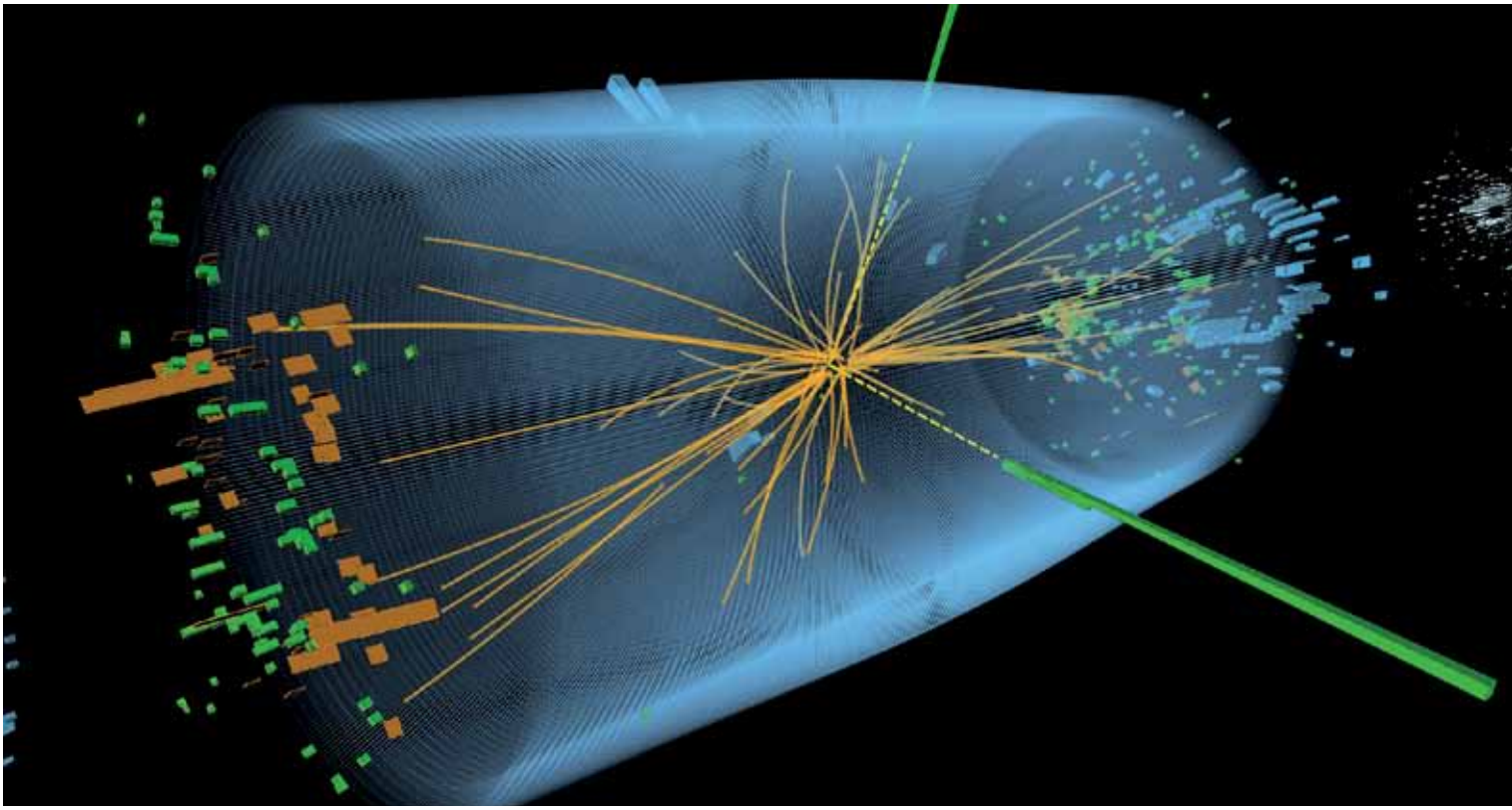
DESY inFORM.

07+08|12
Newsletter of the
Research Centre DESY

Higgsteria: new particle observed at the LHC

Higgs seminar causes euphoria in the DESY auditorium



A possibility of how a Higgs can be spotted in the detector: by decaying into two photons (yellow dots and green lines)

A packed auditorium at DESY and a live connection to CERN – something big must be happening. In fact, the seminar "Update in the search for the Higgs boson" was broadcast from CERN to the whole world, including a two-way link to Melbourne, host of the ICHEP 2012 conference. This rather modest hid a scientific sensation that was only revealed on 4 July at 9 a.m.: scientists have observed a new particle at both LHC detectors ATLAS and CMS. It could possibly be the long-sought Higgs particle which could help to explain how elementary particles obtain their mass.

"What is looming here, I think, looks like the discovery of the century," DESY particle physics director Joachim Mnich enthuses.

Since 2010, protons are accelerated to highest energies and brought to collision in the 27-kilometre Large Hadron Collider LHC. At the huge detectors installed around the collision points, scientists from ATLAS and CMS have recorded about two quadrillions of these collisions up to now and presented their preliminary analysis at this seminar. During the live broadcast, many of the contributing scientists sitting in the jam-packed DESY auditorium were just as excited as the attending journalists.

After all, many years of work precede these results and nobody knew the results of the other team, so there was great applause when the spokes-persons of both experiments talked about the observation, with a probability of nearly two millions to one, of a new boson in the mass region around 125 to 126 giga-electronvolts.

"It was really exciting, we also did not know our collaboration's result until shortly before because the last data

CONTINUED ON PAGE 2

DIRECTOR'S CORNER

Dear colleagues,

"Herr Scherf, what's up with DESY finances?" This is a question I constantly have to deal with as director of administration. 2012 is a special year. We are preparing the next evaluation of the Helmholtz Association, with financial effect from 2015, and we still do not know some of the essential boundary conditions.
Operation of the European XFEL will cost a lot of money from 2015 onwards. The distribution of the German contributions is still an open question. DESY offered to provide part of its basic funding for operation of the European XFEL. However, a contribution of more than 10 million euros would substantially curb the possibilities of the DESY research programme. Until the end of the summer break, we will discuss our participation with the Federal Ministry of Research and the Helmholtz Association.
Considerable financial problems loom because of a simple tax issue. The Federal Central Tax Office currently inspects our colleagues at Jülich and at the DLR. The entrepreneurial status of these research institutes is being challenged. The Federal Finance Ministry's position now is that fundamental research should no longer benefit from its special entrepreneurial status. This means that, for the first time, DESY might have to pay value-added tax for all purchases. This is an enormous financial risk for current projects and it creates a deficit for DESY amounting to about 10 million euros per year. Nevertheless, we believe that we can avert this risk or get compensation from our funding bodies.
Last but not least: the financial situation of the federal and state governments is very tight. Difficult times await us, forcing us to find our own solutions to financial challenges. Returning now to the initial question: I can verify that in 2012, DESY has a sound budgetary position and I can guarantee that we will make every necessary effort to make sure that we will have enough water under the keel also in the coming years to sail away and leave the international competitors behind.
At the beginning of this summer, I wish you to enjoy many carefree and sunny hours.

Yours,
Christian Scherf

were only available ten days before the presentation," said Kerstin Tackmann, head of a young scientists' group at DESY doing Higgs physics at the ATLAS experiment. She too worked day and night and evaluated data until the very end.

The spokespersons of the experiments are still very reluctant to confirm that this particle is the expected Higgs, but CERN Director-General Rolf Heuer said: "As a layman, I would say: I think we have it." To definitely find out if this is the long-sought Higgs particle or rather an exotic twin, further analyses are necessary. Particles emerging from collisions only exist for a very short time and can only be identified through their decay products in the gigantic detectors. Depending on how often the new particle decays into which kinds of other particles, scientists will determine whether this is the Higgs particle as predicted in the Standard Model, or something else.

Crowds in the DESY seminar wait for the results presented during the broadcast of the seminar.

"The main part of our work still remains to be done," said Kerstin Borras, head of the DESY CMS group. "We have now observed a new particle, but before we can definitely say what it is, we must study in detail the properties of this particle."

By the end of July, the scientists will announce first updates, followed by the publication of their results. But for now, a magnum bottle of champagne was popped in the DESY auditorium to celebrate the discovery. *(gh)*

INFO
www.weltmaschine.de (in German)

The benefits of science

ERF Workshop at DESY on the socio-economic relevance of research infrastructures

By Frank Lehner

Like no other cultural asset, science has profoundly shaped our modern world. Major research institutes like DESY providing large-scale scientific facilities, for example X-ray radiation sources for users, represent the cornerstones of a modern science system. These sites of scientific excellence and high technology attract top-level researchers of various disciplines from all over the world and, with their facilities, offer excellent training and further education possibilities – not only for students and young scientists but also for numerous engineers and technicians.

More than 120 participants from 20 countries came to the workshop in Hamburg.

Nevertheless, in times of limited funding and in the light of enormous challenges in the field of energy, climate and environment, financial contributors as well as the public quite rightly ask for the direct benefits for and the actual impact on economy and society.

All people involved are aware that research is of great importance for the future of our society; however, a complete methodical, not to mention a quantitative, description and assessment of all direct and indirect socio-economic effects is still missing. Previous studies, for example, only consider part of the economic aspects or are restricted to individual case studies or illustrative examples.

These are often impressive enough: Wilhelm Pfähler from the University of Hamburg for example investigated the regional and sectoral demand effects caused by the construction and operation of the new European XFEL X-ray laser and, on the basis of experiences made with the DESY particle accelerator HERA, he quantified jobs and income effects concerning supply and high-technology enterprises. Assuming German construction expenditures for the European XFEL of 77 million euros per year over a period of eight years, this will produce a turnover of about 120 million euros, 56 million euros of income and 1400 secure jobs throughout Germany every year. About half of these effects are not specific for the project but are produced elsewhere.

Equally important are the effects in the field of training and further education, i.e. the creation of "human resources". These contributions of the research centres are a significant asset for the economy and the region. About 100 doctoral theses at DESY every year – 40 per cent of the graduates continue their career in industry – speaks for itself, as well as 700 young scientists working in the environment of DESY.

Moreover, science drives innovation; this is manifested through new technologies, spill-over effects, spin-offs or technology parks. Last but not least, science is a public cultural asset that produces a social and cultural value, not only with numerous popular science activities and initiatives at research centres.

A pan-institutional working group of the European Association of National Research Facilities (ERF) will now compile studies, experience reports and analyses in the field of socio-economic relevance and develop a methodical structure. This was agreed at the two-day ERF workshop on "The Socio-Economic Relevance of Research Infrastructures" that recently took place at DESY with more than 120 participants from 20 European and some non-European countries. The ERF is the umbrella association of European research centres, currently representing 18 laboratories including DESY.

The idea of the Hamburg workshop was to bring together numerous experts from different scientific disciplines with representatives from research policy, regional development and economy to clarify the multifaceted aspects of the socio-economic effects of research institutions and to define first steps towards a mutual methodical approach.

Spokespersons of research institutes, funding agencies, industry, the OECD and other institutions shed light on many facets of social, cultural and economic interaction between research centres and society or economy. The event greatly benefitted from its interdisciplinary composition. However, we are still a long way from a systematic compilation or empirical investigation of all socio-economic impacts of research centres. Some of the effects are measurable; some can now only be roughly described. In this case, the saying of Albert Einstein applies here: Not all that can be counted counts, and not everything that counts can be counted.

INFO

http://erf.desy.de/workshop

Technology for industry

The Helmholtz Association has decided to promote commercialisation of electronic systems developed at DESY and finance this through the Helmholtz Validation Funds. In the two-year four-million project "MTCA.4 for Industry", the electronic system originally developed for the linear accelerators FLASH and European XFEL – the so-called low-level RF system – is now prepared for application in industrial enterprises and other large-scale research projects.

For the control of superconducting linear accelerators, DESY scientists have developed control hardware which – after measuring the parameters of a traversing particle bunch – already acts on the following particle bunches in the same particle jet. However, it is necessary to process very quickly a wide range of data in parallel. In their development, the electronic cards that are based on the new electronics standard MTCA.4 (Micro Telecommunications Computing Architecture) proved to be true all-rounders. They cannot only process analogue and digital signals; the system also reads out up to 100 parameters in real-time with a rate of several 100 MSPS (million samples per second) and it can be operated and maintained by remote control. It provides a considerable scalability and it is applicable and extendable from the smallest units up to complex gigantic systems. These modules are installed in standardised crates and can be combined in different ways and maintenance and replacement is possible during operation.

"These components developed at DESY are not only required for basic research and for the new accelerator projects; already now they are also sought after and urgently needed by industry," said Katja Kroschewski, head of DESY technology transfer. Together with the system developers from the DESY groups MSK, MCS 4 and FEB, DESY-TT submitted the proposal for this validation project to the Helmholtz Association. *(tz)*

Construction start of CTA prototype

Model of future gamma ray observatory

A traditional sod cutting ceremony on 25 June in Berlin started the construction of the first telescope prototype of the Cherenkov Telescope Array CTA. The model of the medium-sized of three different CTA telescope types will be built at the Adlershof research campus and completed by the end of the year. The CTA – its location has not yet been determined – is a facility to measure light of highest energies, and it is one of DESY's future projects. CTA will observe thousands of natural particle accelerators in the cosmos with unprecedented sensitivity, thus becoming the gamma astronomy observatory of the future.

The CTA consortium comprises more than 1000 members from 27 countries worldwide. DESY in Zeuthen is responsible for the design and construction of the mechanical structures and the drive systems of the telescope with a 12-metre mirror surface diameter, and it coordinates the complete construction of these telescopes. Moreover, DESY makes substantial contributions including controls and monitoring of the planned telescope array, electronics, optimisation of CTA performance as well as computing-intensive simulations and analyses.

Christian Stegmann from DESY in Zeuthen and Anke Kaysser-Pyzalla from Helmholtz-Zentrum Berlin jointly opened up the construction site.

The foundation of the mechanical prototype of the medium-size telescope with a mirror surface area of a total of 100 square metres will be laid in July, followed by the mounting of the individual components. "After this, a data taking programme of several months will be carried out to understand the properties of the prototype in detail, to optimise the drive and security systems, and calibration aspects," Stefan Schlenstedt outlined the task profile for the coming months. *(ub)*

INFO

Cherenkov Telescope Array
www.cta-observatory.org

Surfing on plasma waves

New virtual institute for plasma acceleration at DESY

The so-called plasma wakefield acceleration has the potential to accelerate particles to highest energies over very short distances, thus offering a promising technology for future accelerator applications. The Helmholtz Association now decided on funding a virtual institute at DESY to do basic research to explore the possibilities of using the extremely high electric fields created in a plasma to reliably accelerate high-energy electrons.

In a plasma, a highly excited state of ionised matter, electrons move freely between the atomic nuclei and produce enormous electrical fields – ideal to accelerate charged particles. The problem is that it is necessary to shoot a particle bunch into the plasma at exactly the right time when it is accelerated; an experiment which so far has not been carried out successfully. This is one of the topics of the new virtual institute which involves the University of Hamburg, Max Planck Institute in Munich, John Adams Institute (Great Britain), as well as the accelerator centres SLAC, LBNL (both USA) and CERN. In various experimental setups, the scientists will inject the electron beam of the FLASH II accelerator into a plasma cell, thereby further accelerating it with the plasma.

"With FLASH, we have the ideal facility to make a big step forward with this kind

of research," says Brian Foster, spokesman of the virtual institute. "However, we want to reliably accelerate not only single electrons but the whole bunch. To achieve this, we still have to put a lot of effort into our beam diagnostics – to synchronise the plasma and electron beam, femtoseconds make the difference."

For their cooperative work in the virtual institute and for the acquisition of appropriate measuring instruments, the scientists applied funds of 3 million euros. For the five-year funding period, they plan several experiments which go hand in hand with the construction of the FLASH II beamline. First beam threading experiments will start in 2013. *(tz)*

DORIS reveals ozone killer from volcanic eruptions

Analysis of up to 70 000-year-old volcanic minerals from Nicaragua

Volcanic eruptions can cause large holes in the ozone layer. This is concluded from the analysis of Nicaraguan volcanic minerals by a team of Helmholtz scientists from Kiel and Hamburg. Using a new X-ray technology at DESY in Hamburg, the scientists were able to estimate the amount of bromine in volcanic gases.

The team headed by Steffen Kutterolf from GEOMAR Helmholtz Centre for Ocean Research Kiel investigated 14 volcanic eruptions in Nicaragua over the past 70 000 years. Their main focus was on the amount of chlorine and bromine in the volcanic gases. Both elements are halogens that deplete the ozone layer when they reach the upper level of the stratosphere.

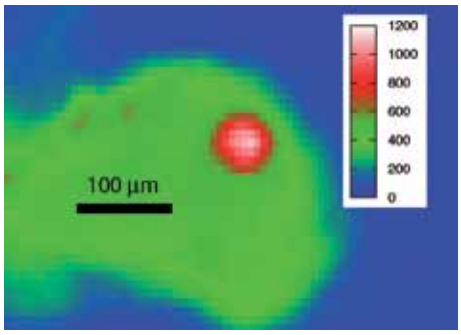
With DESY's X-ray source DORIS, the scientists X-rayed tiny glass inclusions in minerals which crystallised in the magma chambers during past eruptions. These inclusions which are often smaller than 0.1 millimetres store the composition of the melt at that time.

"The X-ray light stimulates the chemical elements in the inclusions to emit light," DESY scientist Karen Appel illustrates the investigations. "Each element fluoresces at different and typical wavelengths – this way we can identify it. The intensity of the light allows determining the element contents." The scientists compared the results with the composition of lava rocks which had formed at the corresponding eruptions. The difference allowed calculating the gas content.

Stratovolcanoes as Mount St. Helens can spew gas more than 20 kilometres up into the atmosphere.

(Photo: U.S. Geological Survey)

The analysis of 14 Nicaraguan eruptions showed that the bromine and chlorine concentrations in the stratosphere jumped to levels that are equivalent to 200 percent to 300 percent of the 2011 concentrations of those gases. The Upper Apoyo eruption 24 500 years ago, for example, released 120 megatons of chlorine and 600 kilotons of bromine into the stratosphere.



Distribtion of bromine in a sample with a glass inclusion.

"When a prehistoric eruption releases bromine and chlorine together with sulfate aerosols into the atmosphere, this can lead to a massive depletion of the ozone layer," GEOMAR meteorologist Kristin Krüger emphasises. She presented her studies at a scientific conference in Iceland.

Ozone depletion can affect large areas of the world because the volcanic gases are carried across the globe – even to polar regions. "The intensity of the chemical ozone layer depletion is a question for future research to address," said Krüger. Some volcanic gases can last in the stratosphere up to six years, she added, although the most significant impacts from eruptions like Mount Pinatubo in 1991 in the Philippines were within the first two years.

"The next step in the research is to investigate how much damage to the ozone layer the volcanic gases caused in the past to determine the damage that future subduction eruptions might produce," Kutterolf points out. *(tim)*

Boring completed

The European X-ray free-electron laser European XFEL reached an important milestone: the construction of the network of tunnels, nearly 5.8 kilometres from Hamburg-Bahrenfeld to Schenefeld in Schleswig-Holstein, is now finished. The tunnel builders celebrated the last arrival of the tunnel boring machine AMELI with tunnel patroness Cordelia Andreßen and AMELI patroness Christiane Küchenhof.

WHAT'S ON AT DESY

July

4 Special Seminar
Update on the search for the Higgs boson
DESY, Hamburg, auditorium, 9 h

13 Public Lecture
Lachen Sie mit Stan und Olli – Physik macht Spaß
Metin Tolan, DESY, Hamburg, auditorium, 19:30 h

15 SRI 2012 Satellite Meeting
(http://science-at-fels-2012.desy.de)
Science at FELs 2012
DESY, Hamburg, auditorium

30 July-1 August Conference (www.qq12.org)
Mathematical Aspects of Quantum Field Theory and Quantum Statistical Mechanics
DESY, Hamburg, auditorium, 9-19 h

August

6-8 Symposium (www.desy.de/2012vhess)
100 Years Cosmic Rays – Anniversary of Their Discovery by V.F. Hess
Bad Saarow/Pieskow

10-15 Symposium (www.desy.de/isvhecri2012)
International Symposium on Very High Energy Cosmic Ray Interactions
Berlin-Brandenburg, Akademie der Wissenschaften, Berlin

22 Series of lectures „Gesund bleiben"
Hirndoping? Neuroenhancement: Hirnleistung mit Medikamenten steigern?
Dr. med. Martin Eichenlaub
DESY, Hamburg, bldg. 1b, seminar room 4a, 16 h

22 5 years Science Café DESY (http://sciencecafe.desy.de)
100 Jahre Röntgenstrukturanalyse – Von Max von Laue bis zum Röntgenlaser
Helmut Dosch, DESY Bistro, 17 h
Please register: science.cafe@desy.de

September

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

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

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

All current events: www.desy.de/events

100 years since the discovery of cosmic rays

Victor Hess discovered cosmic radiation in 1912 – anniversary symposium in Brandenburg

By Michael Walter

When on 7 August 1912 Victor Franz Hess took the train to Berlin, he brought along a discovery with far-reaching consequences which at that time he surely was unaware of. At midday, with his hydrogen balloon, the Austrian physicist had landed in Bad Saarow/ Pieskow in the state of Brandenburg. At this seventh balloon voyage equipped with three ionization measuring instruments, Hess identified the existence of a pervasive cosmic radiation in 5300 metres altitude above the Schwieloch Lake in the southeast of Brandenburg. Only later it became evident that this so-called cosmic radiation was a particle shower. This discovery which 24 years later won him the Nobel Prize in physics became among others a cornerstone of a completely new field of research of elementary particle physics.

DESY, the University of Potsdam astrophysics group and the Max Planck Institute for the History of Science in Berlin jointly organise a symposium on the 100th anniversary of this discovery. From 6 to 8 August, scientists from all over the world will meet in Bad Saarow/ Pieskow to present and discuss the development of various sub-areas ranging from the historic beginnings up to ideas for new projects. A memorial stone will be unveiled, participants may book a balloon ride, DESY is preparing a poster series and a brochure on the chronology of the scientific milestones, and there will be an exhibition of the electroscopes that were then used all over the world to carry out ionisation measurements.

Victor Hess in his laboratory, 1915

In fact, a hundred years after its discovery, cosmic radiation is far from being unravelled and even its origin is still not understood in detail. “The universe is full of natural particle accelerators, for example supernova explosions, in binary star systems or active galactic nuclei. So far, we only know 150 of these objects and we have an initial physical understanding of these fascinating systems,” said Christian Stegmann, head of the DESY institute in Zeuthen. New observatories as the international Cherenkov Telescope Array (CTA) – DESY is currently building the first prototype – will improve the physical understanding. “The Cherenkov Telescope Array will observe thousands of these accelerators with unprecedented sensitivity,” Stegmann points out.

The history of discovery of cosmic rays has not been as straightforward as we might think today. In contrast to X-rays with its accidental discovery that was immediately acclaimed and after a few years revolutionised medical diagnostics, cosmic rays needed more than 15 years to become commonly accepted among fellow scientists. With the Nobel Prize in Physics awarded to Hess in 1936, the dispute was settled which in 1926 Robert Millikan provoked with his claim to have clearly proven the existence of cosmic rays. Nevertheless, it is still being discussed today if this discovery was already made in 1910 by Albert Gockel in Switzerland or Domenico Pacini in Italy, or perhaps definitely verified not until 1914 by Werner Kolhörster. He started with a balloon in Bitterfeld and was able to measure an exponential increase of radiation up to an altitude of 9300 metres.

The first decades of the 20th century are full of missed discoveries. In a publication of 1904, Berlin meteorologist Franz Linke describes the results of his measurements made during his balloon voyages in the years of 1902 to 1903. In six trips to an altitude up to 5600 metres, he too measured the ionisation of the atmosphere. His findings that ionisation at first decreases with the distance from earth, has the same value at 2000 metres again and quadruples at 5600 metres are completely compatible with Hess’ measurements. However, Linke did not suspect

It might have been like this: photomontage of a balloon above the Scharmützel Lake in Brandenburg

that the increase was induced by extra-terrestrial radiation.

One year before Hess' discovery, Charles Thomson Rees Wilson in England put into operation his cloud chamber and took photographs of alpha and beta particle tracks. In his publication, there are images of two long tracks of low ionisation, which Wilson interpreted as beta tracks in an early stage of existence. Very probably these were cosmic particles, as Paul Kunze later wrote. In fact, Kunze himself was not exempt from having missed a discovery. In the same publication, he described two tracks he had photographed in his cloud chamber in Rostock in 1932. One of it was a muon which was discovered four years later by Seth Henry Neddermeyer and Carl David Anderson.

In the second half of the 1920s, scientists started to study the properties of cosmic particles. Newly developed detectors as Wilson's cloud chamber and the Geiger-Müller counter, and the development of the coincidence circuit by Walter Bothe led to spectacular discoveries. With this it was possible to show that – contrary to previous assumptions – cosmic radiation is particle radiation generating air showers in the atmosphere.

The discovery of the positron by Anderson in 1932, the electron's anti-particle introduced by Paul Dirac, initiated the beginning of elementary particle physics. In the 15 years that followed before commissioning the first particle accelerator in Berkeley, particle physics findings were made with cosmic particles. In 1934, Hideki Yukawa developed a theory of nuclear forces which for the binding of protons and neutrons required a particle in the nucleus with a mass between the one of the electron and the proton. It was assumed that this particle had been discovered in 1936. But the penetration capacity and the lifespan of the "mesotron" (later called muon) did not match with the expected properties of the Yukawa particle. Only in 1947 this problem was solved with the discovery of the pion. Donald Perkins and Cecil Frank Powell were able to verify pions in photographic packet emulsions irradiated with cosmic particles.

At the beginning of the 1950's, elementary particle physics changed to experiments at accelerators. Astroparticle physics at first focused on the investigation of high-energy air showers. For a long time, the origin of cosmic rays remained nebulous. In fact, their energy-rich electrically charged particles are deflected on their way through the cosmos by interstellar and intergalactic magnetic fields; therefore, the arrival direction on earth no longer points the way to its origin.

So far, only the small amount of energy-rich gamma quanta in cosmic radiation reveals something about the sources. Mainly with the help of imaging Cherenkov telescopes, astrophysicists developed methods to make a distinction between the very similar air showers of cosmic particles and gamma rays. Cherenkov telescopes as the one in Namibia named H.E.S.S. in honour of the discoverer of cosmic radiation, MAGIC on the Canary Island La Palma and VERITAS in the United States, with DESY participating, by now have detected more than hundred sources of high-energy cosmic gamma radiation. The planned CTA will continue this success story with so far unprecedented sensitivity.

INFO

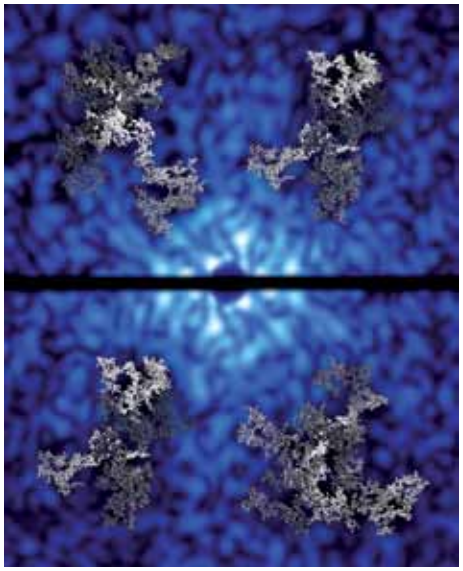
Symposium
„100 Years Cosmic Rays":
www.desy.de/2012vhess

Scientists measure soot particles in flight

Free-electron laser unveils structure of aerosol particles

Smog all over Shanghai. (Photo: Michael Bogan, SLAC)

For the first time, air-polluting soot particles have been imaged in flight down to nanometre resolution. The international team, including researchers from DESY, published their findings in the British journal "Nature". "For the first time we can actually see the structure of individual aerosol particles floating in air, their 'native habitat'," said DESY scientist Henry Chapman from the Center for Free-Electron Laser Science (CFEL) in Hamburg. "This will have important implications for various fields from climate modelling to human health."



Computer generated soot particles in front of an X-ray diffraction image. (Photo: Duane Loh et al.)

Aerosol particles like soot play important roles in a wide range of fields from toxicology to climate science. Despite their importance, their properties are surprisingly difficult to measure: Visible light doesn't provide the necessary resolution, X-ray sources are usually not bright enough to image single particles, and for electron microscopy particles have to be collected onto a substrate, which potentially alters their structure and encourages agglomeration.

Using the world's most powerful X-ray laser LCLS at the U.S. SLAC National Accelerator Laboratory in Stanford (California), the team captured images of 174 single soot particles floating through the laser beam. "We now have a richer imaging tool to explore the connections between their toxicity and internal structure," said SLAC's Duane Loh, lead author of the study appearing in this week's scientific journal "Nature".

The study focused on particles less than 2.5 micrometres in diameter. This is the size range of particles that efficiently transport into the human lungs and constitute the second most important contribution to global warming. Microscopic soot particles were generated with electric sparks from a graphite block and fed with a carrier gas of argon and nitrogen into a device called an aerodynamic lens, that produces a thin beam of air with entrained soot particles. This aerosol beam intercepted the pulsed laser beam. Whenever an X-ray laser pulse hit a soot particle, it produced a characteristic diffraction pattern that was recorded by a detector. From this pattern, the scientists were able to reconstruct the soot particle's structure.

"The structure of soot determines how it scatters light, which is an important part of understanding how the energy of the sun is absorbed by the earth's atmosphere. This is a key factor in models of the earth's climate," explained co-author Andrew Martin from DESY. "There also are many links between airborne particles around two micrometres in size and adverse health effects. Using the free-electron laser we are now able to measure the shape and composition of individual airborne particles. This may lead to a better understanding of how these particles interfere with the function of cells in the lungs."

A primary long-term goal of the research is to take snapshots of airborne particles as they change their size, shape and chemical make-up in response to their environment, explained Michael Bogan from SLAC, who led the research. "Scientists can now imagine being able to watch the evolution of soot formation in combustion engines from their molecular building blocks, or maybe even view the first steps of ice crystal formation in clouds." *(tim)*

INFO

Original publication:
"Fractal morphology, imaging and mass spectrometry of single aerosol particles in flight"; Duane Loh et al.; "Nature", DOI: 10.1038/nature11222

Laser synchronisation record at FLASH

Relative path difference of only one hundred sextillionth

DESY's X-ray laser FLASH has recently become home to one of the most accurate clock generators worldwide. The pulse generator of this synchronisation system is an extremely stable erbium laser. This pulse generator produces time stamps with an interval fluctuating within a range of only a few quadrillionths of seconds (femtoseconds). A substantial breakthrough was achieved by the FLASH synchronisation team of Sebastian Schulz by making two of these pulse generators keep an absolutely common mode over 35 hours. Normally during that period of time, lasers will diverge within the range of several hundreds of femtoseconds, due to environmental influences such as variations in temperature.

With a novel phase feedback procedure which was considerably advanced at DESY, it was possible to suppress this delay almost completely and to stabilise the clock at 1.2 femtoseconds. For large-scale accelerator facilities like the European XFEL X-ray laser, the demonstration of this relative path difference of only 10^{-20} is one of the most important prerequisites to provide absolutely synchronised time stamps to control the facility and above all for user experiments. Only this way, ultra-short laser pulses generated at FLASH and in the future at the European XFEL can optimally be used to investigate processes on the atomic level. *(tim)*

Lab setup for the ultra-precise synchronisation of two laser systems.

PETRA III with record X-ray vision

X-ray scanning microscope has world's best resolution

A novel microscope at DESY offers a record X-ray vision. Thanks to the extraordinary brilliance of DESY's X-ray source PETRA III, the microscope is able to image details having the size of up to ten nanometers – this is absolutely top-level. This kind of fine optical resolution is only possible at a few places in the world. This instrument was jointly built by a team of Christian Schoer from TU Dresden and DESY scientists, and funded by the federal ministry of research. It is already available to all users. Schroer's team describes this technology in the scientific journal "Applied Physics Letters" (DOI: 10.1063/1.4729942).

The X-ray scanning microscope technology is based on the so-called ptychography. This means that it does not deliver direct images of the investigated object but registers the diffraction patterns that are generated when the sample is scanned with a fine X-ray beam. An image of the sample is then created from all diffraction images. "With ptychography, you avoid the limited resolution of conventional microscopy," Schroer explains. The more details registered in the outer areas, the more accurate the image. With the enormous brilliance of PETRA III, the diffraction image is still discernible far out in these areas. Thus, the scanning X-ray microscope has at the minimum a resolution twice as high as possible in conventional microscopy. *(tim)*

NEWS

Excellence Initiative funds Hamburg Centre for Ultrafast Imaging

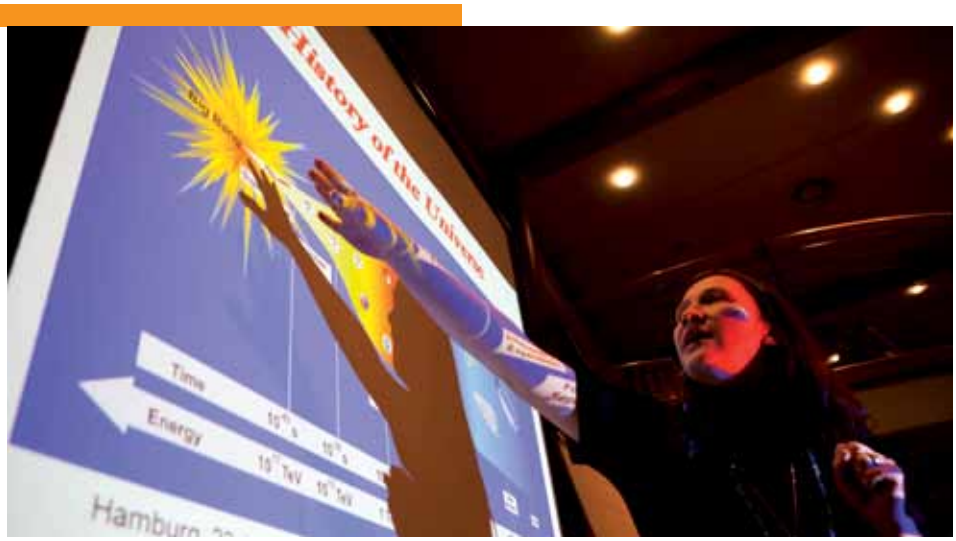
Success for physics in Hamburg: As from November, the Excellence Initiative of the German federal government and states will fund the Hamburg Centre for Ultrafast Imaging (CUI). This research cluster focusses on real-time observation of movements at the atomic level, e.g. in chemical reactions. The central goal is to investigate in detail and understand the dynamics of fundamental physical and chemical processes on all relevant length and energy scales, and specifically and precisely control them. The project proposal submitted by the University of Hamburg was developed in cooperation with DESY, CFEL and the European XFEL GmbH.

Lyn Evans to lead the new Linear Collider Organisation

The International Committee for Future Accelerators ICFA announced in June that it has appointed former LHC project leader Lyn Evans as new Linear Collider Director. He will take up office in summer 2013, when the International Linear Collider ILC has delivered the final version of its Technical Design Report. This report was the mandate and main goal of the ILC planning organisation GDE, and after its delivery, a new organisational structure will be put in place. Evans the overall director, reporting to a new oversight committee, will head three different sections: ILC, CLIC and Physics & Detectors, thus uniting the teams that are in friendly competition but have collaborated for a long time already.

Giulio Rampa Thesis Prize goes to Hamburg

Thomas-Paul Hack from the II. Institute for Theoretical Physics of the University of Hamburg was awarded the Giulio Rampa Thesis Prize. Hack's thesis "On the Back-reaction of Scalar and Spinor Quantum Fields in Curved Spacetimes" marked a breakthrough in the analysis of quantum effects in curved spacetimes and their cosmological applications. Hack will receive the award including prize money of 2000 Euros in December at a celebration opening the academic year at the University of Pavia in Northern Italy. The prize was established in 2011 in memory of the early deceased physicist Gulio Rampa.



Five years of Science Café DESY

Direct dialogue kindles enthusiasm for science

By Ilja Bohnet

Some ideas happen rather accidentally. Legend goes that Newton began to ponder gravitation when he was sitting under a tree and was hit by a falling apple. Science Café at DESY was born being after Waldemar Tausendfreund learned that such discussion and information platforms have already running successfully in England for years. Something like that should also be possible at DESY, he thought. Tausendfreund's idea was that DESY scientists would present all kinds of research topics and exchange views in close and direct contact with often very young people.

Rolf Heuer was the first to show up with a talk at the Science Café. He plucked a poster from a wall in the directorate's office, tucked it under his arm and went over to the bistro, where about 60 guests eagerly awaited the premiere. In typical Rolf Heuer style, the first speaker managed to get the public excited about physics. The young people obviously liked the way Heuer presented his topic, talked to them directly, made fun of himself and sometimes also of them.

For the recruitment of scientists at DESY as well for assistance on the content of the research topics, Tausendfreund could count on his colleagues Werner Brefeld (DESY-FS) and Britta Liebaug (DESY-PR). Although finding lecturers never was and still is not an easy task, the team is looking back at an impressive collection of topics. From the physics of knots, snowflakes as a mathematical winter miracle, the leap year rules up to the Higgs particle, the variety of topics at the Science Café DESY offered everything conceivable in the field of science and technology.

When Helmut Dosch looks back at 100 years of X-ray structure analysis in his talk on 22 August, the Science Café will look back at five successful years of scientific discussions. I am sure that Science Café DESY will continue successfully for many years, offering education for young people and scientific communication in close contact to people outside of DESY. This helps to create the important and essential basis to raise fascination for sciences. Thank you, Science Café!

INFO

More information:
http://sciencecafe.desy.de

HELMHOLTZ ASSOCIATION

A Zeppelin for climate research

Since May, the climate research Zeppelin PEGASOS is doing measuring flights. The first mission was a journey from Friedrichshafen to Rotterdam, the second goes to Italy, with measurements planned in the Po valley and above the Adriatic. In April 2013, the atmospheric researchers will embark on their third mission, travelling for two months towards the north of Europe. The mission routes have been coordinated with existing ground stations. This way, the researchers can directly compare flight data with ground measurements.

The campaign focuses on both aerosol particles and hydroxyl radicals, the atmosphere's "detergents". Hydroxyl radicals initiate the degradation of most of the pollutants and therefore are a measure for the atmosphere's cleaning power. Questions regarding the aerosol particles are: Where do they originate? How do they combine to form larger particles? What chemical and physical impacts do they have on the climate and on air quality? And what part do they play in recycling the natural "detergent"?

The campaign is part of the large-scale EU research project PEGASOS, with 26 partnering institutions from 14 European countries as well as from Israel investigating the correlation between atmospheric chemistry and climate change.

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