



A strong cooperation partner      Impetus for the region  
**researchers**      Training for top researchers  
Large-scale facilities for science      Research for the future  
**Innovations for society**

# DESY.

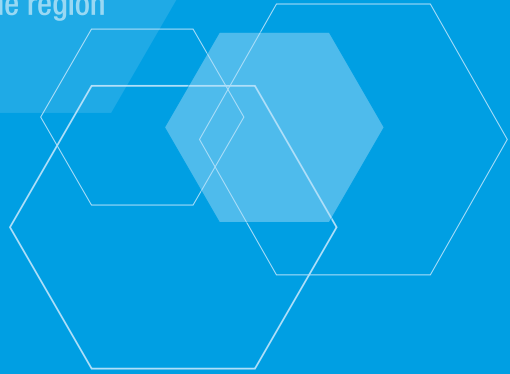
Deutsches Elektronen-Synchrotron  
A Research Centre of the Helmholtz Association





# A strong cooperation partner

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## Insight starts here

DESY is one of the world's leading accelerator centres. Researchers use the large-scale facilities at DESY to explore the microcosm in all its variety – from the interactions of tiny elementary particles and the behaviour of new types of nanomaterials to biomolecular processes that are essential to life. The accelerators and detectors that DESY develops and builds are unique research tools. The facilities generate the world's most intense X-ray light, accelerate particles to record energies and open completely new windows onto the universe.

That makes DESY not only a magnet for more than 3000 guest researchers from over 40 countries every year, but also a coveted partner for national and international cooperations. Committed young researchers find an exciting interdisciplinary setting at DESY. The research centre offers specialized training for a large number of professions. DESY cooperates with industry and business to promote new technologies that will benefit society and encourage innovations. This also benefits the metropolitan regions of the two DESY locations, Hamburg and Zeuthen near Berlin.



**RESEARCH**

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# RESEARCH FOR THE FUTURE

The research carried out at DESY is extremely diverse. The scientists who work here are looking for the tiniest building blocks of matter that make up our world, developing innovative high-tech materials and searching for new mechanisms of action for future medications. As one of Germany's largest research centres, DESY carries out fundamental research that creates new knowledge and new conceptual approaches. This research is the basis on which the challenges of the future can be mastered: issues such as energy supply, climate protection and healthcare require long-term thinking, sustainable solutions and new technologies.

Research at DESY focuses on three areas:

> **Accelerators**

DESY develops, operates and utilizes state-of-the-art accelerator facilities. Scientists from all over the world use these facilities to investigate the structure and function of matter.

> **Photon science**

Several of the world's best light sources are located at DESY. Their special X-ray radiation makes atomic structures and reactions in the nanocosmos visible.

> **Particle and astroparticle physics**

In global cooperations and large teams, DESY scientists investigate the fundamental building blocks and forces of the universe.





## High tech for highest energies

*In a global effort, DESY physicists are developing an innovative accelerator technology*

Together with 50 institutes from 12 countries, DESY has been developing a particularly effective accelerator concept – called TESLA technology – since the 1990s. Unlike conventional facilities, the TESLA accelerator elements are superconducting and therefore operate almost without any energy loss: the energy of the electromagnetic fields is transferred almost entirely to the particle beam. However, these superconducting elements function only under extremely cold conditions and are therefore installed in heat-insulated tubes. Inside these tubes, helium cools the temperature to approximately minus 271 degrees Celsius – a superlative refrigerator.

Today, the free-electron laser FLASH is based on TESLA technology. Starting in 2015, more than 800 superconducting accelerator elements will be used in the European XFEL X-ray laser. And a future linear accelerator for particle physics will also be based on this innovative concept. The international partners are currently working on making the TESLA technology even more powerful and cost-effective.

**“In our international team, we have developed an accelerator technology that is setting benchmarks worldwide.”**

*Dr. Hans Weise, accelerator expert at DESY*

# From niobium sheet to precision component

How a TESLA accelerator module is made



The metal niobium is smelted several times before being processed further.



At DESY, all the niobium sheets are gathered together and subjected to quality inspection.



A scanner checks the surface for impurities and unevenness.



The sheets are formed into accelerator elements.



Special 3D software makes it possible to take a virtual stroll through the accelerator before it even exists.



The accelerator elements are assembled in a cleanroom.



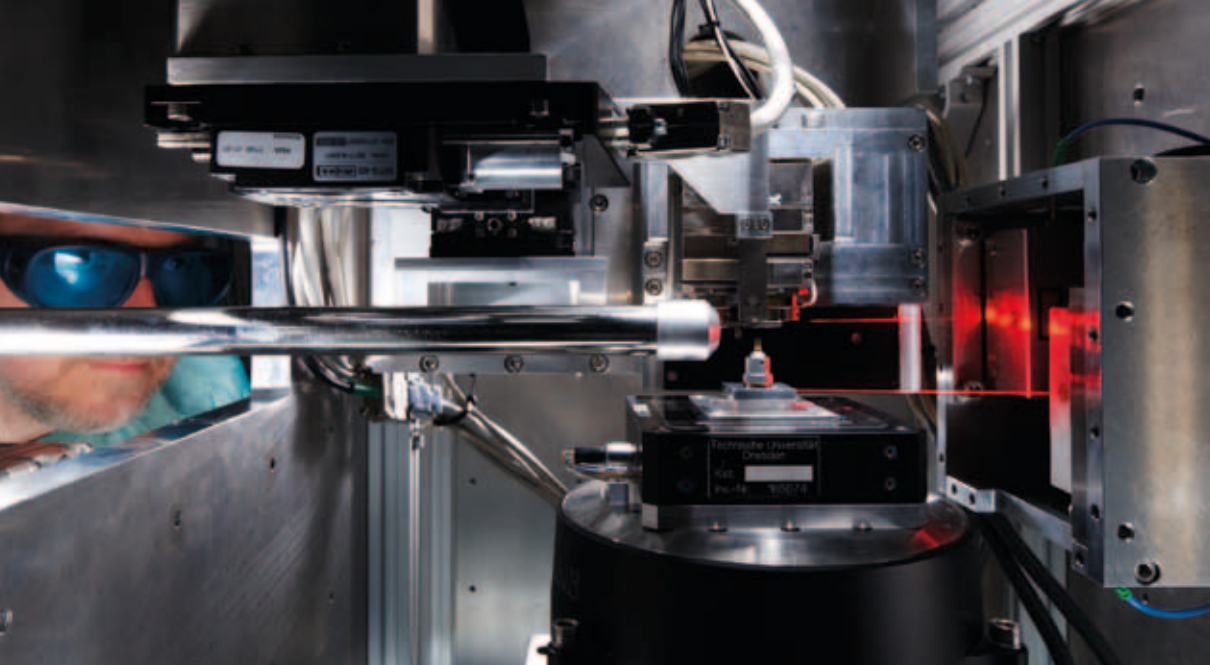
The individual elements are gradually becoming a string; eight of them are built into one accelerator module.



Helium lines and other components are fitted into the module.



The finished modules are installed in the accelerator tunnel.



## Materials and biomolecules

The nanocosmos in X-ray light

The light sources at DESY are based on particle accelerators and generate extremely intense X-ray radiation. These “super-microscopes” reveal the atomic details and the behaviour of materials and biomolecules – and form the basis for developing new technologies.

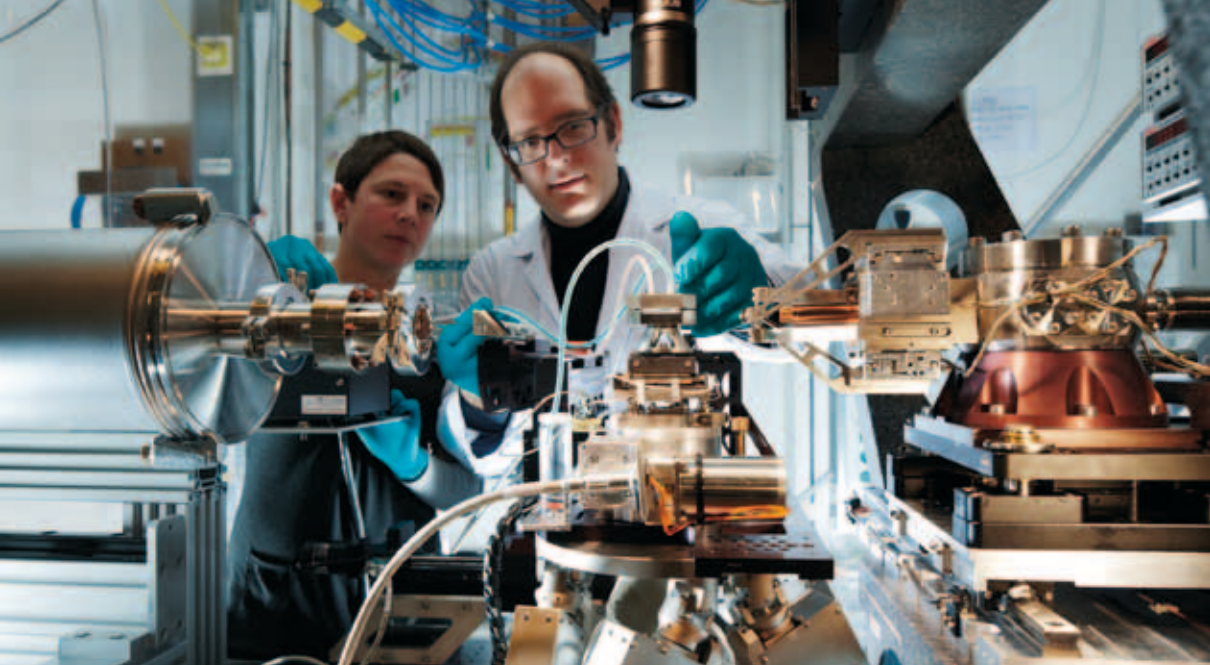
**“With PETRA III and FLASH, we have two of the world’s best X-ray sources for detailed studies of the structure and behaviour of matter.”**

*Prof. Edgar Weckert, DESY Director in charge of Photon Science*

One example is nanomaterials, i.e. materials with structures only millionths of a millimetre in size. They play an ever greater role in everyday life, with applications ranging from computer technology to extremely scratch-resistant surfaces and optimized therapeutic procedures in medicine. New energy-efficient materials for fuel cells and solar cells can be developed as well. Medical science also benefits from the interdisciplinary application potential of the DESY light sources: scientists elucidate molecular mechanisms that form the basis for pharmaceutical companies to develop new medicines.

With the construction and development of excellent light sources and interdisciplinary research collaborations, DESY is one of the world’s leaders in photon science.





## Golden age for solar energy

DESY research improves solar cells

The application possibilities for solar cells that are as bendable and inexpensive as plastic film are truly exciting. Windows could be lined with solar films that produce electricity, and solar-cell-coated backpacks could be used to recharge mobile phones and MP3 players. However, at present these organic solar cells are not particularly energy efficient and do not exhibit long service lives. DESY researchers are striving to improve their properties.

Organic solar cells are made of electrically conductive plastics that are fitted with electrical contacts. As a rule, the better the bond between the contacts and the plastic, the greater the amount of energy that can be reaped. A team led by DESY scientist Stephan Roth is using X-rays from PETRA III to examine how gold atoms and plastic bond. “The intense and extremely fine X-ray beam from PETRA III enables us to monitor the entire production process in detail,” Roth explains. “No other method will work here.”

The experts can watch more or less live how the gold atoms merge into nanoislands, which form the nuclei for the contacts. These observations give the researchers important clues as to how the production process can be optimized.





## Particles and the cosmos

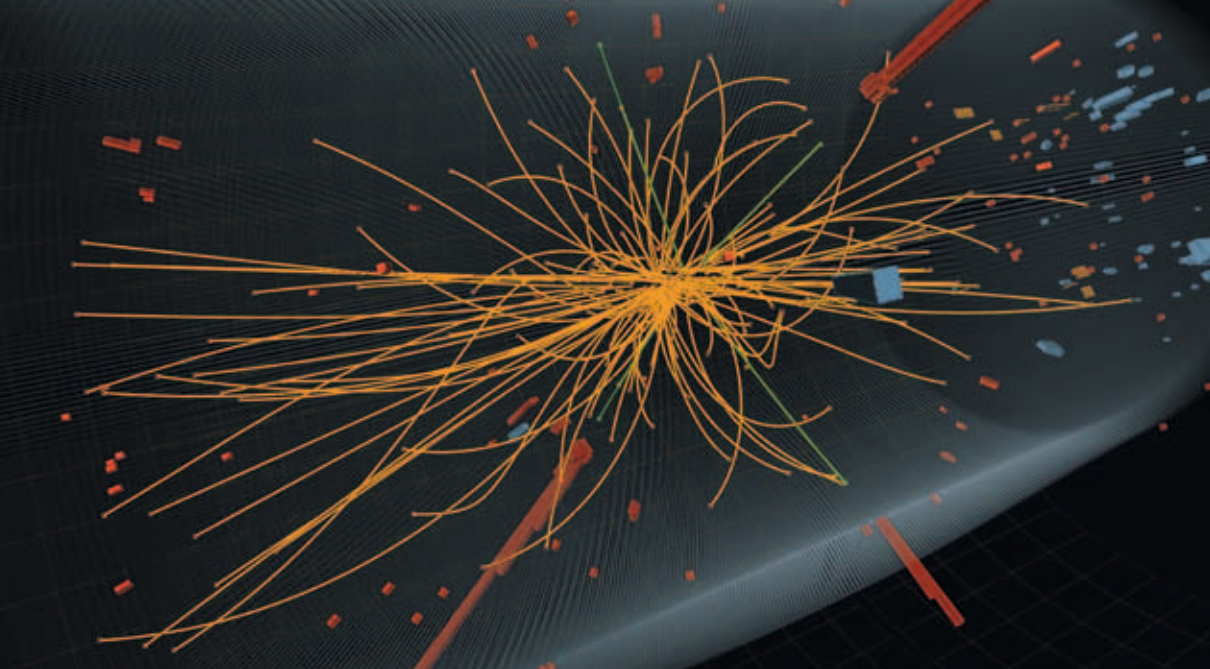
How does the universe work?

Particle physicists are investigating the fundamental mysteries of the universe: what holds the cosmos together, and how do particles acquire their mass in the first place? When DESY was founded in 1959, the primary task of the centre was to investigate the smallest particles. Over the decades, DESY has put into place central pieces of the mosaic of particle physics. With the PETRA storage ring, researchers discovered the gluon, the “glue particle” that holds the quarks together and without which there would be no atoms. Later, they used the HERA accelerator to investigate the proton with unprecedented precision. The surprising result: the inner workings of this particle, which is so important for our world, turned out to be much more complex than expected.

**“DESY’s particle physicists are searching for the basic building blocks of the universe as they work at the forefront of large-scale experiments around the world.”**

*Prof. Joachim Mnich, DESY Director in charge of High-Energy Physics and Astroparticle Physics*

Today, a number of DESY researchers are taking part in the large experiments at the LHC in Geneva, the most powerful accelerator in the world. Others are peering deep into the cosmos. Using spectacular detectors and telescopes, the experts are analysing exotic particles that come from far corners of the universe and could provide information about fascinating phenomena, such as black holes, exploding stars and inconceivably intense eruptions of radiation.



## In search of Higgs & Co.

The research centre CERN operates the LHC, the world's most powerful accelerator

It's the most ambitious project of particle physics: the Large Hadron Collider (LHC) at the CERN research centre in Geneva. The gigantic accelerator boosts protons to unprecedented energies and makes them collide head-on with one another. These collisions can give rise to exotic, short-lived particles that reveal what fundamental building blocks the world is made of. Complex detectors as large as office buildings monitor the proceedings. DESY physicists take part in these experiments, sometimes in leadership roles.

With its record-setting energy, the LHC is expected to answer some of the most exciting questions in physics, for example: how do elementary particles acquire their mass? According to the physicist Peter Higgs, the cosmos is permeated by a special field that offers the particles due resistance and thereby makes them "heavy". If the theory is correct, there have to be special particles, called Higgs bosons. And indeed, in the summer of 2012, the LHC quite likely detected such a particle.

But the largest scientific machine in the world could also detect entirely different, so far merely speculative phenomena. One fascinating result would be the discovery of SUSY particles, which could also provide an explanation for dark matter.

**"DESY is one of our most important partners, and its expertise has played a major role in the success of the LHC."**

*Prof. Rolf-Dieter Heuer, Director-General of CERN*





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# LARGE-SCALE FACILITIES FOR SCIENCE

Large-scale facilities make it possible to carry out top-level research and produce innovations. DESY's accelerators are super-microscopes that are in great demand internationally and can be used for a broad range of applications. Accelerators bring tiny charged particles to high energies and to speeds close to that of light. By causing the particles to collide head-on, particle physicists gain important insights into the nature of the fundamental building blocks of matter. Materials researchers, biologists and chemists, on the other hand, benefit from the extremely powerful and collimated X-ray radiation that the fast-moving particles emit. DESY's accelerators have a high reputation in both fields worldwide.

Three large accelerators dominate the DESY site today: PETRA III is the world's best storage ring when it comes to generating X-ray radiation; FLASH produces ultrashort pulses of "soft" X-ray radiation that make unique experiments possible; and beginning in 2015, the European XFEL will set a new world record by generating the most intensive X-ray flashes in history. This trio makes DESY the world's leading centre for X-ray experiments.



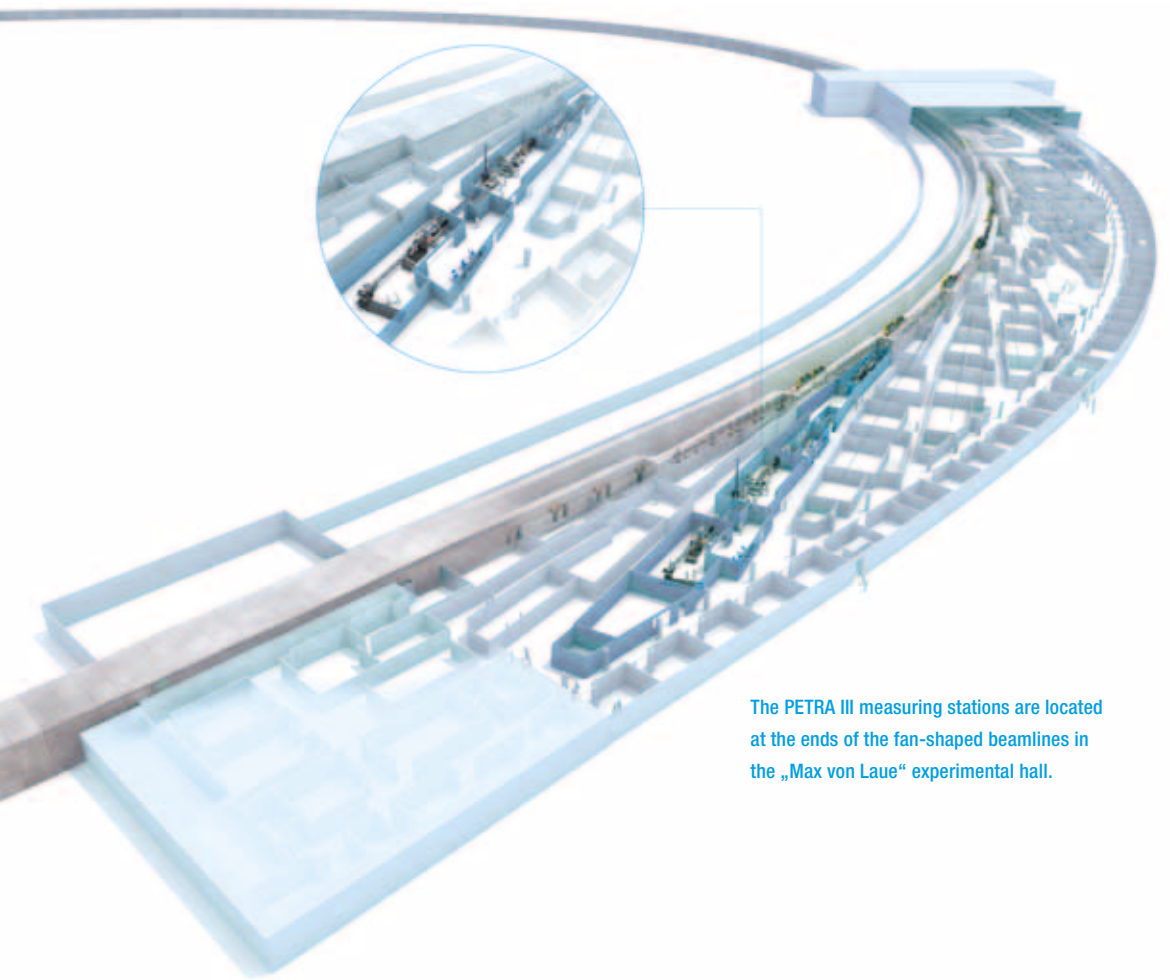
## Brilliant storage ring PETRA III

The world's brightest storage ring opens up new possibilities for nanoresearch

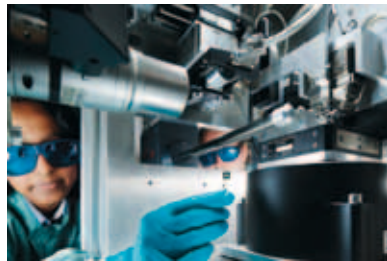
PETRA was the world's biggest accelerator when it was commissioned in 1978. It was used initially as a "collider" for particle physics experiments; later it served as the pre-accelerator for the even larger HERA ring. Following that, it was converted into the most brilliant radiation source of its kind: since 2010, PETRA III has been supplying X-ray radiation that is more powerful and tightly focused than anything produced by other storage rings worldwide.

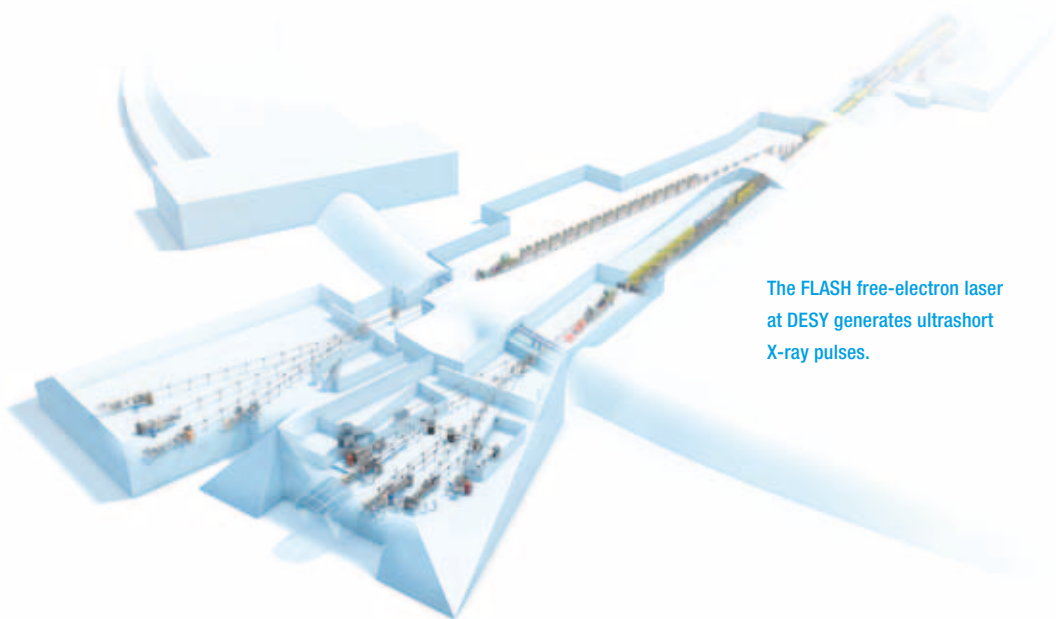
The special characteristic of PETRA III is the tightly collimated X-ray beams, which are up to 5000 times finer than a human hair. These make it possible to study extremely small samples, such as tiny protein crystals or nanocrystals that will be used in the hard drives of the future. PETRA III can also generate very "hard" (i.e. short-wavelength) X-rays, which penetrate deeper into materials than other X-ray radiation. This is an important advantage when analysing new metal alloys such as those being developed for the automobiles and aircraft of tomorrow.

Researchers from around the world are extremely interested in PETRA III. This is why the ring is being further expanded to include two new experimental halls with additional measuring stations that will be ready by 2014.



The PETRA III measuring stations are located at the ends of the fan-shaped beamlines in the „Max von Laue“ experimental hall.





The FLASH free-electron laser at DESY generates ultrashort X-ray pulses.

## Record X-ray pulses at FLASH

The vanguard of a new laser generation is located in Hamburg

For decades, scientists could only dream of a laser that would produce highly intense, ultrashort X-ray flashes. This vision is now a reality at DESY: since 2005, FLASH has been supplying high-intensity laser pulses consisting of “soft” (i.e. relatively long-wavelength) X-rays for research purposes. The FLASH X-ray bursts have special properties. They are a thousand times more powerful than the pulses emitted by comparable conventional lasers, and they are also much shorter than the X-ray pulses produced in a storage ring. This enables scientists to monitor extremely rapid processes in detail, and answer questions such as: What exactly happens during chemical reactions? What occurs when a metal melts?

The international research community is tremendously interested in FLASH, which is why the facility is being expanded. A second tunnel for generating X-rays is being built branching off from the accelerator tunnel. The X-ray flashes will be guided into a new experimental hall with several measuring stations that offer plenty of space for additional experiments.



The FLASH accelerator tunnel (left) and experimental hall (right)





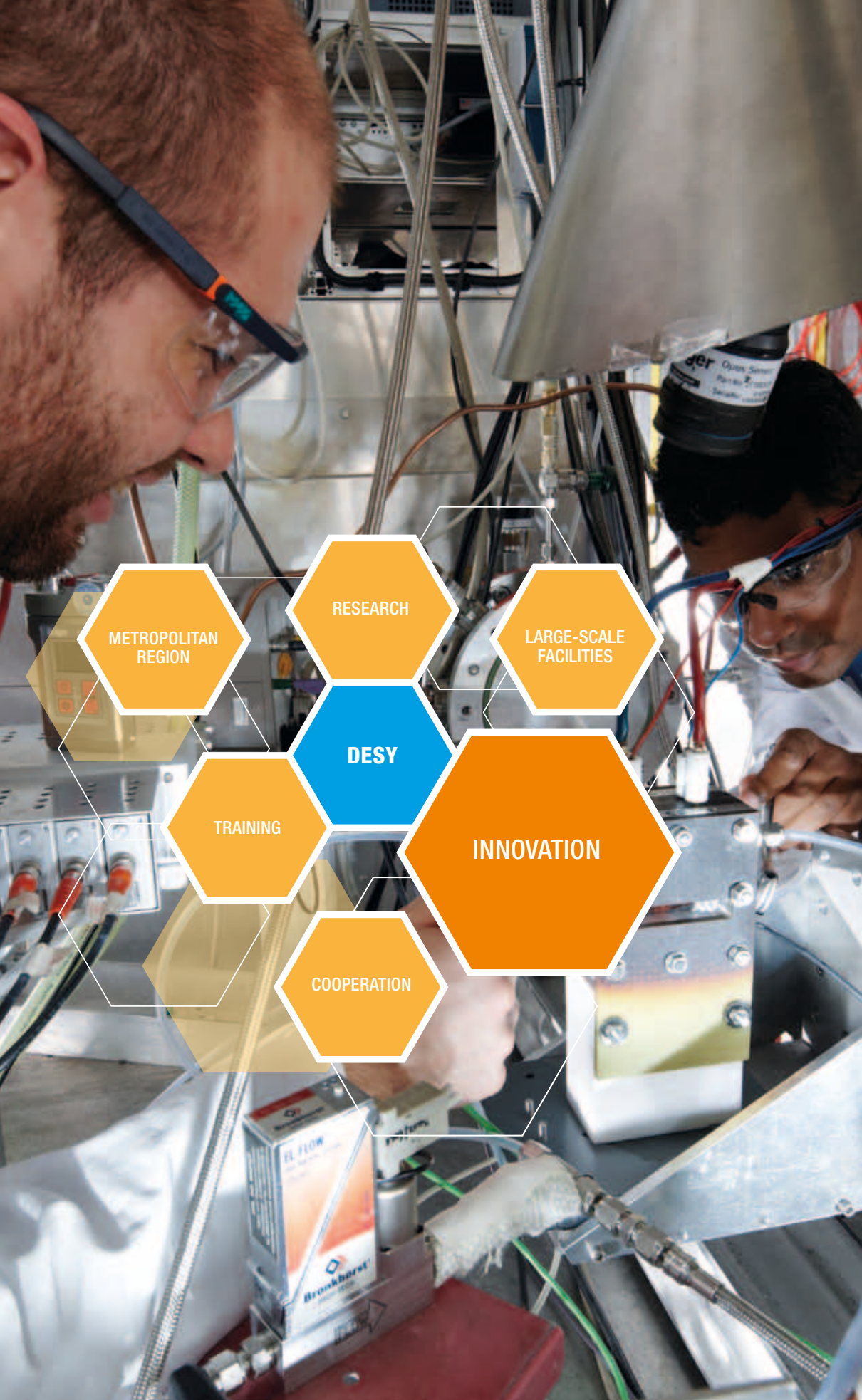
The European XFEL X-ray laser runs from the DESY site to Schenefeld, where the experimental stations are located (pictured).

## A superlative X-ray laser

The European XFEL – a unique research facility – will go into operation in 2015

In 2015, a spectacular laser facility will begin producing X-ray flashes that are shorter than a trillionth of a second and billions of times brighter than the radiation generated in storage rings. The European XFEL is a gigantic 3.4-kilometre-long laser facility located in underground tunnels. It runs in a north-westerly direction from the DESY site in Hamburg-Bahrenfeld to a large experimental hall located in the German federal state of Schleswig-Holstein.

Altogether, 12 countries are participating in the European XFEL project. DESY, the main shareholder, is working closely with the company European XFEL GmbH on the construction and operation of the facility. Among other things, DESY and international partners are building the heart of the X-ray laser facility – the 1.7-kilometre superconducting accelerator including the electron source. DESY will also operate the accelerator after the facility is commissioned. The research possibilities offered by the European XFEL will benefit scientists from various disciplines – from semiconductor physicists to molecular biologists, medical scientists, chemists, astrophysicists and geologists.



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# INNOVATIONS FOR SOCIETY

Our economy depends on innovations. Without inventions and catchy ideas, new and commercially successful products would be inconceivable in our technology-oriented society. DESY contributes to this innovation process in a diversity of ways. On the one hand, knowledge derived from basic research provides a broad, fertile ground for future innovations. On the other hand, some experiments are directly related to applications – for example, when industrial firms book measurement time on DESY's X-ray sources to conduct advanced product development. Furthermore, there are the spin-offs that evolve from some research projects, such as the accelerator and detector technologies developed at DESY that can also be applied to innovative medical high-tech equipment. These technologies hold the promise of more accurate diagnoses and more readily tolerated therapies, for instance in cancer treatment.

An important aspect is DESY's cooperation with firms that are helping to develop its accelerators and detectors. One example is the construction of the superconducting TESLA accelerator modules. DESY generates know-how among the participating high-tech firms. The companies benefit from the cooperation by coming up with new production processes, for example, as the components and processes they develop for DESY require absolute cutting-edge technology and sometimes entirely new technical solutions. The latter can subsequently become useful for manufacturing other products, for instance in the medical industry, in radar and satellite technology and in chemical engineering. As a result, it's not uncommon for DESY's industrial partners to gain a technological advantage over their competitors.

# Mini-detectors for medical use

DESY technology for the doctor's practice

Physicist Erika Garutti's job is to develop highly sensitive sensors for future particle detectors used in basic research. However, the technology can also be useful in a medical diagnostic system, the PET scanner. The idea evolved into a successful European research project conducted by DESY and CERN in conjunction with three medical centres. One application of PET scanners is the early diagnosis of tumours.

"With our new sensors, it should be possible to obtain PET images of a substantially higher resolution," Garutti explains. "And the radiation dose to the patient could be significantly reduced." The scientists have already created a prototype which proves that the sensors work the way they're supposed to. Now the researchers are working on a miniature detector to be used at the tip of a stomach tube to detect dangerous pancreatic tumours as early as possible. Clinical trials are scheduled to begin in 2014.





# Strong partners in materials research

The Helmholtz-Zentrum Geesthacht investigates industrial materials at DESY

The high-strength aluminium fuselage of a passenger jet, corrosion-resistant steels for ship propellers, heat-resistant turbine blades – all of these high-tech materials have one thing in common: materials scientists need to know as much as possible about their “inner life” to customize them for their intended applications. How are the atoms arranged within the materials? Do the materials contain harmful cracks, pores or foreign bodies? Answers can be obtained with PETRA III, one of the world’s brightest X-ray sources. That’s why the Helmholtz-Zentrum Geesthacht maintains an outstation at DESY as part of its German Engineering Materials Science Centre (GEMS).

**“The excellent properties of the PETRA III X-ray source enable us to use innovative approaches when it comes to developing new materials.”**

*Prof. Wolfgang Kaysser, Scientific Director of the Helmholtz-Zentrum Geesthacht*

The outstation, which consists of several measuring stations in the PETRA III experimental hall, is focused on the engineering science aspects of materials research. Here, scientists develop and optimize materials that will sooner or later become commonplace in industrial, transportation and everyday applications – including new materials for lighter-weight cars, more effective manufacturing methods for aircraft construction and improved hydrogen tanks for environmentally compatible drive systems.



Materials research at PETRA III: At the Imaging Beamline (IBL), materials experts can obtain detailed images with exceptionally high resolution.



## Fuel cells in X-ray light

Experts are optimizing environmentally friendly technologies of the future

Fuel cells convert hydrogen or methanol into electric current efficiently and without environmental harm, and may someday endow electric cars with longer ranges. Materials researchers at Technische Universität Darmstadt are studying fuel cells using high-intensity X-rays from the accelerator. Their findings give manufacturers indications on how to develop improved, more effective fuel cells.

**“We’re investigating fuel cells under realistic conditions so that industrial users may benefit from our results.”**

*Dr. Christina Roth, materials scientist*

The researchers bring complete, intact fuel cells to Hamburg to examine them in detail with X-rays. They are particularly interested in the aging process of the platinum catalyst, which ensures that hydrogen and oxygen molecules are split into atoms. These atoms then react to form water, a process that releases energy in the form of electric current. The finely collimated X-rays enable the researchers to observe what is happening on the surface of the platinum particles.

The experts can also identify locations in the fuel cell where the aging process is especially fast – which is of fundamental importance for manufacturers striving to develop systems with a longer service life.



## Smart storage

DESY scientists are developing sophisticated data management software

The LHC produces immense volumes of data. A single year's data would fill more than a million DVDs. To manage this data torrent, information scientists use a new computer concept: the Grid, a variety of distributed computing. In this system, dozens of computing centres around the globe interact synergistically.

DESY scientists are participating in the continual expansion of the Grid. Their specialty is the organization of the data storage. That's a major challenge, because the storage resources on the Grid must not only receive and record vast data volumes reliably, but also make them accessible from anywhere on Earth. "dCache" is a software package developed mainly by DESY – sophisticated technology for managing large data volumes. At present, about half of all LHC data are stored on one of the 60 dCache systems around the globe.

DESY is developing the software in conjunction with international partners, especially the Fermilab research centre in the USA and the Nordic Data Grid Facility (NDGF). dCache is now also used in fields other than particle physics, for instance at the European radio telescope LOFAR. Keen interest is also evident among commercial companies.





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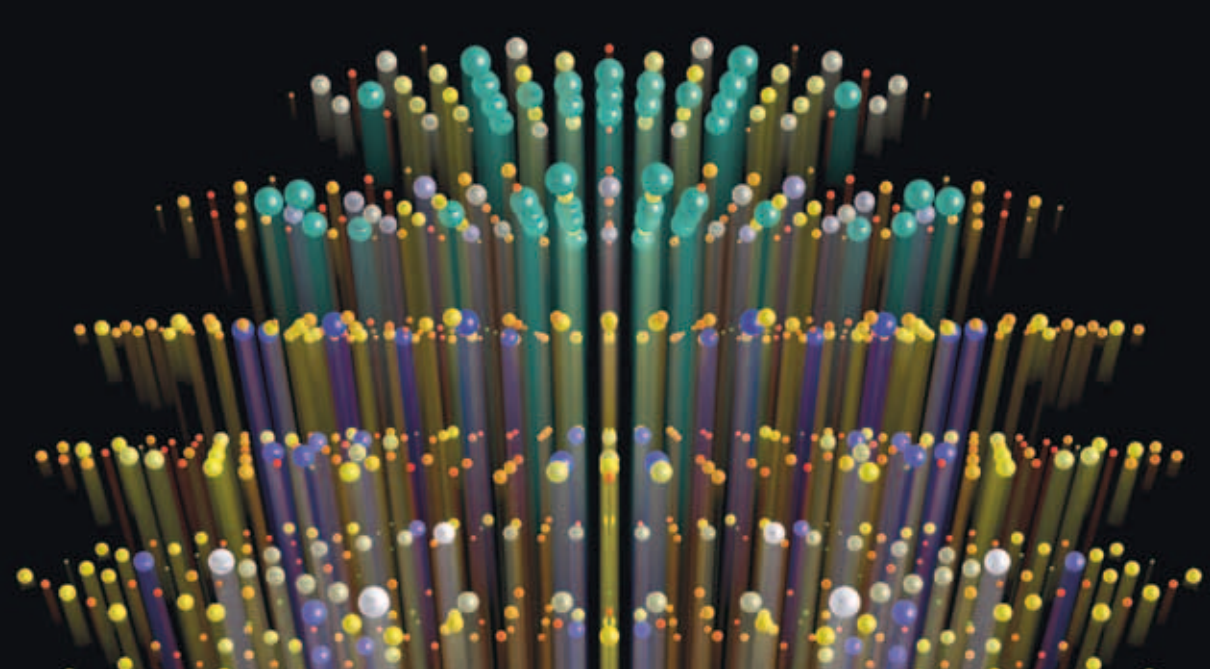


# A STRONG COOPERATION PARTNER

Top-level research is scarcely possible today without networking and cooperation among various institutes, countries and scientific disciplines. DESY too operates within strong networks. Each year, the research centre's unique facilities draw more than 3000 guest scientists from over 40 countries to Hamburg. To work as closely as possible with DESY, more and more institutions are establishing outstations on the campus itself.

Particle physics at DESY has always occupied a well-established position on the international research scene. Experts from around the world took part in the experiments at the storage ring HERA. Today, DESY physicists are playing leadership roles in all of the most important projects in particle physics.

The development of innovative accelerator technology is also taking place within collaborative efforts – whether in the Helmholtz Association's accelerator initiative ARD or in the international consortium that is developing the TESLA technology for the accelerators of the future. Cooperation on X-ray sources is equally intense. DESY has a share of more than 50 per cent in the X-ray laser European XFEL. Countries such as India, Sweden and Russia are involved in PETRA III. And a number of institutions that are closely connected with DESY are being set up on the campus in Hamburg: CFEL is devoted to research into ultrafast physical processes; CSSB will deal with infection research; and the Max Planck Society, which is already involved in CFEL, is planning the construction of a new institute.



## Centre of excellence CFEL

The Center for Free-Electron Laser Science is investigating ultrafast processes

Is it possible to observe how an electron jumps from one reactant to another with incredible speed during a chemical reaction? Can biomolecules be illuminated with intense X-ray flashes in such a way that scientists can discern the atoms they are made of? In Hamburg, a whole research centre is concentrating on such cutting-edge questions: the Center for Free-Electron Laser Science (CFEL), which DESY, the Max Planck Society and the University of Hamburg established in 2007.

**“DESY is the ideal home for CFEL. There is nowhere else in the world that brings together cutting-edge X-ray sources, interdisciplinary science, and an environment for exciting collaborative research.”**

*Prof. Henry Chapman, Center for Free-Electron Laser Science CFEL*

The CFEL experts are studying the tremendously fast processes in the nanocosmos from a variety of perspectives – in other words, with various research instruments. Some groups use the ultrashort X-ray pulses produced by FLASH, by the LCLS X-ray laser in the USA, or – in the future – by the European XFEL in Hamburg. Other teams are working with optical lasers or using electron or scanning tunnelling microscopes. In the future, the Max Planck Society in particular would like to expand its activities and establish a new institute in Hamburg that is closely linked with CFEL.

# Infection research at CSSB

Researchers from different fields work together at the Centre for Structural Systems Biology

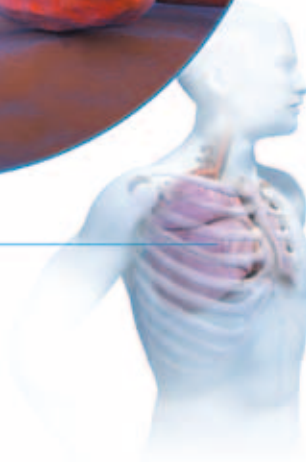
When biologists want to explore fundamental processes in cells or proteins, they often rely on physical methods. One of the most important techniques is X-ray structure analysis, whereby researchers expose proteins to intense X-ray radiation to decipher their structure and mode of operation. This makes it possible, for example, to identify the molecular mechanisms underlying the development of tuberculosis, one of the most dangerous infectious diseases. At PETRA III, the European Molecular Biology Laboratory (EMBL) is studying the tuberculosis bacterium, among others, in order to determine possible points of action for new medicines.

In the future, the experts intend to intensify their efforts at the Centre for Structural Systems Biology (CSSB), an interdisciplinary research institute on the DESY campus. CSSB is coordinated by the Helmholtz Centre for Infection Research; DESY and EMBL are major participating partners, alongside various universities and research institutions from Hamburg, Niedersachsen and Schleswig-Holstein.

Their common goal is to investigate with atomic resolution how pathogens attack.



Tuberculosis bacteria (red) that infect the human body are absorbed by “scavenger cells” (green). But the tuberculosis pathogen has the extraordinary ability to hide itself within these cells without being destroyed.







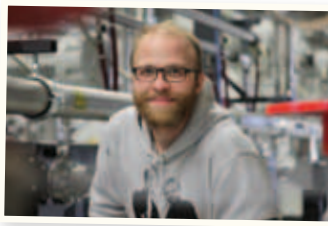
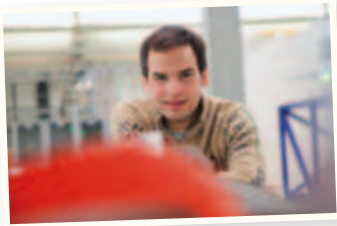
# TRAINING FOR TOP RESEARCHERS

DESY generates scientific insights and ideas for innovations. Just as important is its role as a nursery of young talents. DESY trains young people to be highly qualified, top-level scientists. Here, students and doctoral candidates learn how to develop their scientific creativity, juggle complex data and work in international and interdisciplinary teams. DESY graduates are coveted employees, not only in research institutes but also in business. This success is based on DESY's close networking with universities. DESY has particularly close connections with the University of Hamburg. PIER, a strategic partnership between the two institutions that was founded in 2011, offers ambitious young talents top-level graduate training.

DESY also provides a variety of possibilities for starting careers in commercial-technical and business management professions. Young people can receive training in Hamburg and Zeuthen for future-oriented vocations such as industrial engineering, IT or technical product design. Schoolchildren can learn about science in the DESY school lab "physik.begreifen". Here, children nine or ten years of age on can make balloons or chocolate-coated marshmallows explode in a vacuum under a bell jar. Students from secondary schools can investigate whether certain salts are radioactive and how to shield the radiation. In the "Cosmic Lab", pupils in college preparatory classes can learn more about cosmic particles. The strong interest shows that this concept of teaching physics is effective: year after year, the school labs in Hamburg and Zeuthen are fully booked, with waiting lists.

# A promising career launch

Hundreds of young researchers are pursuing their first scientific research projects at DESY – where they find a highly international and interdisciplinary setting



**Stefan Pabst**, a doctoral student at CFEL, is working in the field of theoretical physics. He calculates how atoms behave when they are irradiated with intense ultrashort laser flashes. “Here at DESY, the research facilities I can use to test my theories are right next to my office door,” he says. Just as direct is his connection with the experimental physicists who are analysing their samples using the X-ray flashes from PETRA III or FLASH, or will be doing so using the European XFEL in the future.

DESY doctoral student **Marc Wenskat** is developing special software. The program automatically analyses the photographs taken by a camera that monitors the inside of accelerator elements. This technology is useful for quality control, because even the smallest impurities or uneven spots can prevent the superconducting component from performing at its best. “What’s special about DESY is the incredible level of interdisciplinary cooperation,” Wenskat says. “Here, you’ve experts from a huge range of areas – biologists, medical researchers, physicists and IT specialists.”

Particle physicist **Isabell Melzer-Pellmann** has been leading a Helmholtz Young Investigators Group at DESY since 2010. At the LHC in Geneva, she is looking for particles that could explain the mysterious dark matter. “The Young Investigators Group is enabling me to build up my own research project with my own team,” she says. “I can decide independently what areas we’re going to work on.” The project will run for five years. During this time, Melzer-Pellmann will receive 1.5 million euro in research funding. Half of this amount will come from DESY, the other half from the Helmholtz Association.

## What became of them...

After their doctoral studies, DESY graduates have excellent opportunities in the job market



**Edith Maurer** works for the German Aerospace Center DLR in Oberpfaffenhofen. She supervises the operation of two radar satellites for observing the Earth. During her doctoral work at Technische Universität München, Maurer was a regular guest at DESY, where she examined polymers – plastic molecules – using X-rays. “One of the things I learned at DESY was how to approach working on a scientific project. Carrying out an X-ray experiment is quite similar to working in a space flight control room right after a satellite is launched. In both cases, the project has to be constantly monitored, everything must be well organized and the teamwork has to be perfect.”



**Linus Lindfeld** is a patent lawyer at Airbus in Hamburg. During his doctoral work at DESY, he searched for hypothetical elementary particles called “leptoquarks” in the data of the H1 detector at the HERA accelerator. After his time at DESY, he spent three additional years training to be a patent lawyer at a law firm. Now Lindfeld works for Airbus, where his job includes applying for patents for the company’s new inventions. “The analytical approach to problem-solving that is required in particle physics has helped me a lot. Especially valuable for my current job is the ability to filter a large amount of data and pull out what’s truly important in the shortest possible time. DESY gave me an intensive education in that.”



During her doctoral work at DESY, **Nanda Schmidt-Petersen** developed a prototype for a new particle detector for future linear accelerators. Now she is doing additional training at a clinic in Stade to become a medical physics expert. “Not only particle physicists but also doctors use accelerators – even though medical accelerators are a lot smaller. With these devices tumours can be effectively irradiated. During my doctoral work at DESY, I learned the essential tools of the trade for my job. The field of application is different, but the basic concepts are the same. And now I can use them in a concrete situation.”





# IMPETUS FOR THE REGION

DESY is one of the most important and renowned institutions on the international research scene. But the centre's significance for the metropolitan regions of Hamburg and Berlin/Brandenburg is also growing. The DESY campus in Hamburg, in particular, strongly enhances the appeal of the region. Its large-scale facilities are major economic factors and attract researchers and doctoral students from all over northern Germany. Local residents are also fascinated by the research done at DESY. Groups of visitors, including schoolchildren, visit the centre regularly to find out about current research. And on the DESY open days, the campus in Hamburg-Bahrenfeld attracts more than 10 000 visitors. DESY is also creating jobs in both regions, as is documented by various studies. Approximately 2000 men and women are directly employed at the research centre. In addition, indirect economic effects safeguard more than 2000 additional jobs, most of them in northern Germany.

The benefits for Hamburg and Berlin/Brandenburg are not merely material ones. For example, DESY cooperates closely with the universities and institutes in the region and offers them unique opportunities for research and training, especially for up-and-coming young scientists. And the fact that DESY attracts thousands of experts from all over the world every year lends the regions renown and international flair.

# A high in the north

The DESY campus in Hamburg is setting benchmarks



The DESY research campus is of growing importance for the metropolitan region of Hamburg. Since 2011, DESY and the University of Hamburg have been cooperating closely within PIER, the Partnership for Innovation, Education and Research. Both institutions are networking their research and training activities more strongly than before and promoting the transfer of science and technology throughout the Hamburg region. In addition, DESY is involved in various initiatives and co-operations that aim to strengthen Hamburg's position as a leading location for high tech, such as the Center for Applied Nanotechnology (CAN) with commercially relevant research projects in nanoscience, or the creation of a technology park in the vicinity of DESY. The research centre is also a highly successful partner in the Excellence Initiatives of the German government and the federal states.

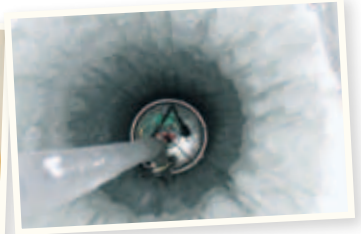
**“DESY is a renowned research centre where scientists from all over the world achieve brilliant results. DESY is developing into a unique interdisciplinary campus where top-level research is being done in close cooperation with the University of Hamburg, among others. And that top-level research is taking place in a process of lively communication with the city, its citizens and the companies that are located here.”**

Olaf Scholz, Mayor of the Free and Hanseatic City of Hamburg

The construction of new research facilities, in particular the large-scale project European XFEL, directly enhances growth in the region. DESY itself is also an important employer, providing jobs for about 2000 employees and more than 100 apprentices in commercial-technical and business management professions. In addition, DESY attracts over 3000 guest scientists from more than 40 countries every year and provides research opportunities for about 700 diploma candidates, doctoral students and postdocs.

# DESY in Brandenburg

The campus in Zeuthen generates momentum for the entire region




The DESY location in Zeuthen is one of the largest scientific institutions in the German federal state of Brandenburg. DESY in Zeuthen operates its own top-class accelerator, the PITZ photo injector test facility, and it also serves as a national centre for astroparticle physics. The centre is ideally networked with the Berlin/Brandenburg region. DESY in Zeuthen has joint appointments with the University of Potsdam and Humboldt University in Berlin, and it also cooperates with other universities and research institutes.

DESY in Zeuthen participates in a variety of regional networks, including the Berlin-Brandenburg cluster and the Potsdam Research Network “pearls”; it is an important partner for science and business. The centre is also strongly involved in the promotion of up-and-coming young scientists. Its offerings for students, its traineeships and internships and its school laboratories on the topics of vacuum and the cosmos are highly coveted and quickly booked out. In addition, DESY maintains partnerships with schools and regularly participates in events such as the Future Day for boys and girls and the Science Night in Berlin and Potsdam.

**“In Zeuthen, something has been created that will reach far into the future. By strengthening astroparticle physics and launching new projects in accelerator physics, DESY in Zeuthen has sharpened its profile in a very impressive way.”**

Prof. Sabine Kunst, Minister of Science of Brandenburg



A strong cooperation partner  
Impetus for the region  
Training for top  
Innovations for society



Deutsches Elektronen-Synchrotron  
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