on proteins. The *Bernina* end-station is designed for femtosecond time-resolved pump-probe hard x-ray diffraction and scattering experiments in condensed matter systems. The pilot experiment program is scheduled for 2018 when the normal user operation will start in 2019.

The Athos soft X-ray FEL branch is in the early phase of construction and should provide its first FEL light to experiments in 2021 in the field of atomic, molecular, and optical physics (AMO), condensed matter and non-linear x-ray Science.

10

EuPRAXIA – a Compact, Cost-Efficient XFEL Source

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One of the main limitations for crystallographic studies – whether it be in structural biology, chemical analysis or material science – is the availability of suitable diagnostic instruments which are to-date typically found in the form of large accelerator-based facilities, such as Free-Electron Lasers (FELs), synchrotron storage rings or accelerator-based neutron sources.
With the Horizon 2020 project EuPRAXIA ("European Plasma Research Accelerator with eXcellence In Applications") we want to present a possible approach towards solving this research bottleneck through the use of novel compact accelerator technology. Currently in its conceptual design phase, the future EuPRAXIA facility will centre around a multi-gigaelectronvolt plasma-based electron accelerator delivering industrial-grade beam quality. Radiation sources will be available in the form of a Free-Electron Laser in the single nanometre to sub-nanometre wavelength range as well as more compact radiation generation schemes tunable in the UV to gamma-ray regime. Compact positron and neutron sources are foreseen as possible additional features. Thanks to the utilized plasma accelerator technology, the generated beams will be intrinsically ultrashort – on the order of single to tens of femtoseconds in duration – as well as small in transverse size – down to single micrometres. This makes them highly suitable as probe beams for various applications, including time-resolved studies and pump-probe experiments.
One of the main aspects that will set EuPRAXIA apart from conventional instruments of the same class is a considerable reduction in size and cost due to its smaller design. It will thus not only provide a novel analytical instrument, but will also present, beyond that, a first European prototype facility paving the way towards future cost-effective, compact light and particle sources.

11

Facilities and Instrumentation for Structural Biology at the ESRF

Gordon Leonard

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The ESRF's facilities for Structural Biology currently comprise 6 end-stations for macromolecular crystallography (MX)[1], one end-station for BioSAXS experiments[2] and one end-station based around a Titan Krios cryo-electron microscope. These are supplemented by a number of support laboratories including the ID29-S 'Cryobench' facility for *in crystallo* optical spectroscopy[3] and a facility for the high pressure cryo-cooling and/or derivatisation of crystals of biological macromolecules[4]. This talk will focus on the instrumentation and experimental possibilities available on the ESRF's X-ray based MX/BioSAXS beamlines and will also describe the present status of the CM01 cryo-electron microscopy facility.

The ESRF is currently preparing the upgrade of its accelerator and storage ring as part of the ESRF Extremely Brilliant Source (EBS) project (see http://www.esrf.fr/about/upgrade for details). This presentation will thus, with particular emphasis on the possibilities for time-resolved MX that the X-ray beams resulting from the EBS project will facilitate, also look forward to the evolution of ESRF facilities for Structural Biology post-2020.

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12

The role of Cryo-electron microscopy in structural biology after the "resolution revolution"

Alevtyna Yakushevska, Max Maletta and Marc Storms
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In 2017 R. Henderson, J. Frank and J. Dubochet have been awarded the Nobel prize in Chemistry for having pioneered cryo electron microscopy (Cryo-EM) and Single Particle Analysis (SPA).
During the last few years Cryo-EM and SPA have grown from techniques able to produce low-resolution structures of protein complexes to tools capable of achieving atomic and quasi-atomic resolution for complexes that nobody could solve with any other technique.
This incredible leap forward has been made possible through the introduction and adoption of new tools, in particular direct electron detectors (DED), ultra-stable cryo-microscopes, such as the Titan Krios and the adoption of new SW for automatic data collection and processing.
Cryo-EM benefits of specific advantages, with respect to other structural biology techniques such as NMR and X-ray diffraction:

- Crystallization or isotopic labelling is not needed.
- The amount of sample required is two orders of magnitude lower.
- Different functional conformation of a protein complex may be revealed.

Cryo-EM has proven to be a very useful technique to be integrated with X-ray and NMR for structure-based drug design. Thus it is no surprise that many structural biology groups all over the world are seeking access to this technology in order to find answers to their most relevant biological questions. Nevertheless most users that are new to the field of cryo-EM are struggling to overcome the adoption barrier that this technique may pose in terms of: sample preparation and screening, automatic data acquisition and progressive users training.
In this presentation we will present how the fast pace of cryo-EM growth is going to revolutionize the structural biology landscape. In addition, the latest Thermo Fisher Scientific technologies will be introduced:
- The cryo-EM SPA workflow with the recently introduced electron microscopes Krios G3i and Glacios - today the most economical and efficient Cryo-EM solutions for getting to the 3D structure of protein molecules.
- The new development of mED (Micro Electron Diffraction): a technology that holds the promise to solve the high resolution 3D structure of proteins crystallized into very small crystals. This method is an interesting cost effective alternative for XFEL.

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New structural biology solution: CRYO ARM

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Since 1949, JEOL's legacy has been one of the most remarkable innovations in the development of instruments used to advance scientific research and technology. JEOL has 60 years of expertise in the field of electron microscopy.

Cryo-electron microscopy has been established as a method to enable observation of cells and biological molecules with no fixation and no staining. Owing to the recent rapid progress of hardware and software, this microscopy technique has become increasingly important as an atomic-scale structural analysis method. In addition, technologies that enable analysis of membrane proteins without crystallization have been developed, resulting in increased use of cryo-electron microscopy for drug discovery. Thus, installation of cryo-electron microscopes (cryo-EM) in universities and research laboratories is greatly accelerating. To meet the needs of cryo-EM users, JEOL has developed a new cryo-EM, the "CRYO ARM™".

The two models, CRYO ARM™ 200 and CRYO ARM™ 300, equipped with a cold field emission gun, an in-column Omega energy filter, a side-entry liquid nitrogen cooling stage and an automated specimen exchange system, are cryo-electron microscopes (cryo-EM) that enable observation of bio-molecules at cryo-temperature. The automated specimen exchange system features the storing of up to 12 samples. In addition, the system allows for the exchange of an arbitrary one or more sample, thus enabling flexible scheduling. Furthermore, the combined use of a newly-designed in-column Omega energy filter and a Hole-free phase plate dramatically enhances the contrast of TEM images of biological specimens.

CRYO ARM™ 300