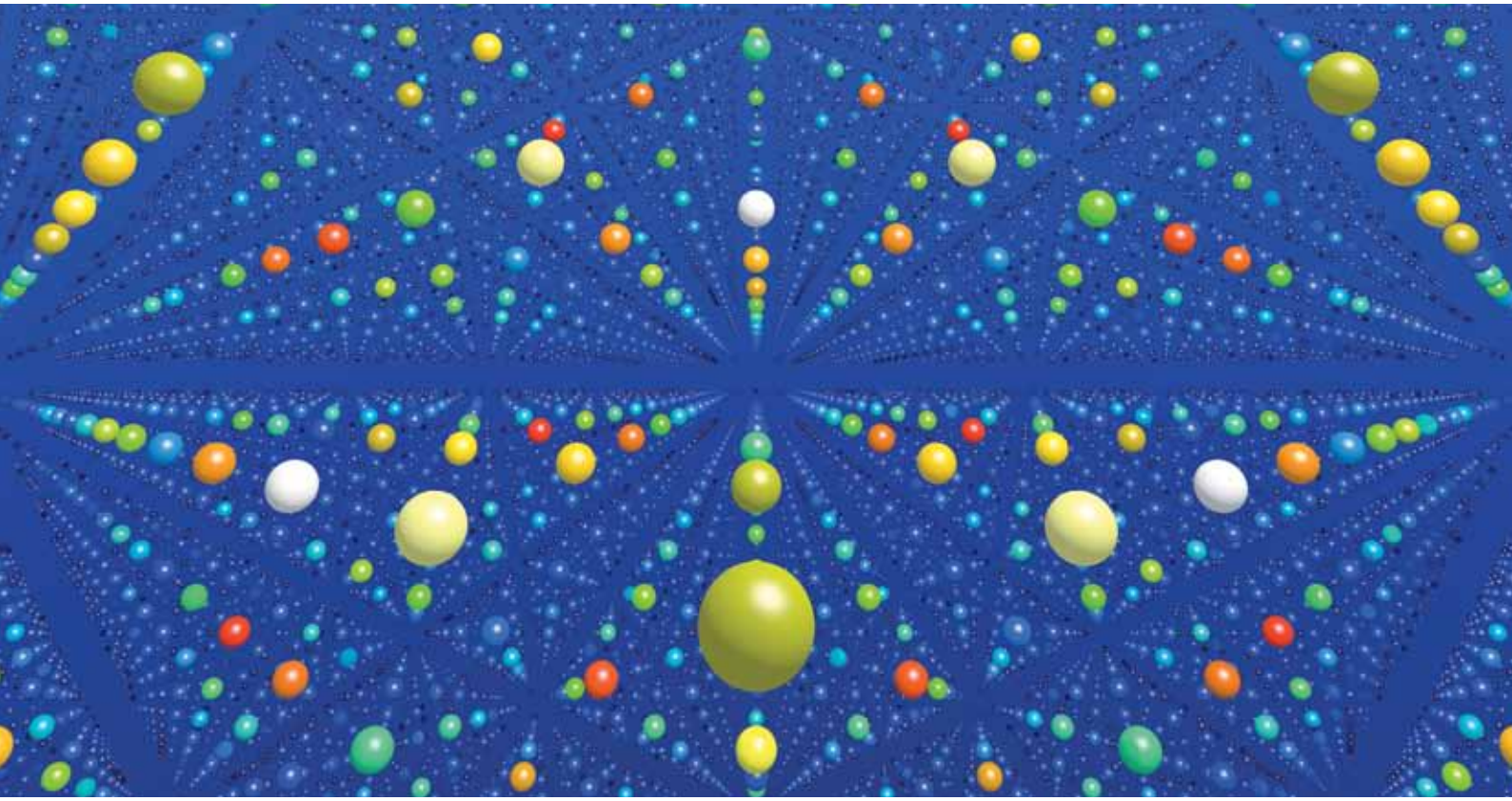
DESY inFORM.

09|12
Newsletter of the
Research Centre DESY

The gate to the nanocosm

100 years ago, Max von Laue discovered X-ray diffraction by crystals



Simulated 3D diffraction pattern of zinc blende (ZnS). The positions of the coloured spots are related to the lattice geometry, while the colours and sizes of the spots encode information about the types and positions of the atoms.

By Helmut Dosch

2012 is a special year for DESY: just 100 years ago, two pioneering discoveries laid the foundation for today's scientific mission of DESY – the investigation of the structure of matter. Victor Franz Hess' discovery of cosmic rays (see "DESY inForm" 7+8/2012) straightforwardly led to particle and astroparticle physics, and Max von Laue's discovery of X-ray diffraction by crystals laid the corner stone for structural analysis, thus opening the gate to the nanocosm.

The ground-breaking experiment which Max von Laue, together with Walter Friedrich and Paul Knipping, successfully carried out on 20 April 1912 is justifiably celebrated today as one of the experiments of the century. In a basement room of the University of Munich, the physicists shot a thin X-ray beam on copper sulphate placed in front of photographic plates. Von Laue discovered characteristic diffraction patterns on the photographic plates. With this, he was able to interpret correctly the electromagnetic nature of X-rays discovered 17 years before in Würzburg by Wilhelm Conrad Röntgen. Two fundamental physics questions could be answered once for all: X-rays are nothing else than light, only with a shorter wavelength, and crystals consist of precisely arrayed atom and molecule structures.

For the first time, it was possible to see the molecular structure of solid states and associate the function of materials with the molecular configuration and its inner structure. "Dear Mr. Laue! I cordially salute you on your marvelous success.

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DIRECTOR'S CORNER

Dear colleagues,
DESY is still experiencing a hot summer. This has little to do with a southern climate bringing hot air from the African desert to our shores, but instead with research and research policy. DESY is involved in a heated debate with its funding bodies on the financial means which are due from 2015/16 for the operation of the European XFEL. We need the backing of the federal and state governments and the Helmholtz Association to have enough strength to keep our research centre on a level which is necessary to remain at the forefront of international science competition.

Our goal is to have enough resources available in the future for DESY's research. This kind of research is urgently necessary to provide cutting-edge large-scale scientific facilities for our users. We are sure that there will be reasonable solutions which will continue to support DESY's success story.

DESY research is in a hot phase, as usual. In July, the discovery of a new particle – very probably the Higgs boson – at the LHC was proclaimed at CERN. This is probably one of the really great discoveries and it is also a great success for DESY playing a decisive role in both large LHC experiments. In spite of the heavy construction works all around the Hamburg campus, our light sources are running smoothly, producing outstanding scientific results that fill the best scientific journals. The construction of the European XFEL X-ray laser also proceeds according to plan.

This month, there will be a ceremonial event on our campus: on 19 September, prominent guests will join us when we will give the PETRA III hall the name of the physicist and Nobel laureate Max von Laue who, a hundred years ago, made the ground-breaking discovery of X-ray diffraction by crystals. I am looking forward to welcome not only Federal Chancellor Angela Merkel, the First Mayor of Hamburg Olaf Scholz and Nobel Prize in Chemistry laureate Ada Yonath, but also many of the DESY colleagues who registered for this event.

Yours,
Helmut Dosch

Your experiment counts among the most glorious that physics has seen," Albert Einstein wrote shortly after the presentation of the results.

Sodium chloride – commonly known as table salt – was among the first materials which revealed their molecular structure to mankind through this kind of experiment. It was Sir William Henry Bragg and his son, Sir William Lawrence Bragg, who decoded the structure of table salt shortly after Max von Laue provided the proof of X-ray diffraction by crystals. Both father and son won the Nobel Prize in 1915 for their interpretation and application of the Laue technique. In the same year, von Laue retrospectively received the 1914 Nobel Prize in Physics.

"Science has been enriched by a method of research whose full implications cannot yet be fully appreciated," the Nobel Committee wrote at that time on Laue's discovery – and they turned out to be right. With improved X-ray sources and more refined experimental methods, science quickly managed to understand how to produce tailor-made materials and medicine. This has caused a revolution in our understanding of organic and anorganic nature. The discovery of the molecular structure of our genetic substance DNA in the 1950s and the decoding of the molecular structure of the ribosome, the protein factory of the cell, by Ada Yonath are two outstanding examples of this technological revolution; both of them were also awarded with the Nobel Prize.

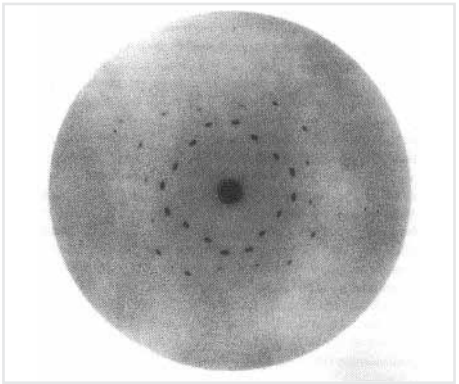
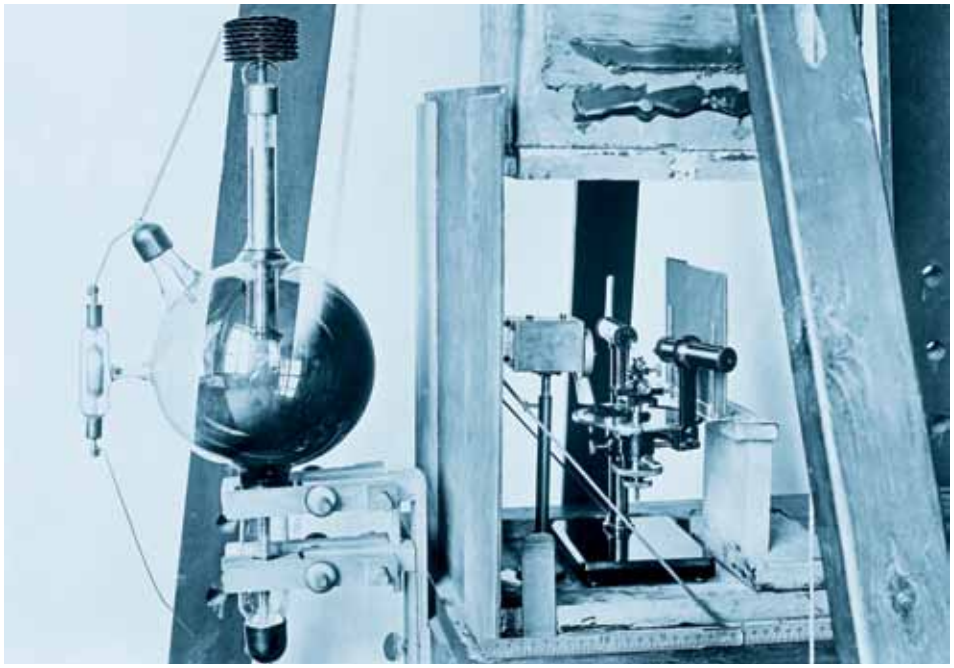


Image taken in 1912 of an X-ray interference of a zinc blende crystal. Zinc blende (ZnS) was one of the first crystals investigated by Laue, Friedrich and Knipping. Photograph: Deutsches Museum

With the increasing knowledge about the structure of matter, materials-based innovations coined the past decades. The development of new high-tech materials took place at a breathtaking speed. Just think of semiconductor technology which at half-a-year intervals provides us with computers that are faster, smaller and have a more powerful memory. When you get a singing birthday card, you have a far greater computational power at hand than the allied forces once had at their disposal at the landing in Normandy. Today, we take it for granted that we have highly brilliant LED flat screens with extremely sharp images. And when we are getting old, titanium high-tech joints may replace our worn-

out hips – to name just a few examples.

Almost none of our contemporary technologies would be conceivable and possible without the bold research on the molecular structure of matter – a good enough reason to celebrate Max von Laue's epoch-making discovery. In a ceremony on 19 September, the new PETRA III experimental hall will receive the name "Max von Laue". Prominent guests assured to come: Federal Chancellor and physicist Angela Merkel, the First Mayor of Hamburg Olaf Scholz and Nobel Prize in Chemistry laureate Ada Yonath, who carried out her key experiments at DESY to identify the structure of the ribosome.



Experimental set-up used by Max von Laue, Walter Friedrich and Paul Knipping at the discovery of X-ray diffraction by crystals in 1912. Photograph: Deutsches Museum

The super microscopes that are necessary for these investigations fundamentally differ from the light microscopes that are commonly found on laboratory tables. The attempt to take a step into the atomic and subatomic world requires large, very complex and (unfortunately) costly particle accelerators which accelerate particles to the highest energies. The particles themselves or the emitted X-ray beams are then used as a probe to investigate the unknown.

With the super microscope PETRA III, a new and decisive milestone has been reached in science. It is the world's most powerful light source of its kind in the hard X-ray region. The highly brilliant radiation produced by means of sophisticated accelerator technologies, and the most modern experimental techniques allow tracking molecular processes in nano materials under environmental and technological conditions for the first time and to decode the atomic structure of complex macromolecules for substance research with highest resolution.

DESY is one of the few research centres in the world that has a unique expertise in the construction of these super microscopes. FLASH, the world's first free-electron laser for short wavelengths was designed and built at DESY, and DESY is the main shareholder of the future flagship of this discipline, the X-ray laser European XFEL, which is currently under construction. Not only DESY scientists benefit from these facilities, hundreds of guest scientists use the existing light sources every year and some of our partners like the University of Hamburg, Helmholtz-Zentrum Geesthacht and the European Molecular Biology Laboratory (EMBL) built their own institutes at DESY. With the foundation of the DESY NanoLab, the Center for Free-Electron Laser Science CFEL and the Centre for Structural Systems Biology CSSB on the DESY campus, a worldwide unique nano-bio research centre is emerging around these special light sources.

Max von Laue – physics pioneer and lover of fast automobiles

Max von Laue (9 October 1879 – 24 April 1960) was born at Pfaffendorf, near Koblenz. His father was an official in the German military administration, who was raised to hereditary nobility in 1913. Max developed an interest in the exact sciences at school and went on to study physics. He later worked with – among others – Max Planck and Albert Einstein, whose theory of relativity fascinated him.
Apart from the epochal discovery of X-ray diffraction by crystals, von Laue made numerous important contributions to physics, for example to the problem of superconductivity. He also wrote a History of Physics which went into four editions and was translated into seven languages.

With his wife Magdalena von Laue had two children. For recreation he loved sailing, skiing and motoring. In Berlin, von Laue first raced to his lectures by motorcycle and later by car. He never had an accident until 8 April 1960, when he was involved in a collision on a speedway in Berlin of which he died 16 days later.

(Source: Nobel Foundation)

Science Photo Library/Agentur Focus

Giant

H.E.S.S. II, the largest Cherenkov telescope ever built, has started operation in Namibia. The 28-metre main reflector of the 600-ton giant extends over an area of the size of two tennis courts and consists of 875 single mirrors. The camera, which is installed 36 metres above the main reflector, weighs nearly 3 tons and has the size of a garage door. When the super telescope is turned vertically upwards, its height equals a 20-storey building. H.E.S.S. stands for High Energy Stereoscopic System. Together with the already existing 12-metre telescopes, H.E.S.S. II will look out for atmospheric particle cascades of cosmic rays and search for new classes of cosmic particle accelerators.

September

5 Public Lecture
Vom Bernstein zur Supersymmetrie – Die Vereinheitlichung der Naturkräfte und der LHC
Thomas Schörner-Sadenius, DESY, Hamburg, auditorium, 19 h

10 Public Lecture
100 Jahre Röntgenstrukturanalyse – Von Max von Laue bis zum Röntgenlaser
Helmut Dosch, DESY, Hamburg, auditorium, 19 h

12 Science Café DESY (http://sciencecafe.desy.de)
Linux – Ein Pinguin erobert die Welt
Yves Kemp, Hamburg, DESY Bistro, 17 h

13 Event for pupils (http://mint.desy.de)
MACH MINT - Erfahre alles über wissenschaftliche und technische Berufe bei DESY
DESY, Hamburg, auditorium, 9-16 h

18 **Staff assembly**
DESY, Hamburg, auditorium, 9:30 h

19 **Max von Laue-Fest**
DESY, Hamburg, 15:30 h

20-21 Conference (www.desy.de/AT2012)
Astroteilchenphysik in Deutschland: Status und Perspektiven
DESY, Zeuthen, 9 h

25-28 Theory Workshop
Lessons from the first phase of the LHC
DESY, Hamburg, auditorium, 17:30 h

26 Science Café DESY (http://sciencecafe.desy.de)
Hollywoods Filmtricks Part III – Die physikalischen Irrtümer von Spielberg, Tarantino & Co
Marc Wenskat, Hamburg, DESY Bistro, 17 h

26 Hertz Lectures (www.desy.de/hertz)
Probing the deep structure of matter
Brian Webber (University of Cambridge, England)
DESY, Hamburg, auditorium, 17:30 h

30 9-2 10 Conference (www.desy.de/2012CMS)
Status and Physics Highlights of CMS
DESY, Zeuthen, SR 3

October

12 Concert
DESY Choir
DESY, Hamburg, canteen

24 Science Café DESY (http://sciencecafe.desy.de)
„Weltuntergänge" – Globale Katastrophen in Vergangenheit und Zukunft
Werner Brefeld, Hamburg, DESY Bistro, 17 h

All current events: www.desy.de/events

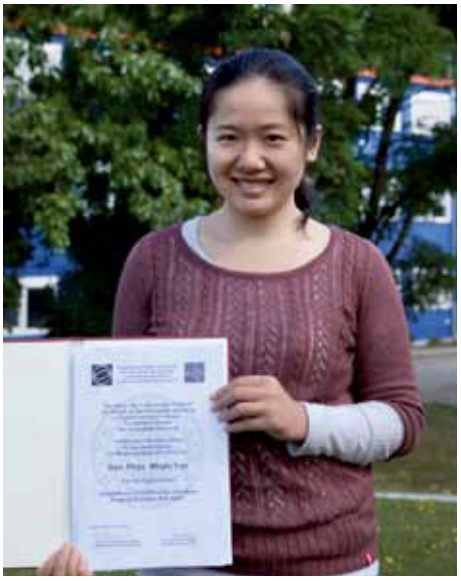
Distinguished accelerator scientist

Minjie Yan wins Otto Stern Prize for the best diploma thesis

She probably is the diploma physics student coming from the most distant country to Hamburg, and she most certainly is the best: Minjie Yan from China won the Otto Stern Prize for the best diploma thesis in the Hamburg physics department. The recently graduated physicist wrote her thesis at DESY's linear accelerator research group FLA. Here, she tested improved electron beam diagnostics for the FLASH accelerator.

Minjie already developed a strong interest in physics at school, where she also decided to learn German as her first foreign language. In 2003, Minjie also began to love Hamburg when she came from Shanghai, twin city of Hamburg, to the Elbe as an exchange student. Four weeks in Hamburg couldn't get out of her mind so she returned four years later to study physics. After attending an advanced lecture, Minjie knew that she wanted to work as an accelerator physicist. Now she is the second student who was ever distinguished with the Otto Stern Prize in this field.

She definitely sees her future career in Hamburg and at DESY: the by now 25-years-old just began as a PhD student in the MSK group and she works at the beam diagnostics for the European XFEL accelerator. *(tz)*



Seven weeks at DESY

Sommer students 2012

In the past seven weeks, about 100 summer students (only partly pictured here) from 33 nations gathered practical research experience at DESY. Both in Hamburg and in Zeuthen, they worked at different projects in the field of photon and accelerator science, as well as particle and astroparticle physics. The programme was supplemented by a series of some 40 lectures which provided the students with basic and specialised DESY research themes. Last but not least, personal exchanges also played an important role.

"The DESY programme is much more international than others that I looked at. That is particularly interesting to me," said Aaron Wilkins from Concordia University in Montreal, Canada. "You get many contacts," confirmed the Armenian Valeri Vardanyan, who studies physics at the University of Yerevan. And Aiveen Finn from Trinity College in Dublin, Ireland, liked the combination of education and research: "The DESY summer students' programme is different from others because of the interesting mixture of lectures and lab work." *(tim)*

Newly elected

Equal opportunity commissioner and women's representation

The equal opportunity commissioner and the DESY women's representation have been newly elected for the next 4-year period. The members of the women's representation are from left to right: Nicola Brenner-Ziegeler (secretary equal opportunity office), Nadja Häbe (PT, deputy for the "guest" sector), Katrin Lando (MHF-sl, for the "administration" sector), Sabine Brinker (MPY, deputy "Science" representative), Monika Kaut (IT, deputy "technology" representative), Sylvie Faverot-Spengler (FH1, equal opportunity commissioner and deputy "administration" representative), Brunhilde Racky (MPS, "technology"), Stefanie Tepaß (PIER, "guests"), Isabell Melzer-Pellmann (CMS, "science"). Women's representative in Zeuthen is Anne Oppelt (PITZ, far right) and deputy is Katrin Varschen (ZEU-SEK) next to her. *(tim)*

New leading scientist

Ralph Aßmann took up office in the accelerator division at DESY in August

The 47-year-old from Bonn came to DESY from CERN where, among other things, he built the collimator system for the LHC and where his last job was machine coordinator. Aßmann has worked in both particle and accelerator physics, including participating in one of the very first plasma accelerator experiments at SLAC in California.

At DESY, Aßmann will also do a lot of work in the field of plasma acceleration and he will assume tasks within the framework of the ARD (Accelerator Research & Development) portfolio programme of the Helmholtz Association. Moreover, he will represent DESY in European accelerator physics programmes and networks, for example EuroNNAc (European Network on Novel Accelerators) or EuCARD (European Coordination for Accelerator Research and Development). However, in the first place he wants to continue to design and build accelerators. "I think that within the coming ten years we should be able to build a reasonable plasma wakefield accelerator," Ralph Aßmann says. For this aim, he will build up his own team. He thinks that the conditions at DESY for such a project are perfect: "Excellent research is done here, and the existing accelerators and know-how are a big advantage of DESY." *(tz)*

Badge of honour

Rüdiger Knuth, long-time chairman of the DESY works council, has received the DESY silver badge of honour. Helmut Dosch, Chairman of the DESY Board of Directors, and Christian Scherf, Director of Administration, awarded Knuth for his outstanding contributions to the research centre.

PIER supports ALPS seminar

The Partnership for Innovation, Education and Research PIER between DESY and the University of Hamburg supports academic exchange within the framework of the ALPS (Any Light Particle Search) project: For the biweekly ALPS seminar, PIER grants a travel allowance inviting external speakers. The seminar is open to all, guests are welcome, and discussions are encouraged. You will find the agenda at **http://desy.de/~doebrich/jch.html.**

"Parcel accelerators"

Since August, two new lorries have been cruising the Hamburg DESY campus as "Teilchenbeschleuniger" (particle accelerators). The DESY transport service uses these prominently labeled vehicles to deliver all kinds of goods at the Hamburg premises and also to carry out small removals. Occasionally, they also transport goods in the Hamburg city zone or to the European XFEL to Schenefeld. The project is currently limited to a period of three years. All DESY staff members can reach this service at: **transport@desy.de**

Ofer Aharony from Weizmann Institute, Israel, at the blackboard in the DESY auditorium.

Pulling Strings

String Theory Summer School attracts talents from around the world

By Manuel Gnida

Visitors are anything but a rarity at DESY. Over 3000 guest scientists come to Hamburg's accelerator facilities annually to pursue their research. When approximately 120 students attended the "International School on Strings and Fundamental Physics" in July, it was therefore less about the number of participants – it was the participants themselves that turned the summer school into an outstanding event. "We had students from all continents," says Hamburg University scientist and main organiser Marco Baumgartl. "A few participants came from countries whose scientific institutes cannot afford paying for international conferences or schools." Thanks to funding from the German Academic Exchange Service DAAD, the PIER partnership between Hamburg University and DESY, and the Hamburg excellence cluster LEXI, the organisers were able to provide applicants from economically underprivileged regions with travel grants.

Organisers and participants alike benefitted from the event. "Students had the opportunity to expand their network, and the organisers got in touch with new talents that are hard to reach otherwise," Baumgartl points out. Take Bryan Larios, for example, a master student from Honduras. "I wish to find a PhD position, and the summer school will enrich my CV," Larios says. "I noticed at the summer school that it is possible for students from very poor countries to work at centres with high educational standards. One only needs to be given the chance."

The school covered the fundamentals and advanced topics of String Theory, with internationally renowned scientists holding lectures and tutorials. Among the school's highlights were the student presentations, generating interesting discussions and potential future collaborations. Nobody could summarize the event better than Liliana Vazquez Mercado, a PhD student from Mexico. "The school was terrific: full of excellent speakers and interesting people from around the world. DESY was the perfect place to have this experience."

INFO

http://sfp.desy.de

HELMHOLTZ ASSOCIATION

Energy roadmap

On behalf of Greenpeace International, experts from the German Aerospace Center DLR developed a scenario for a global sustainable energy supply. The energy [r]evolution study shows ways in which renewable energy sources can guarantee secure, sustainable energy supplies by 2050, with 80 percent of the primary energy obtained from renewable energy sources. If this is possible, the emission of energy-related carbon dioxide could be reduced from nearly 28 000 million tons in 2009 to around 3080 million tons in 2050. Currently, energy supply is still based on more than 80 percent of fossil energies. Until 2050, 94 percent of the global electrical power could come from renewable sources. Wind power, photovoltaic and geothermal energy alone could cover 60 percent of the global energy demand.

"With the 2012 scenario, we were able to show that it will be possible to move away from the use of oil and gas resources even faster than in our 2010 calculations," explains Thomas Pregger from the DLR Institute of Technical Thermodynamics, project leader of the scenario. Greenpeace used the scenario to show that secure energy production is possible without oil drilling in the Arctic or the exploitation of oil shale and shale gas.

www.helmholtz.de/hermann

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