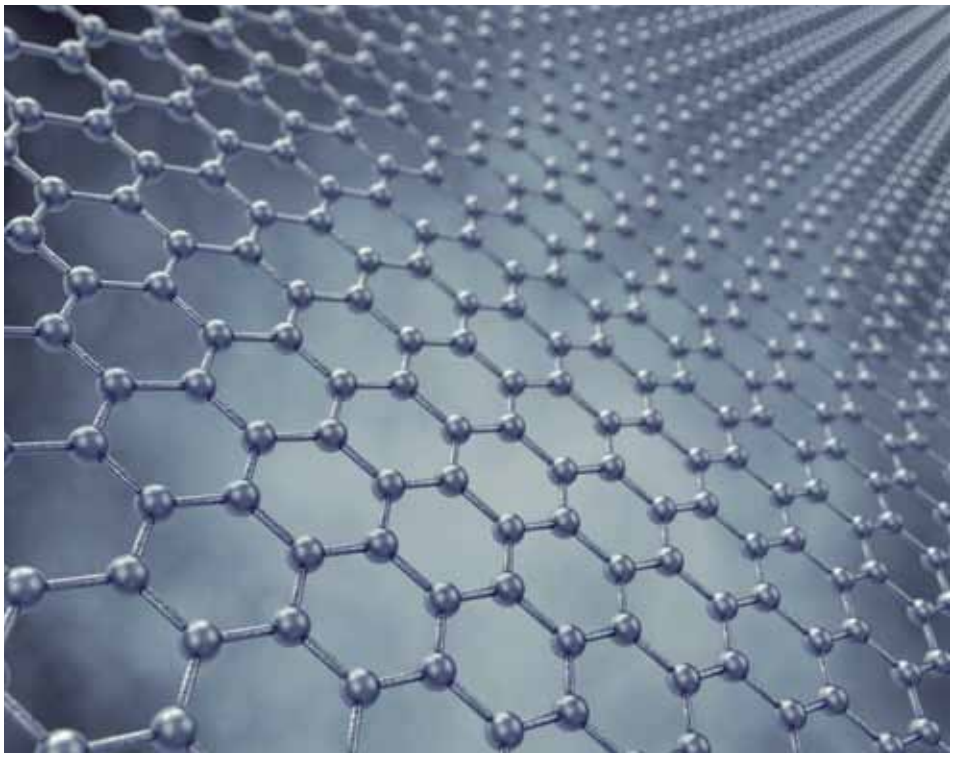
DESY inFORM.

05|12
Newsletter of the
Research Centre DESY

The future is tiny

DESY builds a NanoLab for external users and in-house research

How do you transport a nano wire that is a thousand times thinner than a human hair across hundreds of kilometers undamaged? Users who want to X-ray materials with DESY's X-ray sources PETRA III or FLASH may face this kind of challenge. Numerous users bring along the most delicate samples: bio crystals, nanometre-sized semiconductor structures, atom-thin carbon lattices. Currently, scientists mostly depend on producing their objects of investigation in their home laboratories and transferring them to Hamburg, which often requires special containers to keep them intact. In the future, the DESY NanoLab on the Hamburg campus will significantly simplify this. A laboratory of about 600 square metres of space is being built that will feature a complete infrastructure to prepare samples and test their usability right next to the X-ray sources, including the possibility to test them again after X-raying. The opening of NanoLab is expected in 2014.



Graphene, a kind of atomic carbon chicken wire, is considered as a promising nanomaterial.

"This offers completely new possibilities to our external users," Andreas Stierle points out; he is responsible for the construction and operation of NanoLab at DESY. Not only external users, but also DESY scientists benefit from the new building. Three research groups will move into NanoLab, thus strengthening DESY in-house nano research. "Nanotechnology will have a considerable impact on future developments, from fuel cells to solar panels," DESY director Helmut Dosch emphasises. "With the help of various investigation methods at DESY's research facilities, from tomography to small-angle scattering experiments, we are able to optimally handle scientific questions of nanotechnology, thus making important contributions to promote this future technology."

DESY's NanoLab will be equipped with a diverse arsenal of instruments. "We are planning a combined scanning tunnelling and atomic force microscope, an electron beam lithography facility for the nanostructuring of samples, laboratories for vapour deposition and sputtering of samples, a wet chemistry laboratory and a focused ion beam, a kind of ion lancet," Stierle enumerates. With the ion lancet, it is possible to cut extremely small pieces with nanometre precision from semiconductor circuits which are then submitted to the PETRA III X-ray beam to investigate with atomic resolution whether the inner structure really has the designed manufacturing properties.

"The questions of nano research are very complex; therefore, one kind of technology is usually not enough," Stierle explains. "You often need a whole range of methods, for example to find out what really happens at the investigated nanostructure." Stierle plans a workshop with DESY X-ray sources' users to discuss the required equipment

CONTINUED ON PAGE 2

DIRECTOR'S CORNER

Dear colleagues,

The European XFEL Project, for which civil construction began about three years ago, is moving with large steps into a new phase: just recently the 2.1-kilometre-long accelerator tunnel was completed and handed over to DESY so that now installation of technical infrastructure has started. In the following year the first sections of the superconducting linear accelerator will occupy the tunnel. With a total volume of approximately 400 million Euros DESY contributes about two thirds of the components and sub-systems in kind to this international project. Many of the components have by now been ordered from industry and it becomes visible that the foreseen cost frame can be well matched. This underlines the good planning by the project management team led by Hans Weise and by all colleagues involved in the participating technical groups. This is, not the least with a view on our funding agencies, a very satisfactory development.

In addition, DESY has a special responsibility for the construction and commissioning of the facility as the coordinator of the international XFEL Accelerator Consortium. From 16 to 19 April 2012 a meeting of the consortium was held at DESY with many colleagues from the 16 participating institutes from the XFEL partner countries, at which the progress of the work was intensely discussed. The synchronisation of the ongoing activities necessary for the integration of the components into a complete system according to schedule is not a small challenge, for all participating institutes and for DESY as the coordinating lab in particular. It is not unlikely that we temporarily may get stuck here and there, but I'm fully convinced that in the end we will altogether be able to be happy about the success of our joint effort.

Sincerely yours,
Reinhard Brinkmann

for the NanoLab service area. Not only preparation and investigation will be simpler for users. "Sample transport from and to the beamline will also be easier, even in ultrahigh vacuum," Stierle clarifies. "And afterwards, it is easier to test whether the sample was altered during investigation."

NanoLab will move into the lower floors of the new photon science building which is erected on the Hamburg DESY campus. In the basement, about 300 square metres of especially low-vibration laboratory space is designated for vibration-sensitive instruments like the scanning tunnelling microscope; moreover, there will be about 800 square metres of additional laboratory space. The building will also include 1800 square metres of office space. About 30 per cent will be available for scientists from Helmholtz-Zentrum Geesthacht (HZG), one of the partners of the photon science building. A second construction phase will allow for the same amount of laboratory and office space, including plans for an auditorium with about 150 seats. *(tim)*

Andreas Stierle (46) studied physics at Ruhr-Universität Bochum. He obtained a doctorate in the field of solid state physics and worked as a postdoc at the European Synchrotron Radiation Facility ESRF in Grenoble, France. Subsequently, he worked at the Max Planck Institute for Metals Research in Stuttgart for 11 years before he went to University of Siegen as a professor of solid state physics.

At the beginning of March, Stierle became professor of nanoscience at the University of Hamburg and team leader at DESY. He is responsible for construction and operation of NanoLab.

Helmholtz Association funds PIER Graduate School

Good news from Berlin: in the coming six years, the Helmholtz Association will fund the PIER Graduate School with a total of 2.4 million Euros. The Graduate School is part of the new PIER (Partnership for Innovation, Education and Research) cooperation between the University of Hamburg and DESY. As an interdisciplinary umbrella structure, it will not only expand the existing high-quality university and DESY doctoral training in the PIER research fields, but also create optimal structures and parameters with transparent access information and services for doctoral students, thus attracting young talents from all over the world to come to Hamburg. "The Helmholtz Association's funding approval gives us the opportunity to put together a comprehensive package for doctoral students, thus creating optimal graduation conditions," said Stefanie Tepaß, coordinator of the PIER Graduate School.

The PIER Graduate School continues to promote an intensive exchange among doctoral students and with representatives of economy and industry. With contact fairs, recruiting events and a special mentoring programme, PIER doctoral students are encouraged to actively plan their future careers. Within the framework of cooperation with international universities and research centres, the PIER Graduate School will provide exchange programmes for doctoral students and facilitate common graduations. Coaching, childcare offers and financial support for travelling with family make reconciling work and family easier.

Apart from the Helmholtz Association awarding two scholarships – one for excellent women – the Joachim Hertz Foundation also participates within the framework of the PIER Graduate School. The Joachim Hertz Foundation funds five attractive scholarships per year for outstanding doctoral students. *(tz)*

INFO
www.pier-campus.de

Neutrino surprise at the South Pole

Observations challenge theory of the origin of cosmic radiation

Cosmic radiation, discovered a hundred years ago, which is constantly raining down from space on earth, is still a mystery for scientists. "We know that this high-energetic cosmic radiation exists, but we don't know where it comes from," says Alexander Kappes from Zeuthen, who uses the neutrino telescope IceCube to track down the origin of cosmic radiation. Results from the neutrino telescope IceCube in Antarctica now challenge one of the well-established theories of the origin of high-energy particles of cosmic radiation.

Promising candidates for the sources of highest-energy particles are massive black holes at the centres of active galaxies and so-called gamma ray bursts. "Apart from the Big Bang, gamma ray bursts are the most powerful explosions we know of in the universe," Kappes points out. Scientists think that they are the collapse of the core of a very massive star which produces a black hole. This process generates enough energy to accelerate the subatomic particles of cosmic radiation to the energies observed. However, these gamma ray bursts should also produce neutrinos.

A recent report by the international team of IceCube scientists in the scientific journal "Nature" caused a big surprise: The analysis of about 300 gamma ray bursts in the years from 2008 to 2010 revealed that IceCube did not find a single neutrino that corresponds to one of the explored bursts. "Two possible explanations can be derived from this observation," said Kappes. "It is possible that the postulation that gamma ray bursts are the main source of the extremely high-energy cosmic radiation is wrong. The other explanation is that our calculation models of the processes in gamma ray bursts are based on incorrect or highly simplified assumptions." In any case, the current models of cosmic radiation and neutrino production in gamma ray bursts have to be reworked. *(tz)*

„Cool Runnings“

A photo exhibition in the auditorium foyer at DESY in Hamburg illustrates the history of a cavity through the stages of raw niobium, melting furnace, test bench and cleanroom, ending up as a brilliant 9-cell cavity in a cryomodule. From 30 May to 14 June, you will have the opportunity to see this fascinating photo spread by science photographer Heiner Müller-Elsner on the development of an accelerator cavity. On 30 May, Karsten Büßer will give a public lecture on this topic and the photographer will also be present to answer your questions.

WHAT'S ON AT DESY

May

2 Public Lecture
Vom Kleinen und Großen – Elementarteilchen, Kräfte und das Universum
Christian Stegmann, DESY, Zeuthen, seminar room 3, 19 h

7-8 Workshop (www.desy.de/2012FCAL)
FCAL Workshop
DESY, Zeuthen

9 Seminar Series
The Large Hadron Collider (LHC)
Paul Collier (CERN)
DESY, Hamburg, Geb. 1b, seminar room 3, 14 Uhr

22 **Staff assembly**
DESY, Hamburg, auditorium, 9.30 h

23 Science Café DESY (http://sciencecafe.desy.de)
Higgs, das meistgesuchte Teilchen der Welt
Marcel Stanitzki, DESY Bistro, 17 h

29 **Staff assembly**
DESY, Zeuthen, seminar room 3, 14 h

29 5 -1 6 Workshop (http://psr12.desy.de/)
Event Generators and Resummation
DESY, Hamburg, bldg. 1b, seminar room 4b

30 Public Lecture
Cool Runnings – Kalte Technologie für schnelle Teilchen
Karsten Büßer, DESY, Hamburg, auditorium, 19 h

June

2 Event (www.langenachtderwissenschaften.de)
Lange Nacht der Wissenschaften in Berlin und Potsdam
Visit DESY at HU in Berlin

6 Seminar Series
The International Linear Collider (ILC)
Eckhard Elsen (DESY)
DESY, Hamburg, bldg. 1b, seminar room 3, 14 h

13 Science Café DESY (http://sciencecafe.desy.de)
Überall ist Materie – Aber wo ist die Antimaterie?
Wilfried Buchmüller, DESY Bistro, 17 h

20 Seminar Series
The Compact Linear Collider (CLIC)
Steinar Stapnes (CERN)
DESY, Hamburg, bldg. 1b, seminar room 3, 14 h

21 Bridfas Lecture (www.bridfas-hamburg.de)
AGM followed by History of English Fairs, Markets and Shops
Andrew Davies
DESY, Hamburg, auditorium, 20 h

All current events: www.desy.de/events

“Good Vibrations” for Cutting-Edge Science

Low-Vibration Laboratory for Free-Electron Laser Science (CFEL)

By Manuel Gnida

Some 20 construction sites currently mark DESY’s striving research landscape. One of them is located near the Center for Free-Electron Laser Science (CFEL), where DESY and its partners Max Planck Society, Hamburg University and European X-ray Free-Electron Laser GmbH (European XFEL) are creating approximately 400 square meters of laboratory space and additional 100 square meters for general technical equipment. Four research groups, developing vibration-sensitive instruments to study ultra-small objects with ultra-fast and ultra-powerful lasers, are expected to move in within the next few weeks.

The future buildings 49b–d will not be your everyday buildings. What will look like one building from the outside is in reality four separate buildings, three laboratories and one shared technical room, all with their own intermediate walls. Moreover, the floor sections are not connected to the outer walls, creating one of DESY’s most vibration-cushioned facilities.

Artist’s impression of the new laboratory.

This is particularly important for Sebastian Loth, whose lab is built on an especially developed concrete foundation. Loth’s group wants to study ultra-small structures assembled from single atoms using scanning tunneling microscopy (STM). In this technique, a metal tip scans the topography of surfaces with very high resolution. Single atoms brought onto the surface beforehand can be moved and placed in desired locations. The challenge: the STM tip is only 0.000 001 millimeters away from the surface. “This corresponds to only five atom diameters,” Loth says. Typical vibrations of a regular building are at least a thousand times larger.

One of Loth’s projects is to study ultra-small magnets. “When we make objects from only a few atoms, we observe effects that do not occur in our normal world,” Loth says. “A classical magnet must rotate to change the direction of its magnetic field. An ultra-small magnet can do this without rotation.” Loth’s group intends to study what happens during this process by combining STM with the time resolution of ultra-fast lasers.

The laser light for Loth’s experiments will be delivered from the adjacent lab, where CFEL scientist Andrea Cavalleri and his group develop laser methods to steer phase transitions in strongly-correlated materials with quite unusual behaviors. One example are high-temperature superconductors with vanishing electrical resistances below unusually high critical temperatures. Using ultra-short laser pulses, Cavalleri’s group has recently been able to switch such materials into a superconducting state even above the critical temperature, in the extreme case also at room temperature. “The phase transitions we study are very sensitive to stimulation with femtosecond pulses of mid-infrared wavelengths,” says Michael Först, senior scientist in the Cavalleri group. “In our group, we are currently trying to shape these pulses in any desired way to optimize and control the phase transformation.”

The third lab will be shared between two groups developing high-power ultra-fast lasers. In general, ultra-fast lasers are instrumental to the operation of facilities

such as XFELs. Max Lederer’s team develops femtosecond lasers of unprecedented peak and average power, suited to the emission pattern of the future European XFEL. Lederer’s lasers will be used, for instance, in pump-probe experiments, in which a laser pulse first excites a sample, followed by an X-ray pulse that “reads” the laser-induced effect. “These lasers are far from being commercially available and require a major development effort on our side, tying in some of the most advanced high-power laser technologies,” Lederer says.

Franz Kärtner’s group pursues similar scientific goals. “We try to generate all sorts of high-energy wave forms and use them in strong-field laser physics,” says Kärtner. Such techniques are the only way to produce high-energy ultraviolet laser pulses shorter than 100 attoseconds (0.1 femtoseconds). “It has been the dream of researchers to observe an atom’s electrons in motion,” Kärtner says. “Attosecond pulses will allow following the dynamics of such processes.”

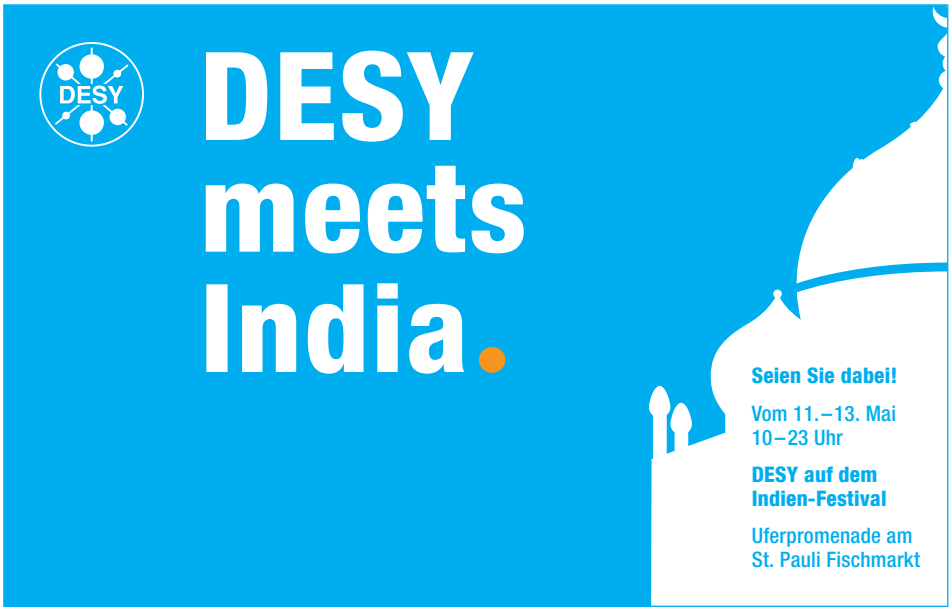
FLASH passes the ILC performance test

Accelerator gradients far more stable than planned

If you plan a next-generation accelerator like the International Linear Collider ILC, you sometimes need to crank things to their limits. A team of ILC and DESY accelerator experts recently descended on the FLASH control room to push buttons and run programs that bring the superconducting linac closer to ILC properties, delivering a wealth of data and interesting results for FLASH and the ILC.

The overall goal of the studies is to run FLASH with long bunch trains and heavy beam loading, with cavities at the top of their gradients. Tuning FLASH for maximum performance is an intricate interplay of information, with signals being fed back and forward to each individual cavity. For the ILC, all the cavity gradients should be as constant and stable as possible during the 800-microsecond beam pulse, and the team managed this better than planned. FLASH itself was modified before the ILC studies. It now has a control mechanism that can ramp down radiofrequency power if cavities approach their quench limit, and the electron gun can produce 800-microsecond bunch trains.

"Every time we have come back to FLASH it has behaved and performed better," says study leader John Carwardine of Argonne Lab, US. Apart from the ILC tests, the studies can help the FLASH team reach higher energies and thus the water window that is interesting for users. The water window marks a wavelength range where water becomes transparent, so that samples can be probed in aqueous solution. In September the team will have its last chance to push the limits before the ILC Technical Design Report. *(baw)*



DESY meets Harbour Birthday! – Down-to-earth research

Out of the ivory tower and into the harbour mile: at this year's 823th Hamburg Harbour Birthday, DESY presents itself and its research in a way that is easily understood by everybody. True to the motto "DESY meets India", DESY and guest country India, together with the accelerator centre FAIR, show the fascinating and exciting facets of current research to visitors in a tent at St. Pauli fish market. The focus is on cooperation with Indian scientists and institutes participating in research at the X-ray source PETRA III, with experiments mainly in the field of materials and nano research.

Apart from impressive large photographs, informative posters and exhibits, this event also includes a science quiz with attractive prizes and - twice a day - a 20-minute science show with entertainer Delf Deicke, who you may remember from DESY's 50th anniversary celebration.
Be there! *(uw)*

NEWS

DESY promotes applied nanotechnology

The research centre DESY has become a member of the nanotechnology sponsors' association which is the holder of the Center for Applied Nanotechnology (CAN) in Hamburg. CAN is a nanotechnology enterprise providing nanotechnology products applicable for example in medicine and food industry, and tailor-made nanotechnology research.
In March, DESY was admitted as a participating member of the CAN sponsors association. DESY and CAN GmbH will deal with issues in the field of life sciences, energy research and materials science. In a next step, expert teams will clearly define the common research fields.

Kestrels breeding again

The DESY kestrel couple has returned to its nesting box on the DESY campus in Hamburg. For many years, these birds of prey have been using this place at DESY to breed numerous chicks. Like last year, you can watch the birds named "DESYrée" and "FLASH Gordon" with a live camera. At http://d5-extern.desy.de you can see them flying in and out of the nesting box and you can take a secret look right into the nest.

6th international dCache Workshop in Zeuthen

In April, nearly 60 participants from 13 countries attended the 6th international dCache Workshop in Zeuthen. Computer administrators - beginners and experts – had the opportunity to expand their knowledge on data administration software originally developed at DESY. This makes a total of 300 users that attended the successful annual workshop programme.
The dCache software was developed at DESY to store the data of the HERA experiments. Today, this project has been further developed on an international level, including DESY, Fermilab and the Nordic Data Grid Facility. Worldwide, dCache is used at many computing centres to store and exchange large amounts of data – adding up to nearly 100 petabyte stored in dCache systems. Traditionally, these are mainly high-energy physics data, e.g. from the Large Hadron Collider. Currently, the focus is on further developing the supply of these data via long established protocols as well, for example via web browsers.

Don't be afraid of soldering irons! Girls investigated the multifaceted professional world at DESY.

Distinguished!

Federal state of Brandenburg honours DESY for promoting young talents

Soldering, designing, programming – on "Girls' Day" in Hamburg and "Future Day" in Brandenburg, about one hundred pupils investigated the multifaceted professional world at DESY. In the cryotechnology sector, at the PITZ accelerator or in the web office; many DESY staff members gave girls and boys, sixth to ninth graders, the opportunity to gain a personal insight into their working environment. For its ten-year commitment to the "Future Day", DESY in Zeuthen was distinguished by the federal state of Brandenburg.

Apart from DESY, nine other Brandenburg institutions were honoured. "For many years, these ten firms and public institutions participate in the 'Future Day', some from the very beginning – like DESY in Zeuthen," said Brandenburg labour minister Günter Baaske (SPD). "All of them give young people the opportunity to get practical advice directly at the enterprises for career decision making." Christian Stegmann, head of DESY in Zeuthen, was grateful for the distinction. "In our opinion, this day has been successful for young people when they get a first idea of the working world and the tasks, and learn which skills are necessary for this," he pointed out.

In Hamburg, the pupils attending the "Girls' Day" were invited to see a premiere. DESY's new and also Germany's first accelerator show "Rennmaschinen" (Speed Machines) was put on stage for the first time. For one hour, with a Tesla coil and a Van de Graaf generator, Marc Wenskat and his show team brought home to the children the operating principle of a particle accelerator.

More vocational orientation in the field of mathematics, informatics, natural sciences and technology (MINT) will be offered at DESY on 13 September in Hamburg at a "MINT Day" for girls of 8th to 12th grade. *(tim)*

INFO

www.komm-mach-mint.de
Registration for the MINT Day at DESY:
http://mint.desy.de

HELMHOLTZ ASSOCIATION

New research vessel POSEIDON

The 36-year old research vessel POSEIDON will be replaced by a new ship. Chancellor Angela Merkel announced the news during a visit to the GEOMAR Helmholtz Centre for Ocean Research Kiel, where she informed herself on the future challenges in the field of marine research. After a short trip aboard the Kiel-based research vessel ALKOR, Chancellor Merkel visited the GEOMAR facilities at the eastern bank of the Kiel Fjord, where young scientists presented gas hydrates as a potential energy source and explained climate research methods. This was followed by a presentation of the deep-sea robot ROV KIEL 6000 at the GEOMAR technology and logistics centre.

Chancellor Merkel emphasised: „With the admission to the Helmholtz Association, the federal government clearly supports the future development of GEOMAR and ocean research as a whole. This includes the gradual implementation of the recommendations made by the Scientific Council. One of the first steps will be the replacement of the POSEIDON research vessel by a new ship."

The existing POSEIDON, which was launched in 1976, is currently on its 428th expedition in the Mediterranean Sea. The new, by then third POSEIDON will again have Kiel as its port of registry. Commissioning is expected not earlier than 2015. The estimated building costs amount to about 80 million euros.

www.helmholtz.de/hermann

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