NEWSLETTER

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National Center for Scientific Research "Demokritos", Greece

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Spectral imaging: from CERN to medical technologies

The Medipix Collaborations, whose activities started in the 1990s developing a detector technology for the needs of the Large Hadron Collider (LHC) experiments at CERN, have commercialised Medipix in other scientific fields, in particular the medical imaging field.

Through the Medipix Collaborations, a family of read-out chips for particle detection was developed, and to date there have been three generations of the Medipix chips – each with improvements and new features. Among a wide range of other applications, Medipix can be used for Computed Tomography (CT) scans.

The third generation of read-out chips, named Medipix3, also allows 'colour' imaging during CT scans, or so-called spectral imaging. At present, spectral imaging has several applications on the market, but it is still in the emerging phase and has not been widely adopted. The start-up company MARS Spectral Imaging is working on spectral molecular imaging technology based on Medipix3. When combined with biological tracers attached to metal nano-particles, their scanners can allow researchers and clinicians to measure biochemical and physiological processes, modelling human diseases in animals. Although still in a pre-clinical phase, meaning that the scanners cannot yet be routinely used on humans, the MARS team has concluded that the technology will be useful in the diagnosis and treatment of heart disease, stroke, arthritis, joint replacements and cancer.

In addition to pictures with new and improved diagnostic information, MARS promises that spectral imaging will enable faster and cheaper radiology procedures while working with significantly lower radiation doses. This will considerably broaden both the value and use of Computed Tomography (CT) as a diagnostic tool.

More information

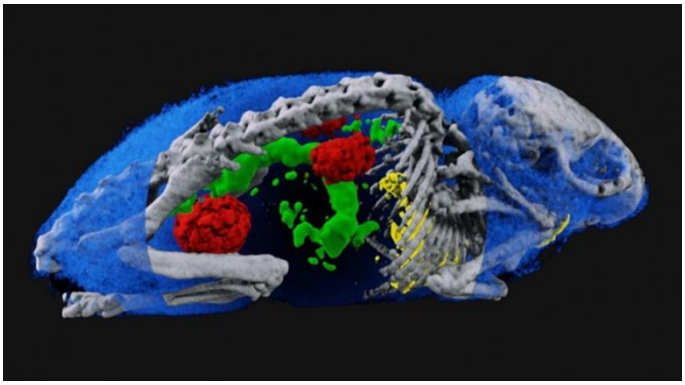


Image: MARS Spectral Imaging

CERN is about to start an entrepreneurship student programme

Recognising and valuing entrepreneurial development as a key factor for economic growth, CERN is contributing to build a culture of entrepreneurship. For the Knowledge Transfer group at CERN, this is all about building bridges: between engineers and financers, between physicists and marketers, and more generally between science and business. In this context, CERN is ramping up its attention to entrepreneurship education and high-quality, hands-on training, which can **complement** and **reinforce** the theoretical education offered at universities.

This is where the CERN Entrepreneurship Student Programme, or CESP in short, enters the picture. The CESP is the latest addition to the CERN & Society Programme focusing on youth and education, with the ambition to nurture a younger generation of high-tech entrepreneurs. Through a 5-week, intensive training onsite at CERN, master-level students from anywhere in the world will have the opportunity to put in practice and test their knowledge and business ideas, using CERN technologies as case studies. **Explore – Evaluate - Exploit** is the motto that will guide students during their residency under the supervision and coaching of CERN experts.

"CESP gives us a unique opportunity to introduce CERN technologies and know-how to the next generation of high-tech entrepreneurs. Entrepreneurs create jobs. CESP is a way for us to work together, maximizing the impact of CERN to society, while contributing to economic growth", said Giovanni Anelli, CERN's Knowledge Transfer Group Leader

The pilot phase of the programme is scheduled for summer 2018. More information

Photo: Jeff Wiener

International X-ray laser European XFEL inaugurated

European XFEL, the largest and most powerful X-ray laser in the world, was officially inaugurated on 1st September 2017.

Research ministers and other prominent guests from across Europe joined the European XFEL Managing Directors to officially start the research operation of the facility with the first two experiments.

One of them aims to decode the atomic structure of different biomolecules at the SPB/SFX experimental station of the European XFEL. The SPB/SFX instrument, headed by European XFEL scientist Adrian Mancuso, will be used to gain a better understanding of the shape and function of biomolecules, such as proteins, that are otherwise difficult and sometimes impossible to study. During the early phase, the scientists will carefully calibrate and tune their instruments.

Parallel to the SPB/SFX experimental station, the FXE station also started scientific experiments. FXE is designed to create “molecular movies” showing the progression of chemical reactions which, for example, will help improve our understanding of how catalysts work, or how plants convert light into usable chemical energy.

The European XFEL produces extremely bright and ultrashort light pulses. The facility generates up to 27 000 pulses per second – 200 times more than other X-ray lasers. With the help of specialized instruments, these X-rays enable completely new insights into the atomic details and extremely fast processes of the nanoworld. Scientists will use these X-ray flashes to, for example, map the three-dimensional structure of biomolecules and other biological particles, and do so faster and with more detail than has ever been previously possible.

Furthermore, single snapshots of particles produced with the X-ray laser can be sewn together to create “molecular movies” to study the progress of biochemical and chemical reactions – the basis for the development of new medicines and therapies or environmentally friendlier production methods and processes for extracting energy from sunlight. Other applications lie in the field of materials science with the development of new materials and substances, in the optimization of storage media for computers or the investigation of extreme matter conditions such as those found within exoplanets.

European XFEL is an international research facility with currently 11 shareholders from 11 countries. With a share of 58 per cent, DESY is the main shareholder. Leading an international consortium, DESY has developed and built the superconducting linear accelerator at the heart of the X-ray laser and is also operating it.

More information

Ribbon cutting in the experimental hall.
Photo: European XFEL

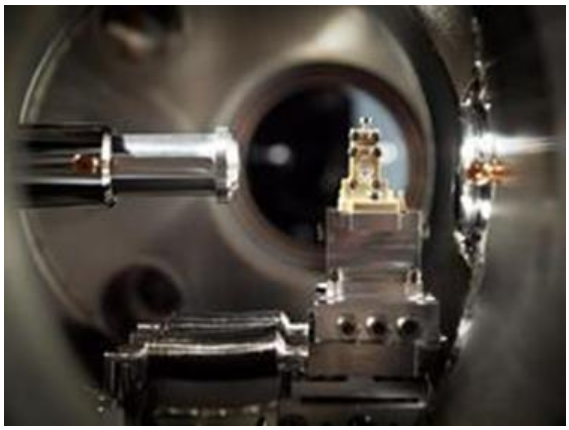
DESY: Plasma accelerator produces first X-rays

For the first time, a plasma accelerator at DESY has produced X-rays. The LUX (Latin for “light”) installation created ultra-short pulses of radiation with a wavelength of nine nanometres (millionths of a millimetre), corresponding to so-called soft X-rays. LUX is part of the LAOLA collaboration between DESY and the University of Hamburg.

Physicists are hoping that the technology of plasma acceleration will lead to a new generation of high-performance particle accelerators with unique properties for a range of applications. In this technique, a laser or a beam of high-energy particles creates a plasma wave inside a fine capillary. Plasmas are electrically charged gases. At the moment, the technology is at an experimental stage; a considerable amount of development will be necessary before it can be put to practical use.

The next thing the physicists want to do is to further optimise their plasma accelerator and their undulator, so as to produce higher-energy electrons and brighter X-rays with a shorter wavelength. Finally, the scientists hope to improve their set-up to a point where they reach a self-amplifying laser process. This would turn the machine into a compact X-ray laser.

More information



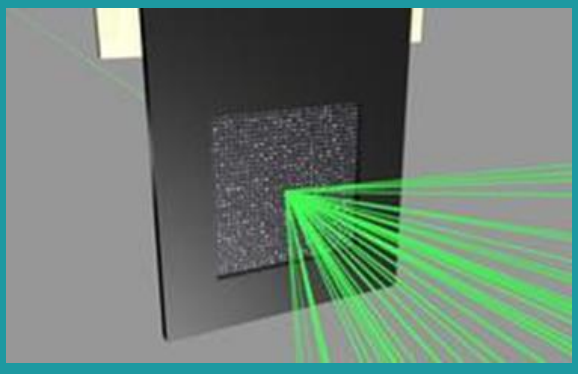
The plasma cell (centre) accelerates the electrons. Photo: Niels Delbos, Universität Hamburg

DESY: First atomic structure of an intact virus deciphered with an X-ray laser

An international team of scientists has for the first time used an X-ray free-electron laser to unravel the structure of an intact virus particle on the atomic level. The new method dramatically reduces the amount of virus material required, while also allowing the investigations to be carried out several times faster than before.

In this method, the scientists use a micro-patterned chip containing thousands of tiny pores to hold the protein crystals. The X-ray laser then scans the chip line by line, and ideally this allows a diffraction image to be recorded for each pulse of the laser.

This approach not only reduces the data collection time and the quantity of the sample needed but also opens up the opportunity of analysing entire viruses using X-ray lasers. The scientists now want to increase the capacity of their chip by a factor of ten, from 22,500 to some 200,000 micropores, and further increase the scanning speed to up to one thousand samples per second. This would better exploit the potential of the new X-ray free-electron laser European XFEL. More information



Scheme of the experimental set-up: The chip loaded with nanocrystals is scanned by the fine X-ray beam (green) pore by pore. Ideally, each crystal produces a distinctive diffraction pattern. Photot: Philip Roedig, DESY

Photon science building to be constructed at DESY

Politicians and scientists have broken the ground for a new laboratory and office building at DESY's site in Hamburg-Bahrenfeld. The new Photon Science Building is to become a research facility for scientists from Helmholtz Centre Geesthacht (HZG), Christian Albrechts University in Kiel (CAU) and DESY. The new building will have direct access to DESY's light sources and, along with its close connections to research groups on campus will provide ideal conditions for photon research and nanoscience. The Photon Science Building costs 14.1 million euros and is scheduled to be finished in spring 2019.

The new five-storey building is also to become DESY's centre for nanoresearch. The technically sophisticated laboratories on the ground floor will permit implementation of new methods especially in nanoresearch. They offer ideal conditions for structuring, manufacturing, characterising and marking nanosamples, which can then be studied under high-intensity X-rays at the research facilities PETRA III or FLASH. The high-sensitivity laboratory equipment needed for this kind of research will stand on separate, ultra-low-vibration foundations within the building, and the fragile samples can then be moved to PETRA's experimental hall "Max von Laue", which is only a short distance away.

More information

Architectural rendering of the new Photon Science building
Photo: Reiner Becker Architekten BDA/DESY

Sofia University starts a new Horizon 2020 Teaming project

The Faculty of Mathematics and Informatics, together with the Faculty of Physics and the Technology Transfer Office of Sofia University started a project that will prepare the creation of a Centre of Excellence (CoE) in the field of Big Data.

The project "GATE – Big Data for Smart Society" is funded by Horizon 2020 WIDESPREAD-2016-2017 TEAMING Phase 1 programme and is implemented in partnership with Chalmers University of Technology and Chalmers Industrial Teknik, Sweden.

It is unique for Bulgaria as it is the first attempt towards establishment of a CoE in this fast developing field and also because it won the grant in a severe international competition with 286 project proposals. Within one year, the project consortium will elaborate a sound business plan that will be then evaluated by the EC and if successful, it will get European and national funding for the real establishment and functioning of the CoE.

GATE's vision is oriented towards the establishment and long term sustainability of a Big Data Centre that will produce excellent science by seamlessly integrating connected fields and associating complementary skills. GATE will play a dynamic role in the surrounding innovation system by adding value to knowledge, will boost the next-generation of early-stage researchers and will achieve high level of international visibility and scientific and industrial connectivity.

Its main research objective is to advance the state-of-the-art in the whole Big Data Value Chain, including development of advanced methods and tools for: Data collection, structuring and storing; Data consistency checking and cleaning; Data aggregation and linking; Data processing, modeling and analysis; Data delivery by providing both accessibility and visualization.

GATE's cross-cutting components are education and developing Big Data skills as well as innovation and commercialization of GATE Big Data research results.

The future CoE will be focused on data-driven innovation pillars such as data-driven government (public services based on open data), data-driven industry (manufacturing and production), data-driven society (smart and sustainable cities) and data-driven science (new generation data scientists).

More information www.gate-coe.eu

IN FOCUS

National Center for Scientific Research “Demokritos”

Founded in 1962 as a Research Centre for Nuclear Research, “Demokritos” is the largest, multidisciplinary, public research centre of Greece with approximately 190 researchers in faculty positions and over 500 research personnel working under research contracts with the European Union, the state of Greece, international research organizations and private industries. “Demokritos” is governed by the Board of Directors and is supervised by the General Secretariat of Research and Technology of Greece. Today, “Demokritos” comprises of five Institutes: Institute of Nanosciences and Nanotechnology, Institute of Nuclear and Particle Physics, Institute of Nuclear and Radiological Sciences and Technology, Energy and Safety, Institute of Biosciences and Applications and the Institute of Informatics and Telecommunications.

In September 2017, the recently appointed new President, Dr.G.Nounesis, paid a two-day visit to CERN to support the activities of the “Demokritos”’ high-energy physics researchers and to develop further the collaboration with HEPTech and KT Group.(Photo: “Demokritos”)

“Demokritos” coordinates research laboratories that are part of the Greek National System of Research Infrastructures providing unique installations and user access availability.

These include: the National Infrastructure in Nanotechnology, Advanced Materials and Micro/Nanoelectronics (INNOVATION-EL), the Infrastructure of Chemical Biology and Target-Based Screening Technologies for Human and Animal Health, Agriculture and the Environment (OPEN SCREEN) and the Cluster of Accelerator Laboratories for Ion-beam Research & Applications (CALIBRA).

Highly committed to supporting innovation and technology-driven entrepreneurship “Demokritos” is currently running the Industrial Fellowship Program supporting approximately sixty fellows doing industry co-sponsored research. In the same direction “Demokritos” operates the “Lefkippos” Technology Park of Attica, which serves as a pole of attraction for spin-off companies and high-technology start-ups in a dynamic, continuous interaction with the research community of the Centre.

Basic and applied research projects are carried out involving researchers at all ranks, postdoctoral associates and candidates for doctoral degrees. Graduate-level educational programs are organized in collaboration with university departments in Greece and abroad as well as an annual Summer School, workshops on special topics and seminars.

Electronic lithography infrastructure at the Institute of Nanoscience and Nanotechnology

(Photo: NCSR “Demokritos”)

THE INTERVIEW

Michele Barone

Technology transfer officer and Industry liaison officer for Greece at CERN

How does "Demokritos" exploit CERN technologies?

"Demokritos" holds a portfolio of more than 100 patents covering its research fields in Greece, Europe and USA. So far, none of them is exploiting CERN technologies and the technology transfer is made through procurement, persons and training in situ. The major role of the TT workshops, organised in the framework of the Hellenic Forum, should be acknowledged. The most recent one, "Open Innovation, Open Software and Hardware", took place in July 2017 and was supported by HEPTech.

The HEPTech supported TT workshop "Open Innovation, Open Software and Hardware" (Photo: "Demokritos")

Earlier this year "Demokritos" traditionally organised the 5th Hellenic Forum for Science, Technology & Innovation. What is the added value and follow-up of this event?

The event, consisting of a series of workshops, has been organized so far in collaboration with WIPO (Geneva), OPI (Hellenic Industrial Property Organization, Athens) and KTB Network (London, UK). The focus was on technology licensing, IoT and Big Data analytics, open science, operations support systems, Biz models, communication with funding bodies, case studies such as Collaboration Spotting, and others.

Students, researchers, industry and representatives of the Ministry of Education have taken part in the various editions of the event demonstrating huge interest.

How does "Demokritos" support the establishment of spin-offs for exploitation of in-house generated know-how?

The recently created Innovation Office at NCSR Demokritos facilitates the technology transfer and negotiates special licensing agreements and explores investment opportunities for the exploitation of the centre's research results. Innovation driven entrepreneurship efforts of the research personnel are highly endorsed. On the average, agreements are reached so that the royalties are split by 60% to the inventor and 40% to the Centre. In addition, start-ups have high priority for office space at the Lefkippos Technology Park and use of the incubation services there.

HEPTech upcoming events

- Steering Committee, November 16th 2017 at CERN with VideoConference
- HEPTech Board Meeting, December 4th 2017 at CERN with VideoConference
- Hands-on Advanced Training Session on Technology Licensing Workshop, December 5th 2017 at CERN
- Workshop on Business Incubation and Technology Transfer, March 6th 2018, Coimbra, Portugal
- AIME Industry 4.0 @ HEPTech, 15-16 March 2018, Slovakia