RESEARCHERS' WORLD.

DESY
Insight starts here

Every year, the regular researchers on the DESY campus are joined by more than 3000 scientists from 45 countries. Together, they make DESY one of the world's leading accelerator centres for investigating the structure of matter. DESY offers a broad research spectrum of international standing.

Accelerators | Photon Science | Particle Physics

Deutsches Elektronen-Synchrotron
A Research Centre of the Helmholtz Association

Deutsches Elektronen-Synchrotron DESY

- **A Research Centre of the Helmholtz Association**
- **A publicly funded national research centre**
- **Established in Hamburg on 18 December 1959**
- **Locations: Hamburg and Zeuthen (Brandenburg)**
- **Budget: 183 million euros**
  (Hamburg: 166 million euros; Zeuthen: 17 million euros)
- **Financing: 90% on the national level (Federal Ministry of Education and Research); 10% on the state level (the city of Hamburg and the federal state of Brandenburg)**
- **Employees: approximately 1900, including 600 scientists, who work in the fields of accelerator operation, research and development**
- **Guest scientists: more than 3000 from 45 countries each year**
- **Training: around 100 young people in commercial and technical vocations**
- **Young scientists: more than 700 diploma students, doctoral candidates and postdocs**

DESY.

Insight starts here

DESY is one of the world's leading accelerator centres. DESY develops, builds and operates large accelerator facilities, which are used to investigate the structure of matter. The combination of photon science and particle physics at DESY is unique in Europe.

DESY carries out fundamental research in a range of scientific fields and focuses on three principal areas:

> Accelerators:
DESY develops, builds and operates large facilities that accelerate particles to extremely high energies.

> Photon science:
Physicists, chemists, geologists, biologists, medical researchers and materials scientists use the special light from DESY's accelerators to observe structures and processes in the microcosm.

> Particle physics:
Scientists from around the world use DESY's accelerators to investigate the fundamental building blocks and forces of the universe.

The spectrum of research at DESY is correspondingly diverse – as is the cooperation with partners both national and international. All in all, more than 3000 scientists from 45 countries come to Hamburg each year to work at DESY. The research programme is not restricted to the facilities in Hamburg and Zeuthen. Indeed, DESY is closely involved in a number of major international projects, including the European X-ray free-electron laser XFEL in Hamburg, the Large Hadron Collider LHC in Geneva, the neutrino telescope IceCube at the South Pole and the International Linear Collider ILC.

PACE SETTER.

DESY develops accelerators to bring particles up to speed

The development of particle accelerators involves special challenges for both humans and machines. Time and again it is necessary to push back the frontiers of science and technology. Many of the technical achievements arising from accelerator development eventually lead to new applications in industry. Over almost 50 years DESY has accumulated vast experience of accelerator development and is one of the world's leading authorities in this field.

Twin pack

DESY develops, builds and operates particle accelerators for two principal areas of research:

- The development of light sources for photon science in order to enable structures and processes to be observed on extremely small space and time scales. To this end, particles are first accelerated and then deflected by means of large magnetic structures in such a way that they emit a special form of radiation.
- The development of increasingly powerful accelerators for particle physics research in order to accelerate particles to ever greater energies and thereby obtain deeper insights into the very heart of matter and the origin of the universe.

High tech

Owing to the development of ever better accelerator facilities, the limits of what is technically feasible are constantly expanded. DESY's cooperation with industrial companies generates important innovations in areas such as electronics, radio frequency technology, vacuum and refrigeration technology, as well as the operation of complex superconducting systems.

Peak acceleration

Developing the accelerator technology for the planned International Linear Collider ILC is a special challenge. Working in concert with international partners, DESY has developed and tested the TESLA technology, which is based on superconducting accelerator modules. The global community of particle physicists has resolved to use the TESLA technology for the ILC. In addition, this technology can also be used to operate new types of X-ray laser. The FLASH free-electron laser at DESY is the first light source of this kind; it will soon be followed by the European X-ray laser XFEL.

In Zeuthen, DESY operates the photo injector test facility PITZ, which is used to develop and optimize the special electron sources that will be needed for the new generation of free-electron lasers.

TESLA technology:
a superconducting resonator for particle acceleration

HIGH LIGHTS.

DESY generates pulses of brilliant light for a deeper insight into the structure of matter

Particle accelerators generate a special kind of light that can illuminate tiny details of the microcosm. Here at DESY scientists from around the world use this light to investigate the atomic structure and reactions of promising new materials and biomolecules that might one day serve to make ground-breaking new drugs. DESY's unique spectrum of light sources makes it one of the world's leading centres for science with photons.

Light sources

The existing and planned light sources complement one another perfectly. Scientists working at DESY therefore have access to exactly the type of radiation they need for their experiments.

DORIS III

The DORIS III particle accelerator provides radiation suitable for a whole range of experimental purposes. This includes the analysis of catalysts and semiconductor crystals as well as research leading to the development of new drugs. Here, industrial companies optimize their materials and develop new products. They are supported by a special service team.

FLASH

Unique experimental opportunities are provided by the new free-electron laser FLASH, which generates extremely intense short-wavelength laser pulses. International research teams obtain groundbreaking results here – results that point the way to a new era of structural research. Their target is to use a single ultra-short, intense X-ray laser pulse to produce images of nanoparticles, viruses and cells.

PETRA III

From 2009, researchers at DESY will have access to the world's best storage ring-based X-ray radiation source, PETRA III. It will provide short-wavelength X-ray radiation of especially high brilliance. PETRA III will offer excellent research opportunities for various applications – from medicine to materials research.

XFEL

The forthcoming European X-ray laser XFEL will complement the unique range of light sources in the Hamburg region. Commissioning is due to start in 2013. The high-intensity X-ray laser flashes from the XFEL will, for example, enable "films" to be made with atomic resolution. The approximately three-kilometre-long facility will extend from DESY in Hamburg to the Schleswig-Holstein town of Schenefeld in the Pinneberg district.

Work in the FLASH experimental hall at DESY

MICRO COSM.

DESY explores what binds the universe together at its core

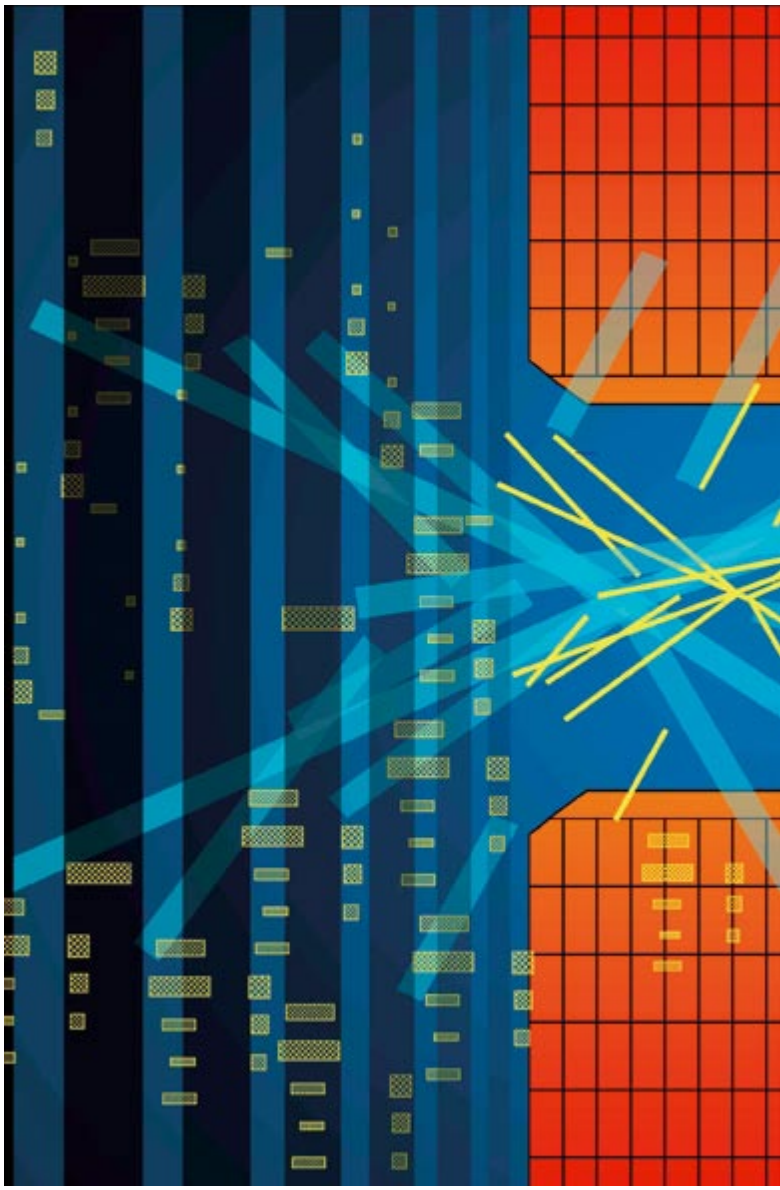
On the trail of quarks, supersymmetry and extra dimensions – particle physicists at DESY inquire into the very structure of our world. To do this, they use their vast experience and state-of-the-art technologies, and work together in national and international networks.

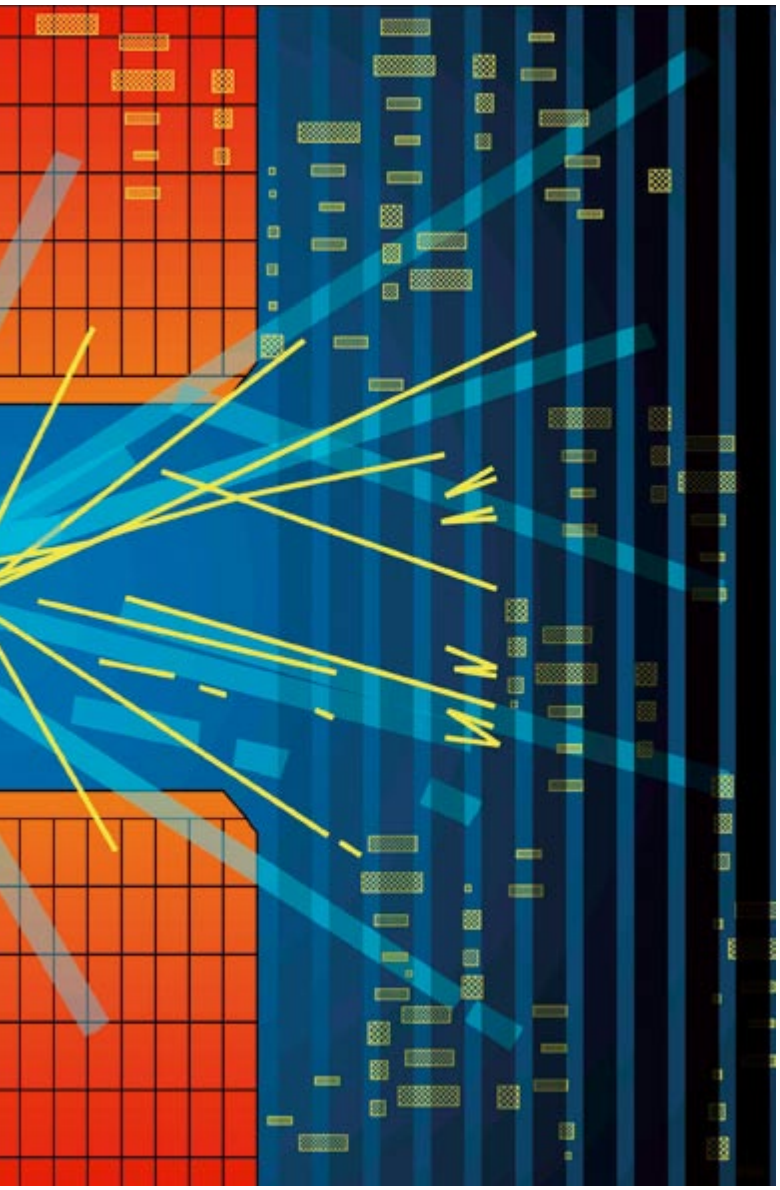
Pointing the way

Using data recorded with the “super electron microscope” HERA, particle physicists investigate the structure of the proton and the fundamental forces of nature. For 15 years, electrons and protons collided inside the HERA particle accelerator, which lies deep in the earth beneath Hamburg. Data taking at Germany’s largest research instrument, which has written physics history, ended in the summer of 2007. The evaluation of the accumulated measurement data, however, will extend well into the next decade. It will give us a comprehensive overall picture of the proton and the forces at work inside it – with a precision that won’t be matched by any other particle accelerator in the world for years to come.

Discovery machine

Global networking is a characteristic feature of particle physics. So it’s only natural that DESY is also playing a part in work at today’s most powerful accelerator worldwide – the new Large Hadron Collider LHC at CERN in Geneva. In the LHC, protons collide at the highest energies ever attained. The results of these particle collisions will provide physicists with information on the as yet undiscovered Higgs particle and possible supersymmetric states of matter. The insights into the proton provided by HERA are an indispensable basis for their work.





Global accelerator

The next big particle physics project for the future is the International Linear Collider ILC – a linear accelerator in which electrons and their antiparticles (positrons) will collide at energies of 500 to around 1000 billion electronvolts. DESY is a major participant in this global accelerator project, which together with the LHC will open up unique opportunities for investigating some of the 21st century's key scientific questions – including the nature of matter, energy, space and time, dark matter, dark energy and the existence of extra dimensions.

Ghost particles

At its location in Zeuthen, DESY is also active in astroparticle physics. It is a major participant in the international neutrino telescope IceCube – the world's largest particle detector. Frozen deep in the ice of the South Pole, 4800 light sensors will record the ghost particles from space, thereby providing researchers with a new window on the vast expanses of the universe.

Supercomputers

Theoretical particle physicists working at DESY are striving to piece together the big picture that corroborates the host of experimental findings. In order to explain the world of the smallest particles and its physical laws, they make use of supercomputers provided by the John von Neumann Institute for Computing (NIC). This institute, which was jointly founded by DESY and the Research Centre Jülich, develops increasingly powerful computers for the physicists' special requirements. ●

More insight:
www.desy.de

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