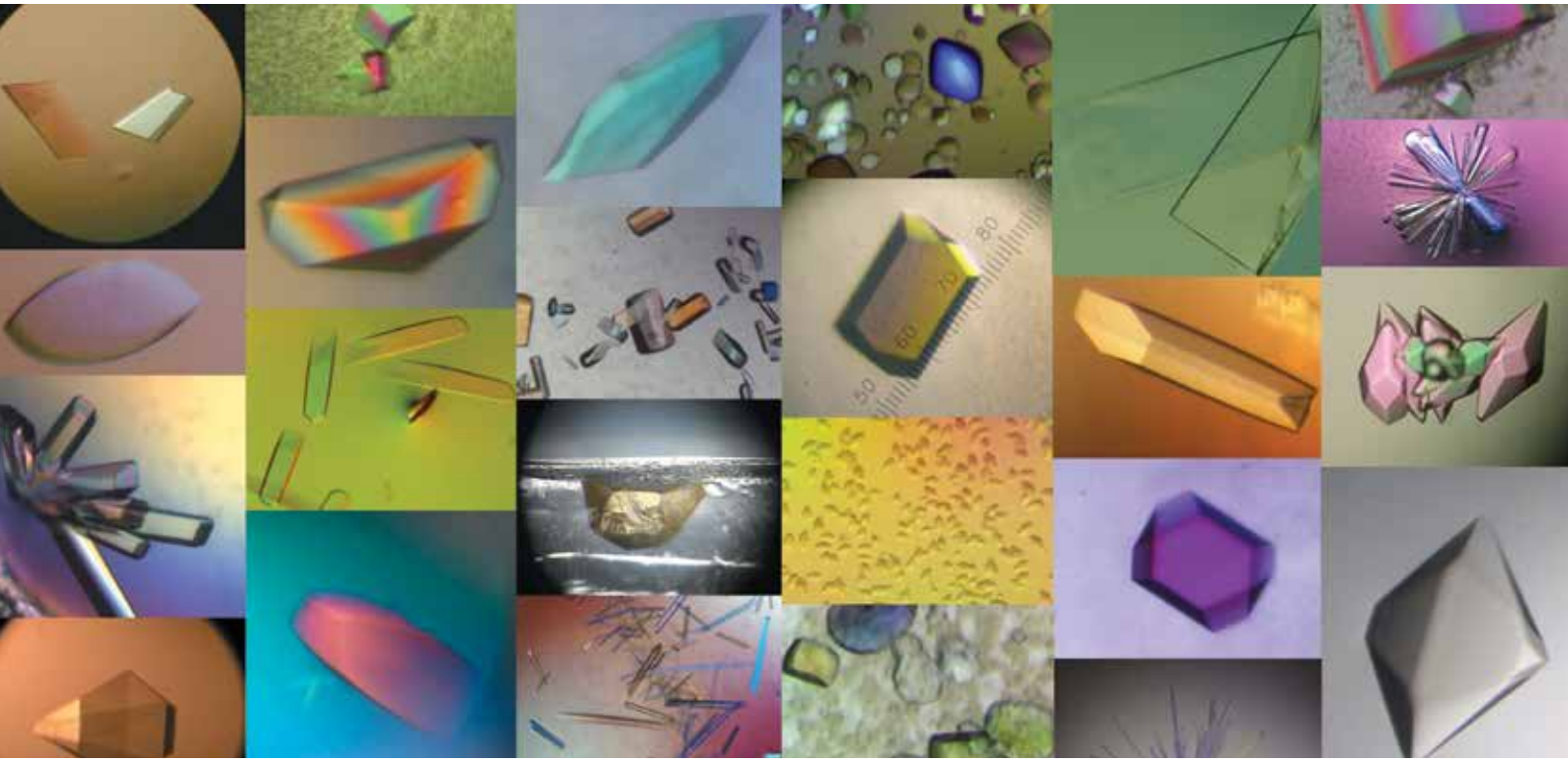
DESY inFORM.

02|14
Newsletter of the
Research Centre DESY

Focus on crystals

2014 is the United Nations International Year of Crystallography



Diversity: biomolecules crystallise in very different shapes. Image: IUCr

Aircraft turbines, medication, memory chips – we are surrounded by achievements of a field of science that is largely unknown to the general public: crystallography. Investigating the inner structure of solid matter paves the way for modern materials like extremely heat-resistant ceramics, more efficient solar cells and tailor-made medication.

"How many people realise when they board a plane or take medication that these products are the fruit of a long process that began with crystallography?," asked Irina Bokova, Director-General of the United Nations Educational, Scientific and Cultural Organization UNESCO. "Even though it permeates our lives, crystallography remains largely unknown." For this reason, the United Nations (UN) has declareded 2014 the International Year of Crystallography. "This year marks the centenary of the birth of modern crystallography," said UN Secretary-General Ban Ki-moon. "We celebrate 100 years of groundbreaking advances."

The birth of crystallography took place in a cellar of the university of Munich. "A century ago, Max von Laue in Germany realised that crystals diffract," said Gautam Desiraju, President of the International Union of Crystallography (IUCr), which jointly hosts this science year with the UNESCO. "And this discovery was harnessed by William Henry Bragg and William Lawrence Bragg in the UK to obtain the internal structure of solids in terms of where atoms, ions and molecules are situated with respect to one another." For his discovery, von Laue was awarded the 1914 Nobel Prize in Physics and both father and son Bragg received the Nobel Prize in Physics in 1915.

This new method opened up completely new possibilities for many fields of science because with the knowledge of the inner structure it was not only possible to explore materials properties

CONTINUED ON PAGE 2

DIRECTOR'S CORNER

Dear colleagues,

"Our successful cooperation benefits from the diverse personalities who work together at DESY, and from their different nationalities and variety of educational backgrounds."

You can find this sentence in the chapter "Joint operations" of our Guiding Principles. It is the personalities that coin DESY and make our research centre unique. One of these personalities is Hans Grabosch, who shaped the development and contributed to the success of DESY in Zeuthen as deputy head from 1998 on. Now he goes into his well-earned retirement. Hans Grabosch gained great respect for his serenity and his detailed knowledge and he kept the institute navigating in calm waters, as one would say in Hamburg. We will miss him much. However, we are glad that his successor Heidrun Bojahr has already energetically assumed office.

One successful example of cooperation between many people and professions is the DESY "Teilchenzoo" (particle zoo) exhibition at the Universum science centre in Bremen which attracts the interest of many visitors and is very popular particularly among school classes.

Sometimes, it is a very small item that needs the concentrated mind power and manpower of many to bring about great science – this is illustrated by the new ALPS sensor with an area of merely 25x25 micrometres and a thickness of 20 nanometres. The sensor is a central part of the experiment and another example of DESY promoting technologies.

Among the honoured personalities at DESY are the Bjørn H. Wiik Prize winners, Kerstin Tackmann for 2012, and Ralf Röhlsberger for 2013. Benjamin Lutz received the CMS Achievement Award, Martin Pohl was elected APS Fellow and Ingmar Hartl Fellow of the Optical Society. Moreover, after the Consolidator Grant for Jochen Küpper, DESY scientists have been successful for the second time at the European Research Council ERC with the Synergy Grant for Franz Kärtner, Henry Chapman, Ralph Aßmann and Petra Fromme. Congratulations to the prize winners and to all who contributed to these projects.

These achievements show that DESY is a place of top-level research, due to the close collaboration of many exceptional people.

May our sucessful cooperation continue to prosper!

Yours,
Christian Stegmann

but also to tailor materials with the desired properties. The first crystals decoded by the Braggs were table salt and diamonds, which have simple inner structures. The more complicated a crystal is structured, the more complex is the diffraction pattern which it produces in the X-ray light.
However, today, sophisticated experimental and computing methods even allow structure investigations of biomolecules with millions of atoms, as for example the ribosome, the protein factory of biological cells, which was decoded with the help of DESY facilities. "Today, scientists investigate complex structures with ultra-modern analysis methods using synchrotron radiation and X-ray lasers to understand the behaviour of materials and active ingredients at the molecular level," said DESY Director Helmut Dosch.
DESY offers outstanding possibilities for modern crystallography. At DESY's facilities scientists can watch catalysts at work, simulate the conditions in the interior of the earth and observe in real time the degradation of solar cells. And at DESY's X-ray source PETRA III, whose large experimental hall is named after Max von Laue, scientists have just paved the way for a new procedure that allows decoding the structure of biological microcrystals using only a few dozen specimens. This is especially interesting for biomolecules which are notoriously difficult to crystallise because crystallising is incompatible with their natural function. The structural analysis of biomolecules offers promising approaches for tailor-made medication. This strategy to combat infectious diseases is in the focus of research at the new Centre for Structural Systems Biology (CSSB) on the DESY campus.

2014
international year of crystallography

Official website:
http://www.iycr2014.org

“Google maps for the human body”

The Centre for Structural Systems Biology CSSB picks up speed



Matthias Wilmanns, founding director of the CSSB. Photos: Heiner Müller-Elsner

The new Centre for Structural Systems Biology CSSB on the DESY campus in Hamburg gathers pace. The programme for the current year is extensive, says Matthias Wilmanns, head of the Hamburg branch of the European Molecular Biology Laboratory EMBL, who was recently appointed founding director of CSSB.

Mr. Wilmanns, when will the excavators start rolling for the new building?

Construction will start end of March. However, the centre is already working; for example, we have had our first board meetings. Until completion of the new building, our office will have a preliminary home. Several of the future nine research groups already reside on the campus. Others are still working in other districts of the city, at our partner institutions like the Bernhard Nocht Institute or the University Medical Center Hamburg-Eppendorf (UKE). The new building will be finished in 2016.

What is the task of structural biology?

We all know Google maps and similar tools. At CSSB, we will operate a kind of Google maps for the human body. Mankind is deeply interested in zooming into the body as precisely as possible. A hundred years ago, we made use of light microscopy, today of X-ray structural analysis. With this method, we are able to see single atoms. This is a major milestone.

With the help of X-ray light, you decode the atomic structures of a biomolecule and this way learn something about its function?

Yes, this is exactly the way it works. And it has applications too. For example, we try to explore new territory in the area of drugs design. However, we have to be realistic. We will not solve all problems of drugs development overnight, since many diseases are very complicated, particularly infectious diseases, which are my field of research. Most of the time there is not only one molecule involved; often, there are hundreds of molecules that interact and lead to an illness.

X-ray crystallography, which is now used to decode many of these biological structures, is no new technology. Why does structural biology develop so rapidly only today?

The method as such – crystallography – has been known for a century. However, we didn’t have the neccessary computers for a long period of time – it is as simple as that. We did not have the necessary tools to evaluate the data in all its complexity to carry out structural biology.

You mean, the rapid development of computer technology paved the way for structural biology?

Synchrotron radiation too was a great revolution. At the end of the sixties and beginning of the seventies, Ken Holmes and Hugh Huxley used synchrotron radiation at the DESY ring to probe biological samples for the first time. Since then, radiation sources have undergone a rapid development. And, of course, it is nice to see that today Hamburg, with DESY’s storage ring PETRA III, is in the vanguard.

And this development is not yet finished.

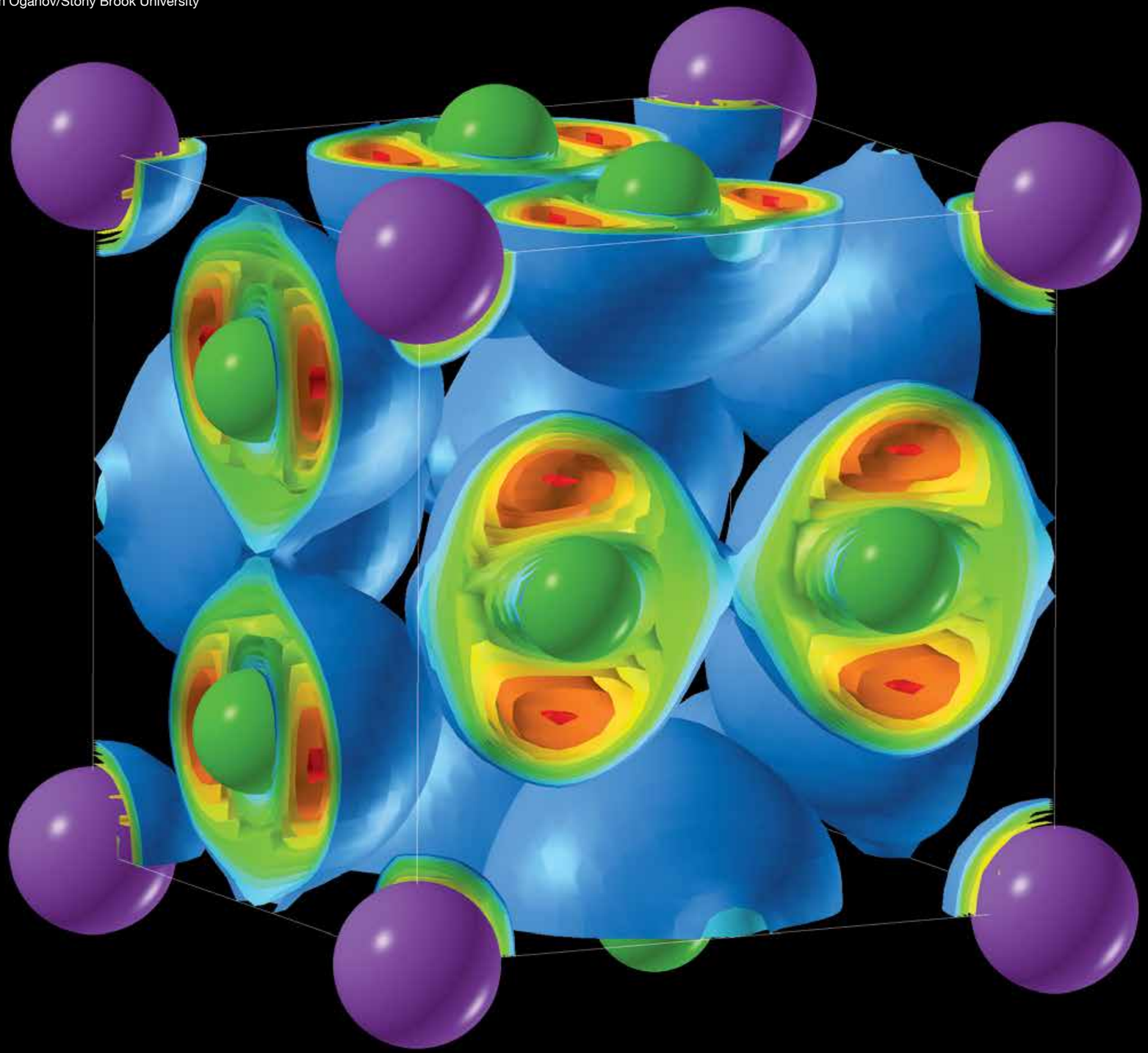
The next revolution with regard to radiation are X-ray lasers like the European XFEL. Looking at these lasers, which currently only exist in Stanford, California, and in Japan, and seeing what they can do, demonstrates that we are able to reach completely new dimensions with them.

Which role does CSSB play in this development?

When we met for the first time in 2004, there was the basic idea: we are having these fantastic infrastructures in Hamburg which we would like to complement by recruiting top-level scientists here, on the premises. It is logical for me that top-level research in the field of structural biology also takes place at sites that have these infrastructures, and in Germany this is Hamburg. Our goal is to cooperate on a par with the world’s leading research institutions in this field. And the combination CSSB, PETRA III and European XFEL is unique worldwide. *(tim)*

Salty surprise

With high-pressure experiments at PETRA III, scientists have produced new chemical compounds which should not exist according to the textbook rules of chemistry. In table salt or sodium chloride (NaCl), one sodium atom (Na) and one chlorine atom (Cl) form the cubic salt lattice. Under extreme pressure, “forbidden” compounds like $NaCl_3$ turned up whose electron distribution is graphically displayed here.
Figure: Artem Oganov/Stony Brook University



WHAT'S ON AT DESY

February

12 Public Lecture
Futuristisch in jeder Hinsicht:
Das Center for Free-Electron Laser Science und seine Forschung
Robin Santra, DESY, Hamburg, 19:00 h

13 Event (http://mint.desy.de)
MINT day for girls
DESY, Hamburg

20-21 Meeting
ICFA & LCB Meeting
DESY, Hamburg

20-21 Event
Jugend forscht – Regional Competition
DESY, Hamburg

22 Public Event (www.kurzundkalt.de)
kurz & kalt – Best of the Antarctic Film Festival – short films
DESY, Hamburg, DESY auditorium, 17:00 h

25 **Staff assembly**
DESY, Zeuthen, SR 1-3, 14:00 h

26 Science Café DESY (http://sciencecafe.desy.de)
Das Fliegenhirn – Ein Parallelcomputer auf kleinstem Raum
Alexander Borst, DESY, Hamburg, DESY Bistro, 17:00 h

March

17-21 Meeting
H.E.S.S. Collaboration Meeting
Universität Potsdam

21-25 Event (http://masterclasses.desy.de)
International Masterclasses
DESY, Hamburg and Zeuthen, and HU Berlin

26 Science Café DESY (http://sciencecafe.desy.de)
Things we see everyday in nature, and what these things tell us – An excursion through resonance, rainbows and radiation
Scott Mandry, DESY, Hamburg, DESY Bistro, 17:00 h

27 Event (http://betriebsrat-hamburg.desy.de)
Girls' Day
DESY, Hamburg

27 Event (www.zukunftstagbrandenburg.de)
Zukunftstag für Mädchen und Jungen in Brandenburg
DESY, Zeuthen

27 Lecture series: Staying Healthy
Venengesundheit
Dr. med. Guido Bruning,
Head physician of the Centre for Venous and Dermatologic Surgery of the hospital Tabea, Hamburg-Blankenese
DESY, Hamburg, seminar room 2, bldg. 2a, 16:00 h

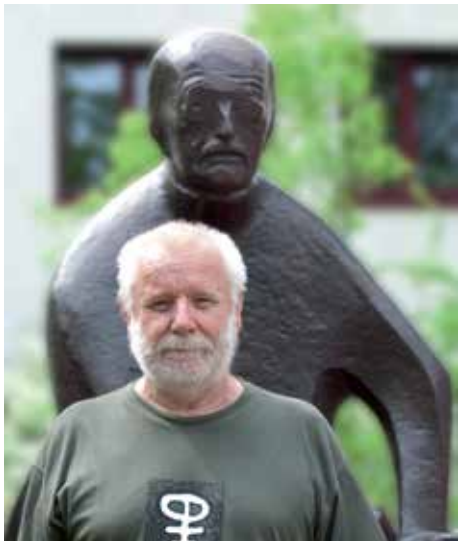
All current events: www.desy.de/veranstaltungen

Hans Grabosch leaves the DESY stage

Successor Heidrun Bojahr assumes office

Hans-Jürgen Grabosch will go into retirement at the end of February. He is the person with the complete overview of how everything works in Zeuthen. He knows about the current finances, building projects and the latest research results. As deputy head of DESY in Zeuthen, he is a member of the division deputy directors group and therefore one of the main information carriers between DESY in Hamburg and in Zeuthen.

In 1979, Grabosch began to work as a physicist at the Institute of High-Energy Physics IFH in Zeuthen. He did his PhD thesis in the field of experimental neutrino physics at the bubble chamber experiment SCAT. From 1986, he worked for five years at the neutrino-calorimeter experiment at IHEP in Protvino, in the former Soviet Union. In 1992, the IFH became the second DESY site. As an experimental physicist, Grabosch joined the ZEUS collaboration at



Hans Grabosch in front of a statue of Max Planck.
Photo: Christine Iezzi

the HERA accelerator. He significantly participated in the construction of the presampler for the ZEUS calorimeter. Since 1995 he has been the right-hand man of the Zeuthen management and became head of the technical division and deputy head of DESY in Zeuthen. Since that time, construction plans, financial tables and project planning have been part of his day-to-day business. However, he still collaborated in experiments, for example in the Photo Injector Test facility in Zeuthen PITZ. He commissioned diagnostic components, did shift work in the control room and supervised diploma students. Over a period of many years, he was able to gather a tremendous wealth of experience. Hence, many discussions on all sorts of topics often end with people saying “we better ask Hans Grabosch…” Hans-Jürgen Grabosch goes into a well-earned retirement. Fortunately, he did not forget to pass on his knowledge, already for the benefit of his successor Heidrun Bojahr. *(ub)*

Bjørn H. Wiik Prizes 2012 and 2013

Particle physicist Kerstin Tackmann and Photon Science researcher Ralf Röhlsberger awarded

In January, not only one but two Bjørn H. Wiik Prizes were awarded in Hamburg. The award worth 3000 € commemorates the lifetime achievements of DESY Director Bjørn Wiik (1937-1999) and is handed out every two to three years to young scientists and engineers who notably advanced projects at DESY with their research or technical developments.

Particle physicist Kerstin Tackmann received the 2012 Prize for her contributions to the Higgs particle discovery in the ATLAS detector at the LHC. With her analysis of the Higgs particle decay into two photons, she played a decisive role in the identification of this particle. She had previously considerably refined the photon detection methods in the ATLAS detector. The resulting increase of the detection sensitivity made the rapid discovery of the Higgs boson possible, which was announced on 4 July 2012.

Photon scientist Ralf Röhlsberger was awarded the Wiik Prize 2013 for his

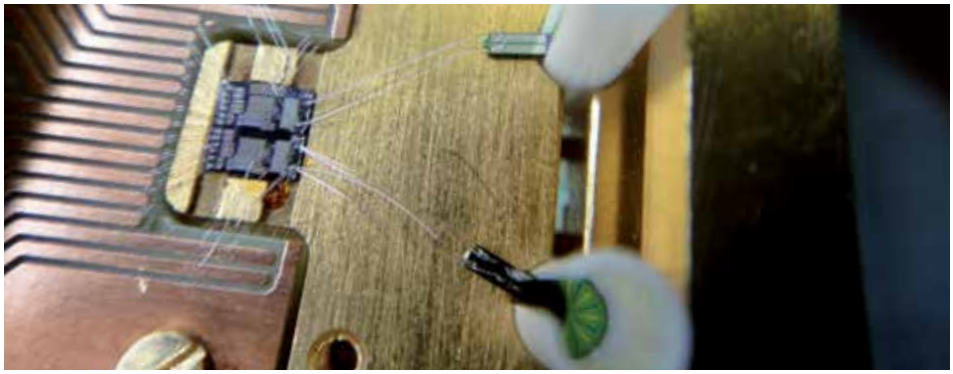
Laureate Kerstin Tackmann. Photo: Lars Berg

fundamental quantum-mechanical experiments with X-rays, which he mainly carried out at the world’s most brilliant synchrotron radiation source PETRA III. To observe for example electromagnetically induced transparency, he used a platinum cavity with the size of one nanometre to induce single iron atoms to cooperative emission, and he made use of experimental methods deriving from Mössbauer spectroscopy. The novel measuring procedure opens up many possibilities for additional experiments, for instance in quantum information technology. *(tz)*

Laureate Ralf Röhlsberger. Photo: Lars Berg

Counting light particles

ALPS experiment puts extremely sensitive transition-edge detector into operation



The 25x25 micron-sized midget is sitting in the middle of the green circle at the lower edge. Photo: ALPS

There is plenty of cryogenic engineering at DESY – kilometre-long accelerators have been and are in operation at four or two Kelvin (-271 degrees centigrade). Recently, a small experiment in the HERA hall west has become a strong contender to become the coldest place of the research centre when the ALPS scientists put into operation a new detector which counts single photons with very high precision. With an operating temperature of only 80 thousandths of a degree above absolute zero, even the universe would be much too warm for this detector. Starting at the end of the year, the scientists will use this detector to test if there are very light particles hidden in our universe.

Let's recap: ALPS, a "light shining through a wall" experiment whose acronym stands for Any Light Particle Search, used a converted replacement magnet of the superconducting HERA proton ring to search for very light particles, so-called WISPs (weakly interacting sub-eV particles). According to some extensions of the Standard Model, these particles could exist in great numbers and should be generated by the conversion of light particles in a strong magnetic field and then reconverted into photons. In 2010, the ALPS scientists published the most precise measurements worldwide in this field and immediately planned the subsequent experiment ALPS II, with a 3000-fold increase of sensitivity.

The central part of the new ALPS II detector is a transition-edge sensor that the scientists will use to record any light from WISPs conversions. The high sensitivity of the tiny sensor (it measures 25 by 25 micrometres and is 20 nanometres thick), results from its measuring principle: the detector is operated at the transition between superconductivity and normal conductivity. When a photon hits the detector, this causes a minimal temperature increase, which brings about a precisely measurable change of the electrical resistance.

The novel detector was implemented at DESY by PhD student Jan Dreyling-Eschweiler in cooperation with international metrology institutes. First tests are promising: "The transition-edge sensor is not only able to detect single infrared photons but also to measure their energy with an accuracy of 10 per cent," says Friederike Januschek from the five-member detector team of Hamburg University and DESY. The inherent noise of the ALPS sensor is smaller than just a single signal within three hours; the arrival time of a photon can be measured with an accuracy of one millionth of a second. These properties allow the ALPS researchers to count single photons and determine their "colour", even when only a few of these photons are produced per hour.

In the middle of the year, the test setup for ALPS II will start operation and reach its full sensitivity by mid 2015. Then the next extension of the experiment could follow – an about 200-metre-long system with 20 HERA dipole magnets in the HERA tunnel. There is a lot of hope among the ALPS researchers' group: "The convincing factor with regard to the WISPs is that at one blow they would solve a whole bunch of existing physics problems and strange observations in astrophysics, including the question of dark matter," said ALPS spokesman Axel Lindner. "And perhaps our detector development would also be interesting for other DESY research activities." *(tz)*

NEWS

ERC grant for "super slow motion"

To trace and understand chemical and biological processes taking place in just some quintillionths of a second with full atomic detail – for this ambitious research project, Franz Kärtner (Center for Free-Electron Laser Science CFEL, DESY and University of Hamburg), Henry Chapman (CFEL, DESY and University of Hamburg), Ralph Aßmann (DESY) and Petra Fromme (Arizona State University) were granted a total of 14 million euros from the European Research Council ERC. Among others, this will fund a new research facility at DESY.

Martin Pohl appointed APS Fellow

The renowned American Physical Society has elected Martin Pohl, astrophysicist at DESY in Zeuthen, as Fellow. With this distinction, the APS recognises his outstanding contributions to the theory of cosmic rays, including modelling of cosmic ray propagation and electron acceleration in supernova remnants.

Ingmar Hartl honoured as OSA Fellow

The Optical Society (OSA) has made DESY scientist Ingmar Hartl an OSA Fellow Member. Hartl is being recognised for outstanding contributions to femtosecond fibre lasers and frequency combs across the optical spectrum. The mission of the Washington-based OSA is the "generation, dissemination, application, and archiving of knowledge in optics and photonics." A total of 71 members were elected fellows at the end of December 2013 because they achieved considerable progress in these fields.

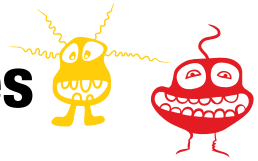
CMS Achievement Award for Benjamin Lutz

DESY Postdoc Benjamin Lutz receives the CMS Achievement Award 2014 for his engagement to improve the outer layer of the hadronic calorimeter in the CMS experiment, for which DESY delivered the essential components. Lutz is acknowledged "for the excellent organization of the process of carrying out full replacement of hybrid photo detectors to silicon photo-multipliers". The CMS collaboration presents this prize for extraordinary contributions to the experiment.

The exhibition "Teilchenzoo" at Universum® Bremen is particularly popular with students. Photo: Universum®

Higgs for couch potatoes

Pay an online visit to DESY's "Teilchenzoo"



Since the opening in September of last year, some 40.000 visitors have seen the DESY and Science Center Universum® exhibition "Teilchenzoo" (particle zoo) in Bremen (see DESY inForm 9/2013), and the exhibitors obtained a lot of enthusiastic feedback. Even visitors who came with tricky questions like "What is behind the universe?" "How can you determine the shape of particles?" "How long will the sun continue to shine?" found answers to their questions (if you're wondering what they are, see http://teilchenzoo.desy.de; answers are in German only). The particles, shown as friendly monsters, are quite popular as postcards and small stamps. Evening events are also a big pull to visit the "Teilchenzoo": on 21 February, Metin Tolan will present fascinating and easy-to-understand science in his talk "Star Trek – searching for extra-terrestrial life" (in German). There are also special events for school classes on how scientists actually work, how they investigate things that are invisible or how it is possible to bring order into the swarm of elementary particles. In a two-and-a-half-hour workshop, pupils will go into detail of various fascinating aspects of the exhibition.

All those who have no time to travel to Bremen can visit the "Teilchenzoo" at home. On the exhibition's website you can find the popular "particl-o-matic" personality test and entertaining and informative particle physics films (in German) in which TV host Delf Deike probes DESY physicists. The world of particle physics for couch potatoes… *(uw)*

INFO

The website of the exhibition with an online personality test, particle physics films, answers to visitors' questions and current events:
http://teilchenzoo.desy.de/exhibition

The special exhibition "Teichenzoo" in the „SchauBox" exhibition rooms of Universum® Bremen will run until 30 June 2014. The admission fee is included in the Universum® admission fee (16 Euros, reduced fee 11 Euros).

HELMHOLTZ ASSOCIATION

EU-Russia year of Science

Late 2013 saw the official launch of the EU-Russia Year of Science. This initiative includes numerous workshops, conferences and forums taking place in both Russia and the European Union that are supposed to establish new and strengthen existing cooperation. Moreover, there are a number of important political milestones pending for the European Union and Russia, e.g. the start of the new EU research programme "Horizon 2020", the renewal of the EU-Russia Science and Technology Cooperation Agreement and the start of the new Federal Targeted Programme for Research & Development in Russia.

In a joint venture with the Russian Foundation of Basic Research, the Helmholtz Association will organise a final seminar on their shared programme "Helmholtz-Russia Joint Research Groups": after five bidding rounds, 32 German and 32 Russian project partners will present the research results of their three-year cooperation on 3 March in Moscow. The topics include genetic disposition to tuberculosis, arctic research, the analysis of climate change by taking the example of the Lake Baikal, and particle physics. DESY is participating in a group that measures cosmic radiation in the Siberian Tunka Valley, and another group is working at DESY's Photo Injector Test facility in Zeuthen (PITZ).

www.helmholtz.de/perspektiven

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