SAXONY – THE SCIENCE STATE

STAATSMINISTERIUM
FÜR WISSENSCHAFT
UND KUNST

Freistaat
SACHSEN

Title: Helmholtz-Zentrum Dresden-Rossendorf: In the so-called target chamber the high-power laser beam meets the electron beam of the ELBE accelerator at the High-Power Radiation Sources Centre. The objective is to generate brilliant X-ray beams. | Photo: HZDR / Frank Bierstedt

Saxony – the Science State

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Welcome Note

Dr Eva-Maria Stange,
Saxon State Minister
for Higher Education, Research and the Arts

Nutrition, health, energy, climate change, communications, peaceful coexistence – these are just a few of the huge challenges facing our society. What is at stake is the Earth itself, its atmosphere and the survival of the diversity of life forms to be found on this planet. But what is also at stake in this context are economic interests and jobs. The issues are consumerism and renunciation, affluence in one part of the world and poverty in the other. How can and must society, with all its contradictory interests, be drawn into the essential decision-making processes?

When problems are complex, solutions have to be complex, too. This is where research comes in. It is the task of science to apply its methods to elaborating the areas of tension between the various interests and poles and to identify scope for action. This is a challenge that is being met by researchers at institutions in Saxony. Already today, the Free State can boast an internationally visible, cutting-edge research performance in microelectronics, nanotechnology, mechanical and automotive engineering, materials science, biotechnology, neuroscience, medical engineering and environmental research, whilst its humanities scholars also achieve outstanding results.

Our highly productive science state of Saxony thrives on these people, who apply their curiosity and perseverance in very different areas in order to address the issues that will face us in the future. Today's researchers are thus part of a fine tradition: great names like Gottfried Wilhelm Leibniz, Carl Gustav Carus and Wilhelm Ostwald are linked with outstanding scientific achievements. Over the centuries, Saxony has been the hub for a wealth of cultural, scientific and economic developments and discoveries.

Building on Saxony's scientific traditions during the last 25 years, it has been possible to create a close network embracing 14 institutions of higher education – four universities, five universities of applied sciences and five universities of fine arts – as well as to build up a mass of non-university research institutions: 14 institutes and facilities belonging to the Fraunhofer-Gesellschaft, six Max Planck institutes, six institutes in the Leibniz Association, two Helmholtz centres, a Helmholtz institute and nine institutions financed by the Free State itself. BA Sachsen University of Cooperative Education with its seven academies and its special dual approach to academic training is another strong component on the Saxon educational landscape.

At the heart of the science state of Saxony are our universities which connect research and teaching across a broad spectrum of subjects ranging from the humanities to mathematics, computer science, natural science and technology. Universities are places of intellectual encounter; they critically generate new ideas for our state and are a top draw for motivated people. The varied and attractive portfolio of study programmes at our universities has con-

vinced school-leavers from all parts of the country and beyond to study in Saxony. But we still have to acquaint even more young people with the diversity of occupational fields in the natural sciences, some of which are already crying out for specialists in vain – and this trend will become more pronounced. We need far-reaching and well-coordinated professional and academic advisory services, high-quality teaching, intensive preparation for students entering employment as well as close cooperation not only between universities and research institutes but also commercial enterprises. After all, we do not only want young people to study in Saxony but to find sustainable job prospects here as well.

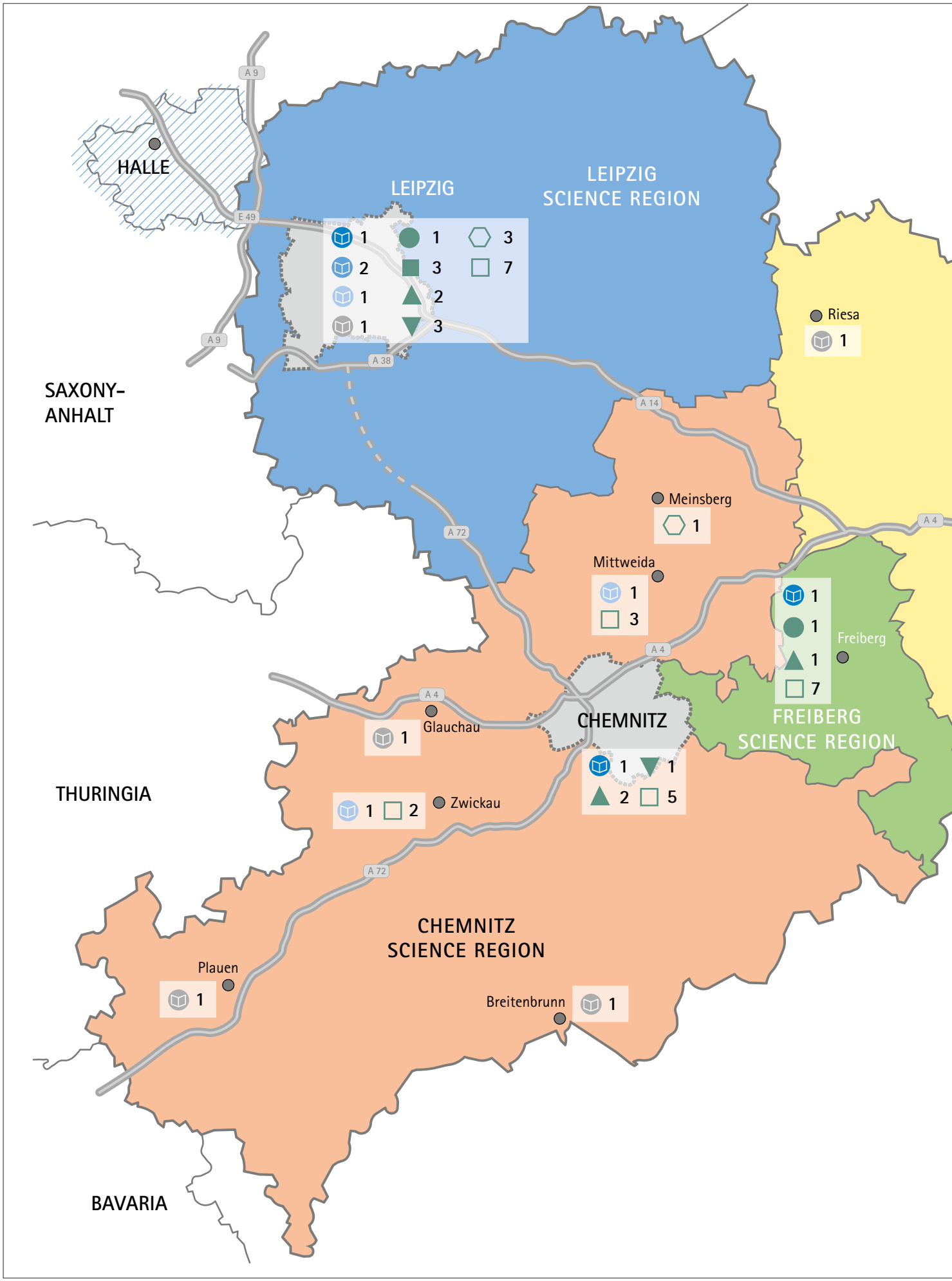
In order to consolidate our university locations, a dialogue should be held with the universities to extend the Saxony Higher Education Development Plan until 2025. The aims are to coordinate study programmes statewide, determine focus areas for each individual location and dovetail the research fields to a greater extent within the various science regions. A further task is to continue extending fundamental as well as applied research by employing all the available funding instruments in a targeted and non-bureaucratic fashion.

Apart from the financial security that is necessary if a strong academic landscape is to thrive, Saxony also needs a climate of social inclusion that welcomes people from all parts of the world. This is equally applicable to students as well as academics and their families. Such cosmopolitanism implies recognition and respect for other people and their cultures. It means enriching all aspects of society and seeking to shape it together. We shall only be able to find solutions for the complex problems that confront us by working together and practising mutual respect.

Our brochure is designed to give you an initial overview of "Saxony – the Science State". We called on our universities and research institutes in the various science regions to present short profiles of themselves. For more detailed information, links are provided.

Happy reading!

Dr Eva-Maria Stange
Saxon State Minister for Higher Education, Research and the Arts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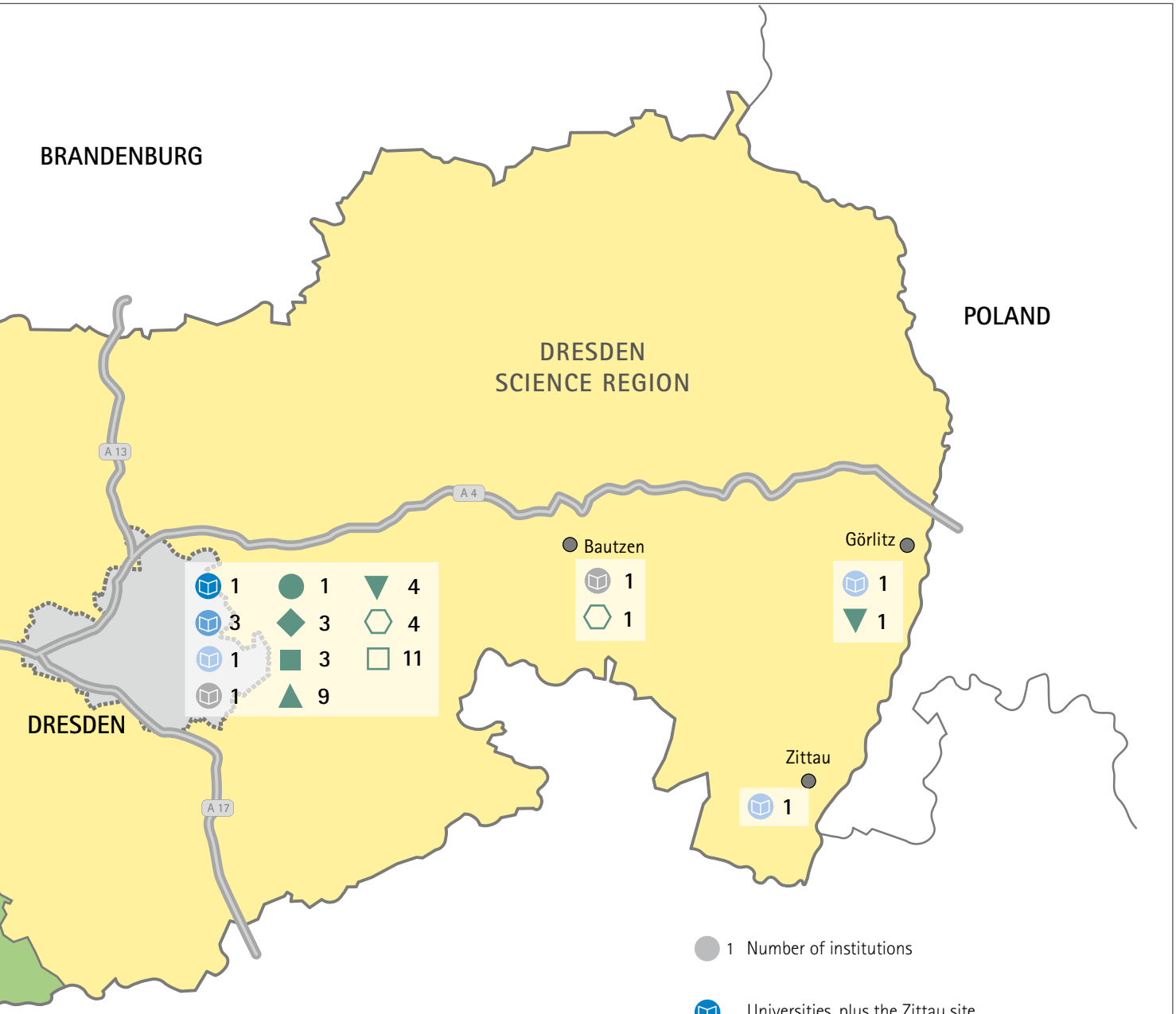


With 14 state institutions of higher education – as well as an abundance of non-university research institutions – 14 institutes and facilities belonging to the Fraunhofer-Gesellschaft, six Max Planck institutes, six institutes in the Leibniz Association, two Helmholtz centres, a Helmholtz institute and nine institutions financed by the Free State itself – Saxony enjoys an excellent position as a science location.

Saxony. A Place of Great Names.

In 1993, the very last shift left the Knappenrode Briquette Factory. Turbines, dryers and presses were all stopped. What has remained is a remarkable piece of industrial history which has been opened to today's visitors.
The factory buildings house a complete historical briquette production line. In the turbine hall, three impressive steam turbines bear witness to the skill of German engineers. | Photo: Michael Lange

Then as now: Great names are linked with outstanding scientific achievements: **Adam Ries,** mathematician and court arithmetician, who taught in Annaberg from 1523; **Gottfried Wilhelm Leibniz,** born in Leipzig in 1646 – a universal genius; **Carl Gustav Carus,** appointed Professor of Obstetrics and head of the maternity hospital in Dresden, where he co-founded the Surgical-Medical Academy; **Amalie Dietrich,** born in Siebenlehn, who discovered nearly 640 species of plants; **Wilhelm Wundt,** known as the founder of the independent discipline of psychology who, over a period of 45 years working in Leipzig, created the basis for the consolidation of scientific psychology; **Wilhelm Ostwald,** who worked in Leipzig from 1887 where he held the world's only Chair in physical chemistry and produced ground-breaking results; **August Horch,** who built innovative motor vehicles in Zwickau from 1904; **Manfred von Ardenne,** who conducted research at his own institute in Dresden from 1955, and whose life's work produced 600 patents.

Just like the Energy Factory in Knappenrode, the Ehrenfriedersdorf Tin Mine – with underground mine tours and a mineralogical museum – is part of the Saxon Museum of Industry.
Here visitors can find out about industrial gallery ore mining and the potential use of the treasures still slumbering in Saxon soil. | Photo: Michael Lange

The Mathematisch-Physikalischer Salon was founded in 1728 during the reign of August the Strong (1694 – 1733) and is still one of the world's most important museums of historical scientific instruments even day. The museum in the Dresden Zwinger reveals how humankind has measured the world for centuries. The exhibits include highly-polished burning mirrors, exquisite historical timepieces and mechanical devices, telescopes, astronomical models, and historic globes featuring the earth and the heavens.
Photo: Hans Christian Krass

Moon globe, Ernst Fischer, 1875.
Photo: Staatliche Kunstsammlungen Dresden

Over the centuries, Saxony became the hub of countless cultural, scientific and economic developments and discoveries. Outstanding achievements were made in law, philosophy, theology, physics, chemistry, astronomy, and particularly in mining science.

Saxon inventions have made a crucial impact on the economic prosperity of Europe. Saxony built the first German engines as well as the first mechanical textile weaving looms. The Free State developed into an important centre of the humanities: at Leipzig University, which was founded in 1409, the seeds of the German Enlightenment were sown, and researchers there fostered scientific contacts worldwide. Shaped by its strong focus on the humanities and social sciences, in the course of time, Leipzig University evolved into a hub of scientific and political debate – vital for the economic, cultural and social development of Saxony.

The centuries-spanning success of mining in the *Erzgebirge* established Saxony's affluence. Amongst the men who worked in the concomitant academic discipline were some of the great names in their field: **Ulrich Rülein von Calw,** author of the first mining treatise in 1501, physician, town planner and Mayor of Freiberg; then **Adam Ries** and also **Georgius Agricola,** who worked in Chemnitz from 1531 to 1555. The humanist and naturalist was the founder of three sciences – mineralogy, geology and mining science – and wrote his major work on mining, *De re metallica,* in Chemnitz. The principle of sustainability was first formulated by mining administrator **Hans Carl von Carlowitz** in Freiberg in 1713.

Industrialisation in Saxony began with **textile manufacturing.** In 1799, the first spinning mill was built in Chemnitz and in 1836, the Royal Mercantile College was established. By 1837, 490,000 spindles were operating in 120 Saxon spinning mills. The construction of textile machinery – initially based on British models – heralded the dawn of mechanical engineering as an important element of life in Saxony at the time. Chemnitz became the "Saxon Manchester".

As a result of the boom in mining in the 12th, 16th and 17th centuries, as well as Saxony's leading role in industrialisation in the 19th century, the Free State became one of the most advanced regions in Germany, technologically, scientifically and economically. Hence, over the centuries, Saxony's industrial progress in mining, textiles, mechanical and automotive engineering shaped the development of the state. This was accompanied by the early and intensive involvement with the economic, social, aesthetic and cultural dimensions of the industrial age.

In order to foster and develop Saxon industrial culture as the foundation of Saxony's cultural wealth and an element of its regional identity, the Saxon State Ministry for Higher Education, Research and the Arts established the Coordinating Office for Industrial Culture. The state-wide Industrial Culture Network is developed and maintained via the information and communication platform *www.industriekultur-in-sachsen.de.*

Saxony. University and Research Location »

Saxony – the Science State.
Scientists from all over the world cooperate with one another at research-intensive universities and non-university research institutions and implement projects together with partners in industry.

Leipzig University, Faculty of Chemistry and Mineralogy. | Photo: Waltraud Grubitzsch

Pupils from Dresden's Dreikönigschule Gymnasium during project week at the DeltaX School Lab at the Helmholtz-Zentrum Dresden-Rossendorf. | Photo: HZDR

Saxony. A Great Address for Top Research

How do you do research in the nanoworld? What is the world made of? How did the universe come into being? How will we live tomorrow?

Taken from the programme of the Long Night of Science in Dresden

Science thrives on curiosity. Every year, when the Long Night of Science in Dresden and Leipzig, the DeltaX School Lab at the *Helmholtz-Zentrum Dresden-Rossendorf* or TU Chemnitz' Future Truck invite the public to conduct experiments, people stream to the Science State in their thousands.

Attractive university location

It is also in their thousands that students and researchers from all over the world make their way to the Free State of Saxony. No fewer than 112,000 young people – 15,000 of whom come from abroad – study here and generate new impetus. And this is what guarantees a place its future: bright minds and their vitality, creativity and thirst for discovering new paths. With its four major universities, five universities of fine arts and five universities of applied sciences, Saxony is a first-class location for higher education with a diverse and modern portfolio of study opportunities. Prospective students can choose between internationally-recognised Bachelor's and Master's degrees, state examinations to acquire teaching qualifications or the highly-respected *Diplom* in Engineering. This is one of Saxony's particular strengths: Almost 30 per cent of all students enrol in courses leading to engineering degrees. The outstanding quality of training at universities, the efficiency of course structures, the excellent mentoring as well as the extremely good facilities with modern labs, libraries and computer working places – these are the reasons why increasing numbers of school leavers from outside Saxony as well as from within are taking the decision to study in Dresden, Leipzig, Chemnitz, Freiberg or in one of the smaller university towns. The figures for freshers from the old Federal states of Western Germany have grown most satisfactorily in the last few years: whereas in 2008, only 2,000 freshers came from the old Federal states, of the 20,605 who started to study at Saxon universities in 2013, 4,744 came from the old Federal states.

"Get your education moving in Saxony!" is the slogan of a joint campaign run by the Saxon State Ministry for Higher Education, Research and the Arts and the universities and colleges in Saxony. Launched in 2008, it provides information on the advantages of studying in Saxony.
www.pack-dein-studium.de

Closely-knit research network

Anyone interested in doing scientific work in Saxony will find a dense network of excellent research institutions. Scientists and scholars can pursue their research at six institutes in the Leibniz Association (WGL), which are jointly funded by the Federal Government and the Free State, as well as at two Senckenberg research centres associated with WGL, two Helmholtz centres, a Helmholtz institute and three German Centres for Health Research, 14 institutions in the *Fraunhofer-Gesellschaft,* six institutes in the Max Planck Society and nine research institutions financed by Saxony. Important pillars of natural and engineering sciences include regenerative medicine, materials sciences, biotechnology, micro-/nano-electronics, resource technology/environmental research/energy technology, automotive and mechanical engineering and systems engineering. Social scientists and humanities scholars address the issue of change – in politics, business, academia, culture and technology.

All these institutions are closely inter-connected, both amongst themselves and with business. They share scientific ideas and conduct joint research projects in various different fields. This networking helps to drive the process both of turning research results into industrial applications and of applying scientific analysis to issues generated by industry.

University research with a wide spectrum

Together with the many non-university research institutions, the universities are the main pillars of the Saxon research landscape. The spectrum of university research ranges from basic research to applied research and development for industry. The universities have created independent research centres and affiliated institutes which act as ever more efficient intermediaries between academia and regional business and expedite technology transfer to companies in the respective science region.

Applied research is one of the particular strengths of higher education in the Free State of Saxony. At three of the five universities of applied sciences, research centres have been established that offer a platform for interdisciplinary collaboration between partners of different disciplines at home and abroad as well as for projects involving industrial alliances – a special vehicle for promoting technology transfer.

Unique feature: diversity of the research landscape

Non-university research institutions cooperate closely with the universities. Many professorships and institutes are linked by joint appointments and the directors of research institutions are also engaged in teaching at universities. There are almost 50 non-university research institutions in the Free State, working on a wide range of fields such as micro- and nano-electronics, materials sciences, production technology, energy, environmental science, biotechnology, natural science and medicine. Germany-wide, such diversity is a unique feature of Saxony.

Saxon university research is excellent

The decision, taken in June 2012, to promote top research at universities in the context of the Excellence Initiative, which is funded by the Federal Government and the Länder, heralded Saxony's admittance to the circle of the strongest research locations in Germany. In a fierce contest, *Technische Universität Dresden* (TU Dresden) and *Technische Universität Chemnitz* (TU Chemnitz) were able to win through. TU Dresden now holds the title of "University of Excellence" based on two Clusters of Excellence and a Graduate School. TU Dresden's successful proposal includes the institutional strategy, "The Synergetic University", which is designed to make TU Dresden one of the leading universities in the world. Top-level research is conducted in the Clusters of Excellence, Center for Advancing Electronics Dresden (cfaed) and Center for Regenerative Therapies TU Dresden – CRTD.
www.cfaed.tu-dresden.de
www.crt-dresden.de
www.dresden-concept.de

Since 2006, Dresden International Graduate School for Biomedicine and Bioengineering (DIGS-BB) has developed into the flagship for international doctoral programmes in Germany. Currently, young researchers can choose from three different doctoral programmes. 91 working groups at 11 institutions offer doctoral candidates the opportunity to gain scientific experience across a broad palette of topics. DIGS-BB's thematic focus complements the CRTD Cluster of Excellence.
www.digs-bb.de

TU Chemnitz made its mark with its Cluster of Excellence, Merge Technologies for Multifunctional Lightweight Structures (MERGE). The cluster's main objective is the fusion of fundamental technologies suitable for the resource-efficient mass-production of lightweight structures with high-performance and functional density.
www.tu-chemnitz.de/MERGE

Funding for all the projects approved began in November 2012 and will continue for five years.

Left: The Saxon State and University Library Dresden (SLUB) is one of the largest and most comprehensive academic libraries in Germany. It is the library of Technische Universität Dresden, the state library of Saxony and a major innovation and coordination hub in the German and European library systems.
Photo: SLUB

Research in the Faculty of Sport Science at Leipzig University. | Photo: Christian Hüller

Research institutions financed by the Free State

Besides the institutions financed jointly by the Federal Government and the *Länder,* research institutions funded by the Free State have also been established. In the last few years, for example, Saxony has expanded research in the humanities outside the university context. Today, there are six humanities research institutions in Saxony funded by the Free State: the Saxonian Academy of Science and Humanities in Leipzig, the *Institut für Sächsische Geschichte und Volkskunde* in Dresden, the Simon Dubnow Institute for Jewish History and Culture at Leipzig University, the Hannah Arendt Institute at TU Dresden, the Centre for the History and Culture of East Central Europe at Leipzig University and the *Sorbisches Institut (Serbski Institut)* in Bautzen.
In addition to these institutions conducting research in the humanities, in the field of technology the Kurt Schwabe Institute for Measuring and Sensor Technology in Meinsberg, the VKTA – Radiation Protection, Analytics & Disposal Rossendorf Inc. and the NaMLab (Nanoelectronic Materials Laboratory) in Dresden are also financed by the Free State.

Established in 2008, the Deutsches Biomasseforschungszentrum in Leipzig is solely funded by the Federal Government. Some 160 researchers work here investigating the best ways of exploiting the potential of bioenergy. **www.dbfz.de**

University-affiliated, non-university research institutions are closely associated with industry and conduct application-related research – another link in the chain between applied research and industrial applications. Some institutions are affiliated to universities.

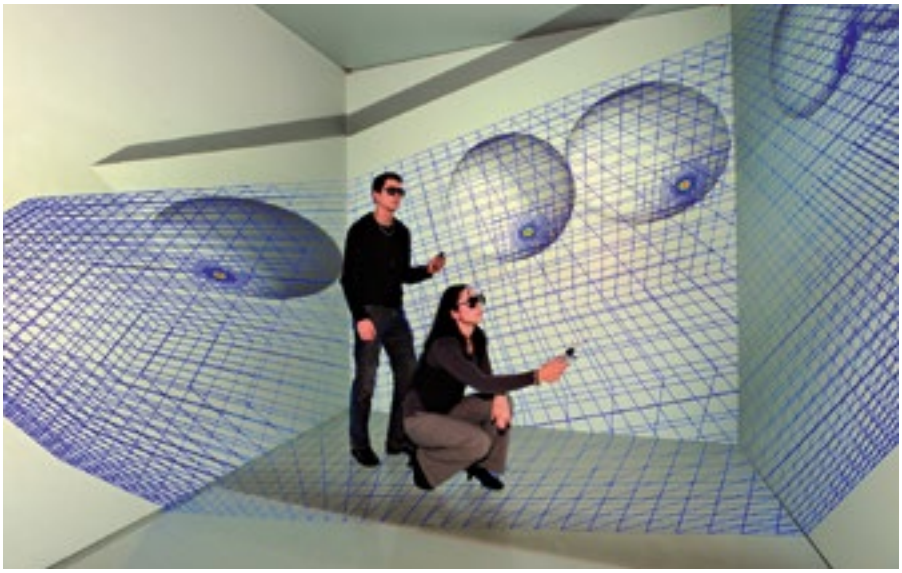
Research at museums

Collecting, preserving, researching, communicating and educating are the pillars of museum activity. The spectrum of research approaches and methods used at the museums is broad. It not only embraces subjects firmly rooted in the humanities like art history, history, ethnology or social anthropology but also natural science disciplines. A modern research approach is an interdisciplinary research approach: Hence the museums are not only centres of expertise in the humanities but are also a forum for exchange between the humanities and the natural sciences.

The Staatliche Kunstsammlungen Dresden, the Archaeological Heritage Office, the *Deutsches Hygiene-Museum Dresden*, the *Militärhistorisches Museum* in Dresden and the Saxon State and University Library Dresden (SLUB) together with a number of other scientific institutions are all members of the DRESDEN-concept. This alliance between TU Dresden and strong partners in academia and culture aims to showcase the excellence of research in Dresden. **www.dresden-concept.de**

Amongst the institutions that have conducted intensive research for many years and for which international academic exchange plays a major role are the *Staatliche Kunstsammlungen Dresden* with their 12 museums. This is reflected in a wealth of different research projects such as the famous Daphne Project on provenance research. The Archaeological Heritage Office in Saxony and the new State Museum of Archaeology Chemnitz, can also look back on decades of interdisciplinary research and communication activities. Both institutions are tasked with investigating prehistoric and early-historic archaeology in the Free State of Saxony on the basis of national and international collaborative research projects, and communicating the results in the form of scientific exhibitions, publication programmes, specialist conferences and workshops. Networking with universities and research institutes as well as a variety of cultural conservation and funding institutions is an essential prerequisite.

www.kulturland.sachsen.de



Scientific staff at the Professorship for Machine Tools and Forming Technology at TU Chemnitz carrying out tests in a virtual environment. | Photo: Wolfgang Thieme

Research in Saxony: An Infrastructure Paradise.

Silicon Saxony: With consistent government support from the Free State of Saxony since 1990, the metropolitan area around Dresden, in particular, has developed into Europe's chief economic and academic centre for **micro- and nanotechnology.** About 50,000 employees work in microelectronics in Saxony today. With some 300 companies and research institutions, Silicon Saxony is Europe's largest industry association for the semiconductor, electronics and microelectronics industries. Manufacturers, suppliers, service providers, universities and research institutions founded this alliance in Dresden in 2000. Today, it is the largest microelectronics network in Europe.

www.silicon-saxony.de www.cool-silicon.de

Automotive and mechanical engineering have a time-honoured tradition in Saxony. In these fields, the technical universities and universities of applied sciences, along with non-university research institutions, have particularly close ties with industry. This is mainly true for small and medium-sized enterprises in the Free State of Saxony, for example in the field of supply, although academia also collaborates with large corporations whose research and development departments tend to be located outside of Saxony.

Materials science provides basic insights for new applications and developments in mechanical engineering as well as nano- and microelectronics, and biomedical engineering. The universities and Max Planck institutes, in particular, as well as applied research institutions (Leibniz Association, Helmholtz Association of German Research Centres, institutions in the *Fraunhofer-Gesellschaft,* universities) conduct basic research in these focus areas.

Valuable support comes from the Materials Research Network Dresden with its 20 university, non-university and industrial research institutions.

www.mfd-dresden.de

Its glow is an intense blue and it is considered one of the important semiconductor materials of the future: gallium nitride. At the Gallium Nitride Centre Freiberg (opened in October 2013), scientists from Dresden NaMLab gGmbH, *TU Bergakademie Freiberg* and Freiberg Compound Materials GmbH explore the new material's potential to drive the performance of microelectronics even further. The Free State of Saxony contributed approximately 1.6 million Euros to help set up the research facilities at the Gallium Nitride Centre, which was founded in 2011.

Above: The virtual forest at the Visualisation Centre of the Helmholtz Centre for Environmental Research (UFZ) Leipzig. A computer model showing different tree species helps researchers understand the role of forests in climate change. This shot made photographer André Künzelmann one of the winners of the German Science Photography Prize, conferred in November 2013. | Photo: UFZ/André Künzelmann

UNU Flores: The United Nations University Institute for Integrated Management of Material Fluxes and of Resources (UNU-FLORES), supported by the Free State of Saxony, addresses the sustainable use and integrated management of resources such as water, soil or waste. Its cooperation with TU Dresden and other research institutions in Saxony will help advance these topics at international level and set them in a global context – forging another link to the international science community, to UN agencies and to practitioners and decision makers, particularly in developing countries.
www.flores.unu.edu

In the vein of sustainable development, **resource technologies, environmental research and energy technologies** are represented across Saxony's science regions. Universities and institutions in the Helmholtz Association work on these topics, as does industry in collaboration with institutions in the *Fraunhofer-Gesellschaft*. The major topics are raw materials such as non-ferrous metals, rare earth elements or fossil energy sources, treatment of water and waste water, application of regenerative energies, development of energy-efficient systems and energy storage. In the field of **hydro technologies,** Saxon science and industry already have an excellent infrastructure and are gaining international visibility.

Within a few years, the biosaxony Alliance of biotechnology research institutions and businesses has earned Saxony national and international prestige as a biotechnology hub. It has grown into one of Europe's most dynamic biotechnology regions. In 2000, the state government of Saxony helped spark this development with its biotechnology campaign in Dresden and Leipzig, providing financial support amounting to approximately 200 million Euros. This was complemented by third-party private and public funding of more than 800 million Euros by autumn 2013, in the form of additional investments in industry and research, new research centres and junior research groups. Today, the Free State of Saxony is home to one of Germany's most dense biotech research landscapes, ranked amongst Germany's top five biotechnology regions. This high-tech industry is a kaleidoscope of more than 30 excellent university and non-university research institutions, about 200 internationally-staffed working groups, over 65 biotechnology companies with more than 2,000 employees, as well as ten pharmaceutical companies and about 70 innovative service providers, with a total of more than 6,000 mostly highly-qualified employees.

www.biosaxony.com

Zebra fish colony at the DFG Research Center for Regenerative Therapies Dresden –Cluster of Excellence (CRTD), which was able to confirm its status as a DFG Research Centre for the third time in June 2012 with its successful application for continued support under the Excellence Initiative.
Currently, there are only six DFG-funded centres of this kind nationwide. | Photo: Karsten Eckold

Staff at the German Centre for Neurodegenerative Diseases in Dresden | Photo: Steffen Giersch

Medicine/biomedical technology/neurosciences are growing into an equally promising field. Thanks to their faculties of medicine and university hospitals, Leipzig and Dresden are home to important regional science centres for medicine. Their work is complemented by institutions in the Max Planck Society and *Fraunhofer-Gesellschaft,* the Research Centre for Life Science Engineering at Leipzig University of Applied Sciences, as well as LIFE Leipzig – Leipzig Research Centre for Civilization Diseases and OncoRay Dresden – Center for Innovation in Radiation Oncology.

www.life.uni-leipzig.de **www.oncoray.de** **www.fz.htwk-leipzig.de**

As a result, Saxony today enjoys a solid infrastructure in medicine, biomedical engineering and neurosciences. This scientific landscape thrives on the collaboration of its engineers, natural scientists and medical practitioners from universities, universities of applied sciences and research institutions in Leipzig, Dresden and Chemnitz.

In this context, the foundation of German Centres for Health Research, with the central mission of exploring widespread diseases, has been of special importance to Saxony. In a national selection process to determine six German Centres for Health Research, Dresden researchers were able to acquire three of these national centres for institutions located in the Saxon capital: the German Centre for Diabetes Research – DZD, the German Centre for Neurodegenerative Diseases and the German Consortium for Translational Cancer Research – DKTK.

With the founding of the National Cohort, Germany now has a unique resource for biomedical research. This representative, population-based, long-term study will produce reliable statements about the causes of widespread diseases in interplay with genetic predisposition, lifestyle and environmental factors. In Saxony, the research site for the National Cohort is the Medical School at Leipzig University.

www.nationale-kohorte.de

With more than 500 researchers, Saxony and Saxony-Anhalt are building one of the largest centres for water research in Europe, the Centre for Advanced Water Research – CAWR. TU Dresden and the Helmholtz Centre for Environmental Research – UFZ Leipzig signed a cooperation agreement to this effect in October 2013. Both partners will pool their existing capacity at the new centre to help solve global problems of integrated water resource management.

Scientists from the Free State of Saxony were extremely successful in the Twenty20 – Partnership for Innovation competition run by the Federal Ministry of Education and Research. Five of the ten winning consortia are coordinated by Saxon researchers. The winning projects will receive federal funding amounting to 45 million Euros each. Nine other projects made it to the second round of the competition, four of them spearheaded by Saxon researchers. These projects will receive funding of one million Euros each.
www.unternehmen-region.de

A Saxon Recipe for Success.

BA Sachsen University of Cooperative Education

Above: Studying at BA Sachsen means closely combining theory and practical application. This includes project work, as shown here in the Business Informatics Programme at the academy in Bautzen. | Photo: University of Cooperative Education Bautzen

Hands-on studies in biomedical engineering in Bautzen, event and sports management in Riesa or automobile management in Glauchau – in Saxony, students can do all of the above in three-year programmes. BA Sachsen University of Cooperative Education has gained a firm foothold in the Free State over the past two decades with its courses in social studies, technology and business at seven academies in Bautzen, Breitenbrunn, Dresden, Glauchau, Plauen, Leipzig and Riesa.

What makes it special: Theory and practical application are closely intertwined in these three-year dual academy programmes with a business, technical or social focus. Students are prepared for their professional careers both at the academy and in the field with their partner in industry. Currently, BA Sachsen has about 10,000 industrial partners. The programme is open to candidates who hold higher education entrance qualifications, such as *Abitur, Fachabitur,* other subject-specific qualifications, a German *Meister* diploma (in the respective subject) with equivalent prior education credentials, or those who pass an entrance examination. For anyone looking for fast, hands-on professional training, BA Sachsen is the right address.

The advantages of a BA Sachsen programme: Alternating between theoretical studies at one of the academies and practical training with a recognised industrial partner, students can obtain a Bachelor's degree within three years while enjoying individual mentoring in small seminar groups, compact schedules, and no *numerus clausus* (restricted admission depending on average marks in higher education entrance qualifications). Another plus for students: The business partners, with whom applicants sign a training contract, pay salaries averaging about 550 Euros per month, depending on the company. After successfully completing the BA programme, the Free State of Saxony confers an internationally recognised Bachelor's degree, which qualifies graduates to embark on a Master's course at a university. The Saxon economy benefits greatly, as well, harvesting cohort after cohort of well-trained BA Sachsen specialists.

BA Sachsen's **success story** over the last 20 years can boast 20,000 successful graduates. From its beginnings with just 81 students at three academies, enrolment figures have now grown to 4,600 young students in seven different locations.

- www.ba-dresden.de
- www.ba-breitenbrunn.de
- www.ba-breitenbrunn.de
- www.ba-glauchau.de
- www.ba-bautzen.de
- www.ba-leipzig.de
- www.ba-riesa.de
- www.ba-riesa.de
- www.ba-plauen.de

Virtual reality at TU Bergakademie Freiberg. | Photo: TU Freiberg

Investing in the Future.

More third-party funds: The 2012 Technology Report, published by the Saxon State Ministry for Higher Education, Research and the Arts, contains various performance indicators for research in Saxony. These include expenditure on research, data on successful third-party fundraising, participation in federal and EU programmes, as well as the success rate for the acquisition of private sector research contracts. Whilst university professors in Germany were able to raise an average of 261,700 Euros in third-party funding in 2010, researchers in Saxony averaged 360,650 Euros in the same year.

Billions invested: In 2011, the Free State of Saxony spent 2.92 per cent of its GDP on research and development. The European Union, the Federal Government and the Free State of Saxony as well as businesses provided 2.8 billion Euros for research and development. Based on GDP, only Baden-Württemberg, Berlin, Bavaria and Hessen invested more in research and development in Germany.

The green laser beam at TROPOS – Leibniz Institute for Tropospheric Research can be seen above Leipzig at night. Researchers developed a lidar system that emits laser pulses into the atmosphere which are then reflected by small particles. Photo: Tilo Arnhold/TROPOS

Extensive research connections: Universities and non-university research institutions are well connected in Saxony. Most heads of non-university research institutions are also professors at Saxon universities, which ensures stable collaboration. Universities and non-university research institutions also collaborate on research projects and training junior researchers.

Well-built partnerships: It takes quality cooperation between science and industry to transfer scientific insight into innovative products and services quickly. The Saxon State Ministry for Higher Education, Research and the Arts has set up Science Forums to strengthen networking and partnerships within Saxony's science regions. This has the advantage that, today, Saxony's scientific research focus areas reflect those of Saxon companies that are continuously engaged in research and development.

Strong industrial research: Saxon companies have been able to increase their research and development activities significantly in recent years. Over the past decade, expenditure on research and development (R&D) increased by approximately 60 per cent. Whilst Saxon companies that are continuously engaged in research and development invested 665 million Euros in R&D in 2001, they increased this amount to 1.2 billion Euros in 2011. However, commercial investment in R&D in the Free State still falls short of the level appropriate for an industrial state like Saxony (the target being at least two thirds of total R&D). This is due mainly to the persisting fragmentation of the Saxon economy. In contrast to the West German *Länder*, Saxony, just like the other East German *Länder*, still relies to a large extent on its small and medium-sized enterprises to engage in continuous research and development. There are not enough large corporations which might assume R&D leadership.
The toolkit of technology promotion, in particular for collaborative projects, is a decisive force driving overarching creative and innovative processes in science and industry in Saxony. Programmes like *InnoPrämie* encourage companies that do not yet conduct their own research and development to enter into dialogue with research institutions. For companies that are already engaged in successful R&D of their own, the focus is on intensifying collaborative partnerships with Saxon research institutions. Knowledge-based spin-offs from universities and non-university research institutions remain indispensable.

For the Technology Report visit www.technologie.sachsen.de
For the Research Report visit www.forschung.sachsen.de

The Federal Cluster of Excellence MERGE Technologies for Multifunctional Lightweight Structures at TU Chemnitz is Germany's only cluster in the pivotal and highly competitive field of "lightweight construction" Photo: TU Chemnitz/Hendrik Schmidt

Lab research at TU Dresden's Institut für Angewandte Photophysik. | Photo: Karsten Eckold

Promoting Research.

In addition to institutional support for universities and non-university research institutions, which amounted to approximately 866 million Euros in 2013 (not counting university medicine), the Free State of Saxony also promotes research and research infrastructure projects. The objective is to empower Saxon research to perform at the highest level, to extend its international academic connections, and to enhance networking between the institutions themselves and with industry. The Free State therefore funds individual and collaborative research projects, preferably in pivotal, interdisciplinary areas, and projects to prepare third-party grant applications or to acquire industrial research contracts.

The European Regional Develepmont Fund (ERDF) and the Free State co-finance projects to improve research infrastructure (e.g. new construction/renovation of buildings or equipment investments), but also fund innovative, application-oriented research ideas and projects with the aim of improving knowledge and technology transfer to industry.

Major funder: The German Research Foundation DFG

For years, Saxon universities have successfully been raising funds for research projects from science-funding organisations, federal and *Länder* ministries, foundations, businesses and other institutions. The major funder is the DFG which provides support for important programmes in Saxony such as SFBs (Collaborative Research Centres), DFG research centres and graduate schools.

www.dfg.de

Collaborative Research Centres (SFBs) are long-term research centres at universities where scientists cooperate in the context of cross-disciplinary research programmes (TU Dresden has eleven SFBs, Leipzig University has four, TU Chemnitz three, *TU Bergakademie Freiberg* two).

Focus Programmes are established when the coordinated promotion of a certain specialist field holds the promise of major scientific advancement.

The objective of **DFG Research Centres** is to concentrate one university's academic expertise on particularly innovative research fields. This enables universities to develop temporary research focus areas with high international visibility.

The Saxon State Ministry for Higher Education, Research and the Arts supports a special humanities programme by contributing at least 800,000 Euros per year. The projects are selected in a competition held by the Saxonian Academy of Sciences and Humanities.
www.saw-leipzig.de

An example for support from the European Regional Develepmont Fund (ERDF) is the Translational Centre for Regenerative Medicine (TRM) in Leipzig. The B-wing of the former gynaecology department of the university hospital, which is a listed building, was modernised and renovated on the strength of ERDF funds of 9.75 million Euros and Saxon state funds of 3.25 million Euros. The mission of the centre is to intensively study the self-healing powers of the human body. The research is expected to yield new therapy approaches to Parkinson's disease, paraplegia, cancer and diabetes.
www.trm.uni-leipzig.de

At the internationally renowned DFG-Research Center for Regenrative Therapies TU Dresden – Cluster of Exzellence (CRTD), scientists from 28 different nations are exploring the self-healing powers of the human body in order to develop new regenerative therapies. CRTD scientists work across disciplines with more than 90 Dresden-based research groups at TU Dresden, Carl Gustav Carus University Hospital, the Max Planck Institute of Molecular Cell Biology and Genetics as well as the Max Bergmann Centre of Biomaterials and other partners. The core groups conduct their research in the new 6,700 square metre CRTD building in the immediate vicinity of TU Dresden's Biotechnology Centre (BIOTEC).. **www.crt-dresden.de**

The hallmark of DFG research centres is the extent to which they are interdisciplinary, internationally-minded and interconnected. The 7th DFG research centre focussing on biodiversity, the **German Centre for Integrative Biodiversity Research – iDiv,** was approved in 2012 and connects Leipzig University with the universities of Halle-Wittenberg and Jena. The grant also includes support for eight non-university research institutions which, together with the universities, are now driving forward the establishment of the centre.
The **Center for Regenerative Therapies TU Dresden (CRTD)** has been receiving support since 2006.

www.idiv-biodiversity.de **www.crt-dresden.de**

Researcher groups are alliances of several researchers who collaborate on a particular research topic. Their work often helps establish new research directions at the universities.
Graduate Schools are long-term, but non-permanent institutions at universities to promote junior researchers (PhD candidates) by involving them in research (TU Dresden: 6, Leipzig University: 4, TU Chemnitz: 1; as well as the international Graduate Schools: Leipzig University/ Netherlands, TU Chemnitz/China and the Integrated Graduate Schools at Collaborative Research Centres: TU Dresden: 3, Leipzig University: 1, TU Chemnitz: 1, TU Bergakademie Freiberg: 2).

www.forschung.sachsen.de

Smart Support for Smart Minds

Saxony is particularly supportive of young scientists and is the first federal state to use funds from the European Social Fund (ESF) for this purpose on a large scale (187 million Euros between 2007 and 2013). A number of different support tools are used to keep these bright minds in the Free State, continue their training and utilise their potential. For instance, 362 PhD projects received support amounting to almost 25 million Euros, and 95 junior research groups received a total of 105 million Euros from the European Social Fund and the Free State of Saxony. In addition, Saxony built and expanded its career services, research networks and post-graduate education opportunities.

www.studieren.sachsen.de

Junior engineers from four departments at Leipzig University of Applied Sciences are looking for ways of preserving the existing building fabric whilst designing buildings as ecologically as possible. The project received 900,000 Euros from the European Social Fund (ESF) and the Free State of Saxony. Photo: Kristina Denhof

Saxon Excellence Initiative

The Saxon Excellence Initiative was launched in June 2007. Until 2014, the Free State of Saxony is providing some 160 million Euros from the European Regional Develepmont Fund as well as from its own funds for top-level research.

Functional Structure Design of New High-performance Materials by Atomic Design and Defect Engineering (ADDE) – *TU Bergakademie Freiberg*
http://tu-freiberg.de/ze/adde/

European Centre for Emerging Materials and Processes Dresden (ECEMP) – TU Dresden
http://ecemp.tu-dresden.de

Energy-efficient Product and Process Innovations in Production Engineering (eniPROD) – TU Chemnitz
www.eniprod.tu-chemnitz.de

Leipzig Research Centre for Civilization Diseases - LIFE – Leipzig University
www.life.uni-leipzig.de

OncoRay – National Center for Radiation Research in Oncology – TU Dresden, Carl Gustav Carus University Hospital, and *Helmholtz-Zentrum Dresden-Rossendorf*
www.oncoray.de

Implementing Bright Ideas Fast.

The speed at which a new insight makes its way from the lab to the market often determines economic success, a mantra that applies to individual companies as well as entire federal states. The Saxon Technology Report is published at regular intervals to inform the public about the technological performance of the Free State of Saxony. It determines Saxony's position in relation to other regions and uses various indicators to analyse strengths and weaknesses as well as opportunities and risks. Overall, Saxony has held and continuously improved its position in the upper mid-field of German federal states.

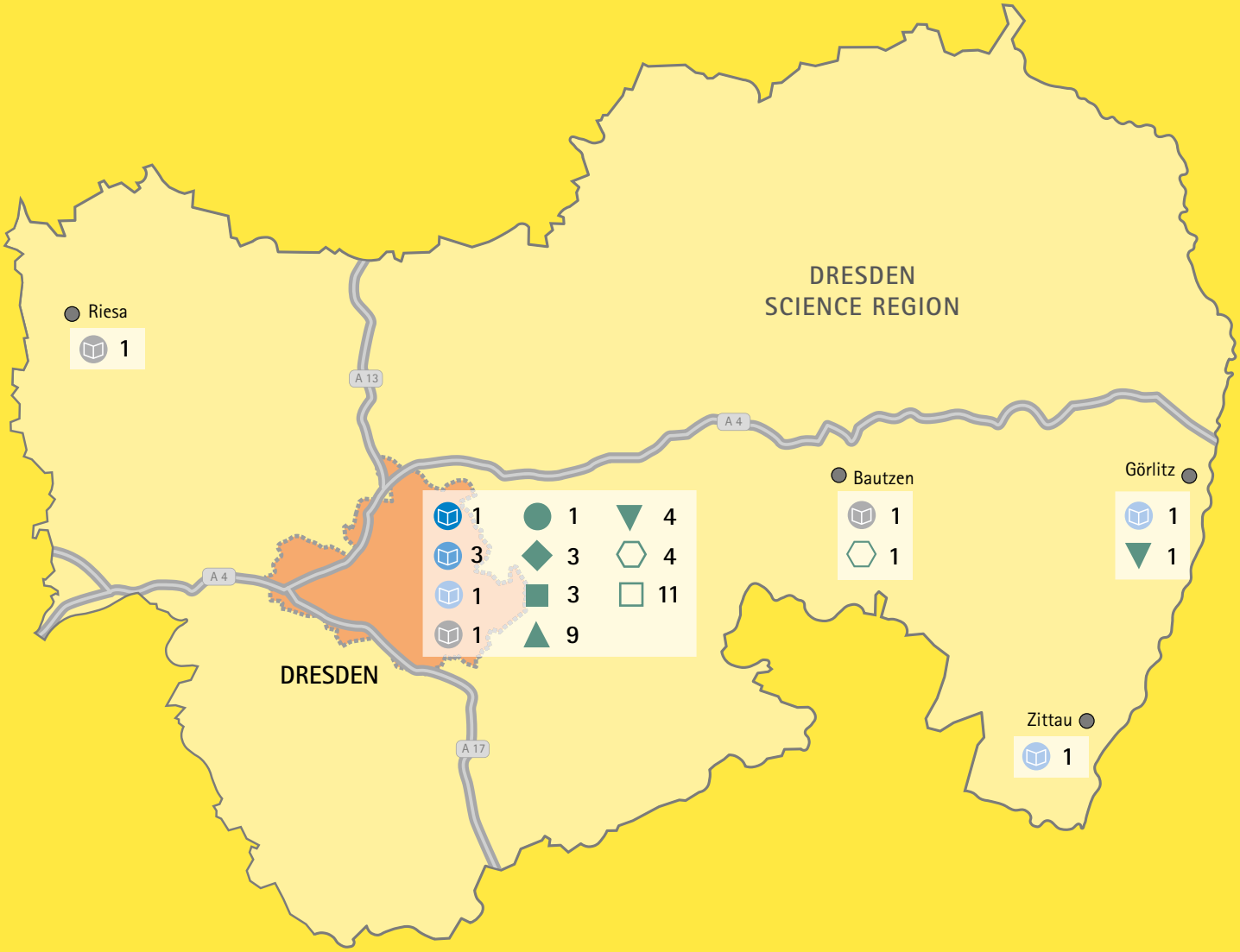
The vision is to make the Free State of Saxony, both academically and economically, one of Europe's leading regions by 2020. To achieve this, Saxon technology policy pursues the following objectives:

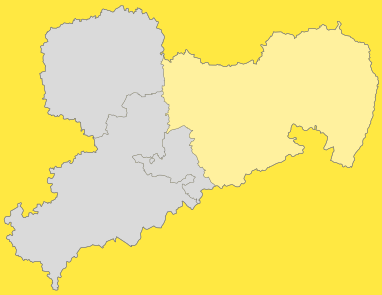
- Strengthen the technological competitiveness of Saxon businesses, in particular small and medium-sized enterprises (SMEs)
- Facilitate projects in research and development that would not be possible without public support
- Bring the world's best know-how to Saxony's small and medium-sized enterprises
- Provide incentives for businesses to entrust junior researchers with more tasks in research and development
- Encourage close collaboration between research institutions, universities and businesses
- Increase and improve commercial exploitation of Saxony's research and development potential
- Increase the participation of Saxon businesses and research institutions in national networks and European technology collaborations
- Strengthen technology-related networks and clusters in key technologies
- Drive forward the internationalisation of Saxon businesses
- Enhance Saxony's appeal as a high-tech location for national and international investors and researchers
- Boost the effectiveness and efficiency of products and processes (e. g. for resource conservation)

Technology policy thus contributes significantly to stable economic growth, sustainable development and helping to secure existing as well as creating new future-proof jobs.

- **www.technologie.sachsen.de**

Above: Innovation made in Saxony. In his role as innovation assistant, Dr Martin Schneider, a specialist in precision-farming technology, has developed a new method to measure differences in pH values on agricultural land, which helps exploit it more efficiently. Agri Con GmbH was able to employ Dr Martin Schneider with support from the European Social Fund. | Photo: Jörn Haufe





1 Number of institutions

Universities, plus the Zittau site

Universities of Fine Arts

Universities of Applied Sciences

University of Cooperative Education

Helmholtz institutions

Sites of German Centres for Health Research

Max Planck institutes

Fraunhofer institutes and establishments

Leibniz institutes

Free State financed research institutions

Affiliated institutes at universities

For an overview of the institutions in the Dresden Science Region, please refer to p. 60 ff.

»Dresden Science Region

Photo: TU Dresden

Scientists in the cleanroom at the TU Dresden Nanoelectronic Materials Laboratory (NaMLab). | Photo: Frank Johannes

Knowledge generates excellence.

Technische Universität Dresden

New therapies for previously incurable diseases; unconventional approaches to Electronics; bridges made from textile-reinforced concrete; monasteries as innovation centres – the breadth of research topics at *Technische Universität Dresden* leaves no doubt that it has established and will continue to expand its profile as a comprehensive university.

Technische Universität Dresden is one of the top universities in Germany and Europe: it is strong in research, offers study programmes that excel in both range and quality, and is also closely connected with the arts, business and society. A modern comprehensive, multi-discipline university with 14 faculties, its broad and diverse academic spectrum is matched by only few other universities in Germany. It is Saxony's largest university. TU Dresden's extensive campus community embraces 37,000 students and approximately 7,700 employees. About 4,300 of these positions (including 492 professorships) are funded by the Free State of Saxony, the remaining 3,400 by third-party funds.

On 15 June 2012, TU Dresden earned the title of University of Excellence in the first phase of the German federal and state governments' Excellence Initiative. It was recognised for its Institutional Strategy or *Zukunftskonzept* – "The Synergetic University", its Cluster of Excellence Center for Advancing Electronics Dresden (cfaed) and the two follow-up proposals, Center for Regenerative Therapies TU Dresden – CRTD and Dresden International Graduate School for Biomedicine and Bioengineering – DIGS-BB. TU Dresden is thus one of Germany's eleven universities of excellence and the only one in the eastern German states outside of Berlin.

This success in the Excellence Initiative corroborates TU Dresden's recent performance as well as the quality of its future strategy and potential for development.

"The Synergetic University" spells out TU Dresden's vision for the future and is funded for a five-year period to the tune of 60.2 million Euros in total. According to this strategy, TU Dresden is pursuing four central objectives: first of all, to attract the best scientists, staff and students from all over the world to TU Dresden. This includes, for instance, an innovative appointments procedure, special development programmes for outstanding students and junior researchers, as well as the development of a Graduate Academy. The second objective is to establish new IT systems and improve structures to provide optimum support for all

Student preparing samples at a scanning force microscope. | Photo: Lothar Sprenger

Students in the Institute for Planetary Geodesy. Photo: Lothar Sprenger

students, teachers and researchers. This is closely linked to the third objective, which is to create integrated and efficient structures by consolidating the 14 faculties into five sections. The aim of the new sections is to generate greater independence, stronger synergies, more interdisciplinarity, greater scope and flexibility. It is assumed that the synergies sparked by this new structure will be felt both in research and teaching. The new sections will enjoy much greater flexibility and independence in terms of staffing, finances and strategic planning than the faculties do at present. Research, in particular, could fund new projects jointly, build shared research infrastructures, and implement new joint PhD programmes. The fourth pillar of the Institutional Strategy is the science network, DRESDEN-concept. Synergies between TU Dresden and non-university research institutions will further hone Dresden's scientific profile and enhance its appeal as a science location.

By far the most comprehensive measure within the Institutional Strategy is Open Topic Tenure Track professorships, first announced in 2013. It is an absolutely novel programme to enlist the world's best minds for research and teaching. These professorships are completely unrestricted in terms of contents and offer scientists the prospect of tenured employment if they sustain their performance for a period of five years. This novel programme has attracted enormous interest worldwide. TU Dresden received more than 1,300 applications, a quarter of them from women. The quality of the submissions proves that TU Dresden is perceived as a coveted employer nationally as well as internationally. Researchers from universities that are ranked amongst the world's top ten expressed their interest in TU Dresden's Open Topic Tenure Track professorships. Numerous applicants have already distinguished themselves in academia and received renowned awards and honours.

About 37,000 young people from around the world study at TU Dresden. | Photo: Lothar Sprenger

TU Dresden continually competes for the best students, the best researchers and teachers, and for third-party funds. This requires it to adopt a serious economic mind-set and practices as well as to build functioning partnerships with science, industry and the business community. Leading companies have recognised TU Dresden's commitment to practice-related teaching and research by sponsoring, amongst other things, a total of fifteen endowed chairs. TU Dresden is a member of the university alliance TU9.

As early as 1994, TU Dresden launched a patent initiative, unique in Germany, to secure the intellectual property rights for its inventors and facilitate the rapid transfer of their inventions into marketable products. TU Dresden is the source of about a third of all the patents that are registered by the nine leading universities of applied sciences in Germany.

TU Dresden is a very successful third-party fundraiser. In 2012, it raised 227.1 million Euros. Most of these third-party funds stem from public sources such as the Federal Ministry of Education and Research, the German Research Foundation and the European Union. Direct earnings from contract research are a growing source of income, as well.

Practical orientation and cooperation across disciplines benefit students, too. The guiding principle of teaching and research at TU Dresden is to involve students in on-going research at an early stage.

It is hard to imagine how all of Dresden's important new industries could have settled in the Saxony capital in recent years without the potential of TU Dresden. Names like Infineon, GLOBALFOUNDRIES and Volkswagen are shining examples of the many high-tech firms in the Dresden metropolitan area and the region known as Silicon Saxony.

http://tu-dresden.de **www.dresden-concept.de**

Scaling the heights.

Carl Gustav Carus Faculty of Medicine and University Hospital Carl Gustav Carus

Over the past two decades, the Carl Gustav Carus Faculty of Medicine and University Hospital have joined the top ranks of German university medicine. This holds true for patient care and research as well as for teaching: the model, Dresden Integrative Problem-, Application- and Patient-Oriented Learning, originally established in cooperation with Ivy League university Harvard, set nation-wide trends. Its forward-looking strategic focus on three core research areas earned Dresden's university medicine an excellent national and international reputation. As a result of their great success as a science location, the Hospital and Medical School have also developed into a significant economic factor. Today, numerous external funders sponsor excellent research projects in Dresden's university medicine, funding more than 700 additional positions in biomedical research. In 2012, the Medical School was able to increase its third-party funding by another 65 percent compared to the previous year. At about 77 million Euros, this is the best third-party funding total since the School was founded in 1993.

Another key to the success of Dresden's university medicine is the unique connection between research activities and innovative patient care solutions. Expert physicians and nurses at the University Hospital Carl Gustav Carus provide services for patients from the region in all areas of in- and out-patient care. As a maximum care hospital and a medical teaching facility, the hospital is a partner for general practitioners and hospitals in Dresden and eastern Saxony.

To best serve its patients, the University Hospital seeks to connect all its medical departments. Specialists collaborate closely in interdisciplinary, quality-certified centres in order to optimise the outcomes of therapy. Thanks to the great dedication of more than 6,000 staff at the Hospital and Medical School, the University Hospital earned another top slot in the 2013 rankings of German hospitals published by the news magazine FOCUS.

http://tu-dresden.de/med www.uniklinikum-dresden.de

Operating theatre at the Hospital and Outpatients' Department for Visceral, Thoracic and Vascular Surgery at Carl Gustav Carus University Hospital Dresden. | Photo: Carl Gustav Carus University Hospital/Christoph Reichelt

Above: Modern, state-of-the-art teaching of dentistry in the new phantom classroom featuring 32 interconnected and fully digitised dental simulation units. Photo: Carl Gustav Carus University Hospital

Unique atmosphere.

Dresden Academy of Fine Arts

They create monsters and save Madonnas. They make trees out of foam and turn modelling clay into art. They work with velvet and silk and run ideas through a compactor – these are the students and teachers at the Dresden Academy of Fine Arts. In its 250-year history, the Academy has produced numerous famous artists, and transformed itself time and again. Its special blend of programmes makes for a unique atmosphere.

Almost 600 students are in enrolled in five courses of study at the Dresden Academy of Fine Arts. The Fine Arts programme has a time-honoured tradition and, at the same time, strives to radiate into the present and future. The course in Art Technology and Conservation of Works of Art operates in the present to preserve artworks of the past. The courses in Stage Setting and Costume Design, on the other hand, address the fleeting moment of action in the theatre or other short-lived staged productions. In the post-graduate course in Art Therapy, artistic methods meet therapeutic approaches.

Students are able to use a number of art studios and workshops, amongst them the "graphics workshop", the "sculpture workshop", the "open media lab" and the "video studio". In addition, each programme has further specialist facilities, for example the excellent, up-to-the-minute restoration lab wing. The Academy buildings form part of a genius loci, a place with a distinctive atmosphere. Anyone who sets foot in the imposing Academy building on the *Brühlsche Terrasse* or takes a look around the remarkable *Oktogon* exhibition space is captivated by this special quality. The recently refurbished Academy building on *Güntzstraße* or the sunlit studios and workshops on *Pfotenhauerstraße* are equally fascinating.

www.hfbk-dresden.de

Setting up an annual exhibition.
Photo: Matthias Rietschel

Above: The Dresden Academy of Fine Arts on the *Brühlsche Terrasse* opens its doors to art lovers every year to showcase the products of its *Diplom* courses. In addition to temporary stage presentations, the display of the graduation pieces is a visual Eldorado attracting about 10,000 visitors annually.
Photo: Andrea Weippertt

Photo on the left: Stephan Floss

A state-of-the-art learning strategy.

Carl Maria von Weber University of Music Dresden

The *Hochschule für Musik Carl Maria von Weber Dresden*, one of the oldest academies of its kind in Germany, teaches more than 600 students from around the world as well as 150 pupils from the *Landesgymnasium* secondary school. With its courses at the university and the affiliated secondary school as well as its children's classes, the University of Music offers one of the most innovative and modern musical education concepts nationwide. The curriculum includes all classical disciplines, complemented by additional specialisations such as Chamber Music, Rhythm Training/Early Childhood Musical Education, Early Music, Improvisation (piano) and 20th-century Classical Music.

The Opera class performs regularly at the *Schauspielhaus Dresden;* and tours through Germany, Italy and Switzerland bear witness to the standard of training. Orchestra classes benefit from the Academy's close ties to the excellent orchestras, *Sächsische Staatskapelle* and *Dresdner Philharmonie*. The University of Music in Dresden was one of the first in Germany to make Popular Music an integral part of its teaching profile: Its department for Jazz/Rock/Pop, founded in 1962, significantly shapes this profile. Big Band, Jazz and Rock ensembles complement the portfolio and make for memorable moments in the daily life of the university, which also comprises special institutions, such as the institutes for Musicology, 20th-century Classical Music, Music Pedagogy and Learning, Performing Arts Medicine as well as the Centre for Music Theory, the Heinrich Schütz Archive and the Studio for Electronic Music.

Above: Making music takes dedication and persistence. Sometimes, it also takes courage, passion and a sense of humour, as proven by students at the Carl Maria von Weber University of Music Dresden in their opera production of "Falstaff" – a co-production with *Staatsschauspiel Dresden* and the Dresden Academy of Fine Arts in conjuction with the Dresden Music Festival. | Photo: HL Böhme

With its new concert hall, its small auditorium, as well as numerous outside venues such as the *Semperoper*, the university is the most prolific concert organiser in the region. More than 400 events are held every year – from children's concerts to opera, from workshops to master classes, from competitions to jazz gigs, from "Song in Dresden" to "Professors in Concert", right through to symphony, graduation and chamber concerts.

www.hfmdd.de

Expanding boundaries through dance.

Palucca Hochschule für Tanz Dresden

The guiding principle of the *Palucca Hochschule für Tanz* in Dresden is to foster creative learning, to encourage all students to discover their own unique language, regardless of whether they are training to become a dancer, dance instructor or choreographer, to learn, grow and become a creative, autonomous artist. Building on more than 85 years of tradition, the university has offered interdisciplinary dance training since 1925.

More than 200 students from 27 nations study on the new university campus where they are offered solid artistic/academic training that combines Bachelor's and Master's degrees. The curriculum focusses on individual expression, comprising the elements of Ballet, Contemporary/Modern Dance, and Improvisation, encouraging students to explore these three complementary disciplines. The idea is that the boundaries between Ballet, Improvisation and Contemporary Dance should disappear in order to inspire new forms of artistic expression. Continuous course development is designed to ensure the programmes are stimulating and inspiring from the first steps through to the Master's courses.

Dance has deep roots in Dresden. Artists like Wigman, Dalcroze, Kreutzberg, Palucca and today, Forsythe, embody the tradition of exploring new paths, progressing, and having the courage to be experimental. Today, the *Palucca Hochschule für Tanz Dresden* shares this vision for Dance with the Semperoper Ballet, the *Festspielhaus Hellerau* and the Forsythe Company, which enables the academy to generate numerous new initiatives and collaborations for the enrichment of all.

www.palucca.eu

Palucca Hochschule soirée at the Dresden *Semperoper*: "Serenade", choreography by George Balanchine
© The George Balanchine Trust.
Photos: Bettina Stöß/Stage Picture

Studying e-beam treated samples at the eblaboratory at HTW Dresden.

Achievement through experience.

Dresden University of Applied Sciences

The lab-greenhouses at the Pillnitz Campus are used for teaching and research in Horticulture. The students shown here are working on biological plant protection measures. | Photos: P. Sebb/HTW Dresden

Dresden University of Applied Sciences (HTW Dresden) is the second largest university in the Saxon capital. Founded in 1992, it now ranks among Germany's leading universities of applied sciences. Technology, Economics, Design, and "Green" Studies shape the course profile at HTW Dresden. The university`s eight faculties offer a broad spectrum of practice-oriented courses and a variety of applied research opportunities.

With approximately 5,400 students and 170 professors, the university strives to initiate major collaborations by networking its faculties and administrative offices. At the same time, HTW Dresden promotes personal contact between staff and students and facilitates individual mentoring.

Research at HTW Dresden primarily focusses on its four profile areas: Mobile Systems and Mechatronics, Foundations of Sustainable Living, Information Management Systems as well as Business Management and Start-ups. The university also has a large number of excellently equipped laboratories

The centrepiece of the profile area Foundations of Sustainable Living, is the "Sustainable Campus HTW Dresden", a research project to develop an exemplary university campus in Saxony that unites all three dimensions of sustainability – ecological, economic and socio-cultural.

At HTW Dresden, education and research are closely linked and strongly practice-oriented, as expressed in its slogan "Hands-on works better". Students can get involved in research projects at an early stage in their Bachelor's, *Diplom* and Master's courses. The best students can obtain a doctorate in the framework of a collaborative PhD programme.

Its application- and industry-oriented research makes HTW Dresden an important business partner in particular for small and medium-sized enterprises but also for large corporations in Saxony and beyond. The curriculum is aligned with current industrial requirements, and many of the faculties' research projects are conducted on behalf of industry.

Above: The motioncapture system at HTW Dresden is Germany's first markerless facility that can capture motion in real time to create a 3D-surface.

In 2012, HTW Dresden raised more than nine million Euros in third-party funding. The increase in the number of projects with foreign partners demonstrates the university`s growing involvement in international research.

HTW Dresden operates an office for research coordination/knowledge and technology transfer, which maintains permanent contact with the region's businesses and promotes the transfer of knowledge and technology to industry. The HTW Dresden start-up office serves as an incubator, supporting young entrepreneurs from the students' community as they develop and launch technology-oriented businesses and connecting them with partners in business and industry.

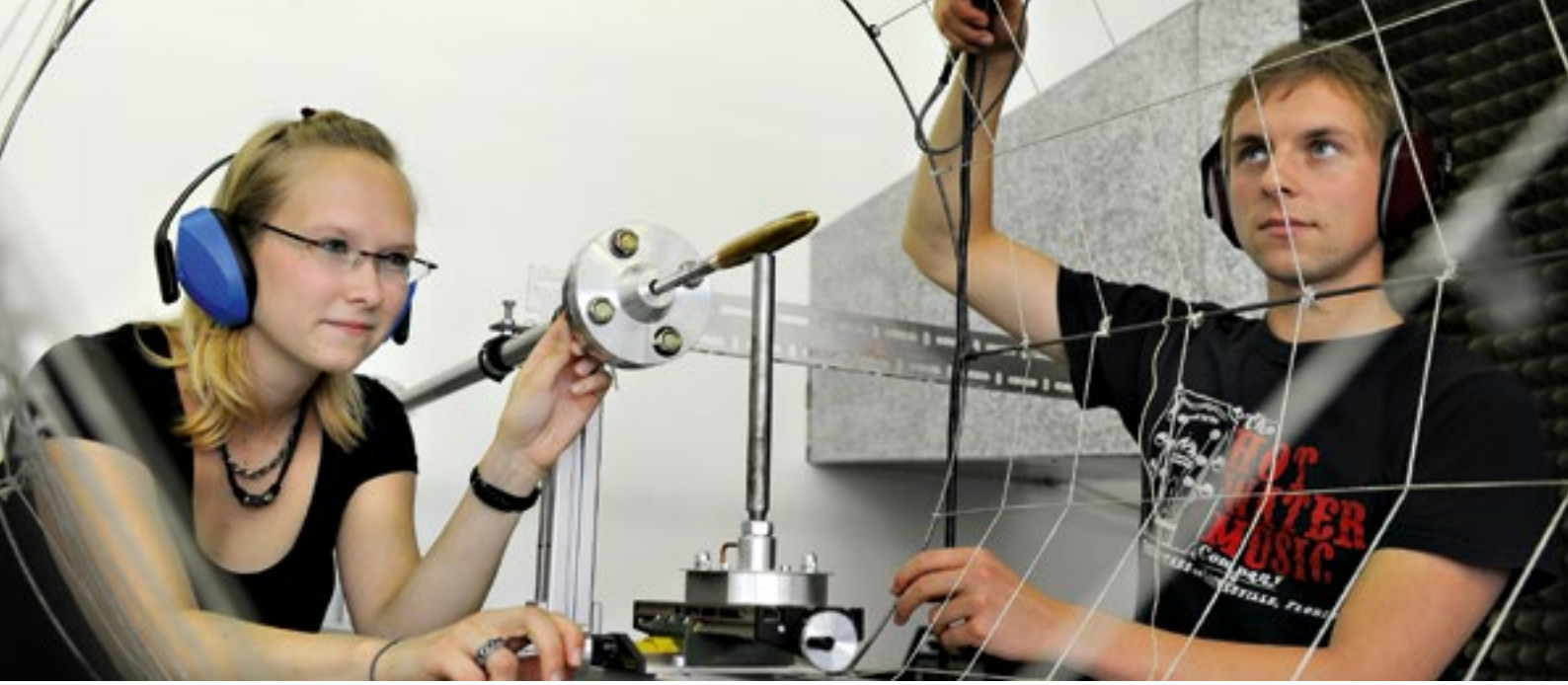
HTW Dresden is a member of HAWtech, the "University Alliance for Applied Sciences". The aim of this alliance, which involves five other universities, is to promote cooperation in teaching, research, technology transfer, continuing education, and university management amongst universities with a strong technical focus in different German federal states.

www.htw-dresden.de

The ZAFT Centre for Applied Research and Technology cooperates closely with HTW Dresden to support research activities, especially with regard to cross-disciplinary and cross-faculty projects. The strong interdisciplinary networking amongst faculties as well as cooperation with business, research institutions and technology centres creates a professional environment that generates innovative products, processes, and services. **www.zaft.htw-dresden.de**

Central building of HTW Dresden on the Friedrich-List-Platz Campus.


Hochschule
Zittau/Görlitz
Mathematik/
Sozialwissenschaften
Maschinenwesen
KIA - Duales Studium



Acoustic measurements | Photo: Peter Himsel/Stifterverband 3

Study without borders.

Zittau/Görlitz University of Applied Sciences

It is hard to imagine a place that could provide better opportunities to "study without borders" than Zittau and Görlitz. Here, amidst the delightful landscapes of the tri-border region between Germany, the Czech Republic and Poland, students enjoy courses with a hands-on focus and intensive personal support.

Low living costs, no tuition fees – as is the case throughout Saxony – a warm, intimate atmosphere, state-of-the-art facilities, and numerous contacts with regional, national and international businesses and institutions make the Zittau/Görlitz University of Applied Sciences an ideal setting for effective learning. Graduates have excellent career prospects. High graduate placement rates testify to the excellence of teaching and research.

Overall, the university offers 40 Bachelor's, *Diplom* and Master's programmes in Engineering, the Natural and Social Sciences as well as Economics. All Bachelor's and Master's courses are accredited. Its dual studies programme, a cooperative course with integrated practical training (KIA), is an excellent way to combine academic education with vocational training.

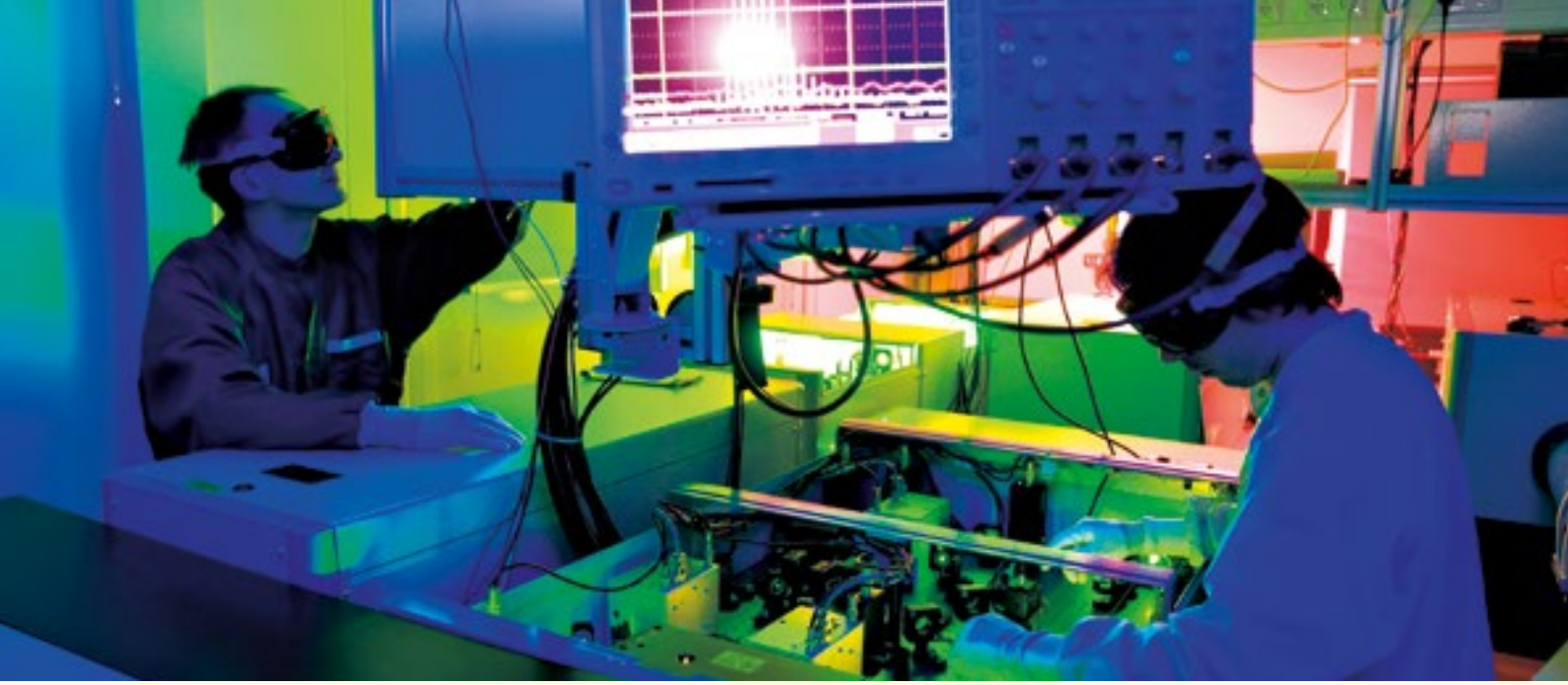
Intensive research activity is the basis for both solid academic teaching that is attuned to the current needs of industry as well as for the early involvement of students in research. Zittau/Görlitz is one of Germany's most successful universities of applied sciences in the field of research.

At Zittau/Görlitz University of Applied Sciences, 3,750 students benefit from ideal conditions with 122 professors and more than 360 other members of staff.

www.hszg.de

At the "Transparent Mechatronics Lab".
Photo: Peter Hennig

Photo on the left: the entrance hall of the Z IV building on the Zittau Campus. | Photo: Peter Hennig



Building tomorrow with sustainable research.

Helmholtz Association of German Research Centres

The Helmholtz Association has good reasons for invoking the name of Hermann von Helmholtz in its title. One of the greatest natural scientists of the 19th century, Helmholtz championed an approach to the natural sciences that connects medicine, physics and chemistry. Today, about 36,000 employees work in 18 Helmholtz Association research centres dedicated to the natural sciences/technology and biology/medicine.

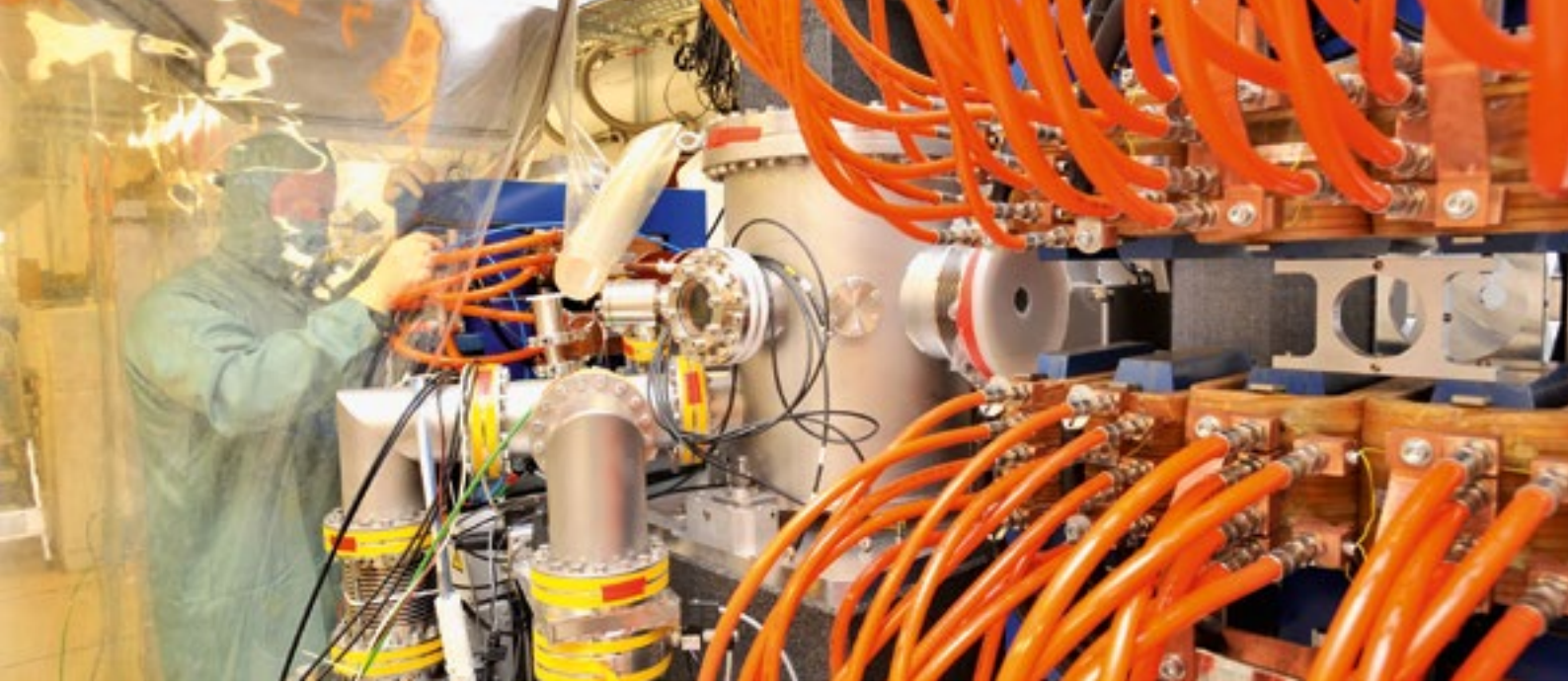
The Helmholtz Association works in six research areas to help address the major, crucial issues facing society, science and industry: Energy, Earth and Environment, Health, Key Technologies, Structure of Matter as well as Aeronautics, Space and Transport. Researchers work in these fields to secure mobility and energy supply, preserve an intact environment for future generations and develop therapies for previously incurable diseases.

The Free State of Saxony is home to two Helmholtz Centres and one branch institute, as well as the sites of three German Centres for Health Research.

The Helmholtz Centre for Environmental Research, which is based in Leipzig, explores the complex interactions between humans and their environment in developed and damaged landscapes, especially in densely populated urban and industrial metropolitan areas, as well as in semi-natural environments. In this context, water research is an important field. The *Helmholtz-Zentrum Dresden-Rossendorf* conducts research in Health, Energy and Matter. In the field of Health, cancer research is a significant focus. In cooperation with *TU Bergakademie Freiberg,* the Helmholtz Institute Freiberg for Resource Technology – which is part of HZDR – develops new industrial technologies for the more efficient supply and use, as well as the ecological recycling of raw materials containing minerals and metals. The Free State of Saxony is home to three German Centres for Health Research focussing on neurodegenerative diseases, cancer, and diabetes: The German Centre for Neurodegenerative Diseases, the German Consortium for Translational Cancer Research and the German Centre for Diabetes Research.

▮ **www.helmholtz.de**

Dresden physicists at the Helmholtz-Zentrum Dresden-Rossendorf working on compact laser accelerators for proton cancer therapy.
Photo: Rainer Weisflog



Research for tomorrow's world.

Helmholtz-Zentrum Dresden-Rossendorf

How can cancer be more precisely visualised, characterised and more effectively treated? How can resources and energy be utilised in an efficient, safe, and sustainable way? How do matter and materials behave under the influence of strong fields and at the smallest scale? Collaborating closely with universities and research institutes around the world, the *Helmholtz-Zentrum Dresden-Rossendorf* (HZDR) endeavours to find answers to these questions and conduct cutting-edge research in Energy, Health, and Matter.

A member of the Helmholtz Association, HZDR develops and operates large-scale equipment of international renown. Many guest researchers are able to take full advantage of Europe's highest pulsed magnetic fields – like those produced at the Dresden High Magnetic Field Laboratory – for their measurement needs. The main focus is on new materials, because the stronger the magnetic field, the more precisely substances can be examined that are eligible for use in novel electronic components and even superconductors. Intense particle beams are also able to reveal many latent material properties. Whilst researchers at the Ion Beam Centre pursue new physical approaches to electronics, magnetism, and optics in an effort to advance storage and computer technologies, highly diverse kinds of particles and beams are used at ELBE – Centre for High-Power Radiation Sources, both for basic research and for cutting-edge accelerator technologies. ELBE researchers are developing a particularly high-power laser to speed up the particles and build new laser-based accelerators. HZDR is working closely with its partners – Carl Gustav Carus University Hospital and TU Dresden – to establish a new proton therapy facility, which, in addition to a conventional ion accelerator to treat cancer patients, will also house the first laser accelerator for reference studies. Concurrently, Dresden researchers are working on radio-labeled substances for application in cancer diagnostics and therapy.

Some 1,000 staff are currently employed at three HZDR sites: the main site in Dresden-Rossendorf, a research site in Leipzig, and the HZDR Beamline at the European Synchrotron (ESRF), a large-scale research facility in Grenoble, France. The Helmholtz Institute Freiberg for Resource Technology also belongs to HZDR. Here, Helmholtz scientists cooperate closely with their colleagues at *TU Bergakademie Freiberg* to research new ways of processing, refining and recycling high-tech metals with the ultimate goal of securing stable industrial supply on a long-term basis.

www.hzdr.de

Above: Terahertz radiation is in great demand worldwide as it enables researchers to examine processes in organisms or materials particularly effectively. A facility is being built at the ELBE Centre for High-Power Radiation Sources, which will be able to emit radiation across a large wavelength range. | Photo: Frank Bierstedt

At the High Magnetic Field Laboratory Dresden, researchers investigate current topics in Solid State Physics. | Photo: Jürgen Jeibmann

Developing new approaches to therapy.

The German Centre for Neurodegenerative Diseases (DZNE) – Dresden site

The brain is a dynamic organ and its structure is directly linked to its function. This reciprocal relationship is known as "plasticity". Researchers at the Dresden site of the German Centre for Neurodegenerative Diseases investigate plasticity mechanisms in the adult and the ageing brain to understand how the brain can compensate for degeneration. The objective is to use findings from stem cell and plasticity research for the prevention and treatment of neurodegenerative diseases. Scientists develop biologically based strategies using the body's endogenous regenerative and compensatory mechanisms. Stem cells in the brain play an important, but not the only, role in this process. Stem cells generate neurons that are retained by the brain throughout life and have an elementary impact on neuroplasticity. If new neurons can be generated at any time, reserves can be built up in the brain to protect it from degenerative processes. In addition, stem cells can be used to develop new and improved models of complex neurodegenerative diseases.
The clinical focus in Dresden lies in identifying neurodegenerative diseases at an early stage and elaborating treatment strategies for early intervention.

▮ www.dzne.de/standorte/dresden.html

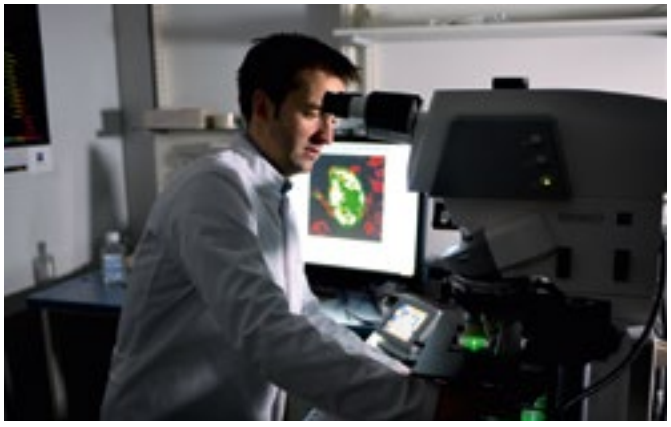
At the German Centre for Neurodegenerative Diseases (DZNE) – Dresden site. | Photo: Steffen Giersch

Focus on Diabetes.

German Centre for Diabetes Research – Paul Langerhans Institute Dresden

When the German Centre for Diabetes Research (DZD) was founded in 2009, the Paul Langerhans Institute Dresden (PLID) was established at University Hospital Carl Gustav Carus Dresden. It has since established itself, both nationally and internationally, as a major player in the field of diabetes research. For more than ten years, diabetes research has been one of the pillars of the Medical School, and the appointment of eminent professors from Germany and abroad has further enhanced its outstanding performance.
The main research focus at the Paul Langerhans Institute Dresden is on pancreatic islets, the hormone-producing cell clusters in the pancreas. Beta cells, which are the most prolific cell type in pancreatic islets, play a central role in diabetes as they produce insulin in the human body. The main objective in Dresden is to prevent the destruction of beta cells and to treat insufficient insulin production.
The Paul Langerhans Institute Dresden also has a singular position as the only German transplant centre for human pancreatic islets. Generally, interdisciplinary cooperation plays a key role at PLID. Experts from different scientific disciplines like Genetics, Immunology, Cell- and Developmental Biology collaborate closely with the clinical departments of Internal Medicine and Visceral-, Thoracic- and Vascular Surgery, implementing a translational research approach that applies basic research outcomes to clinical practice. The outstanding scientific infrastructure in Dresden is the foundation for future scientific excellence. The development of a human pancreatic islet biobank, for example, will facilitate diabetes research on humans directly and may ultimately lead to new diabetes drugs. Currently, Dresden scientists are testing a vaccine for the prevention of type 1 diabetes in children. A platform for high-throughput screening will enable the future identification of active agents.

▮ www.dzd-ev.de/partner/tu-dresden/index.html
▮ www.plid.de



Microscope workstation at the German Centre for Diabetes Research – Paul Langerhans Institute Dresden. | Photo: Michael Haggenmüller

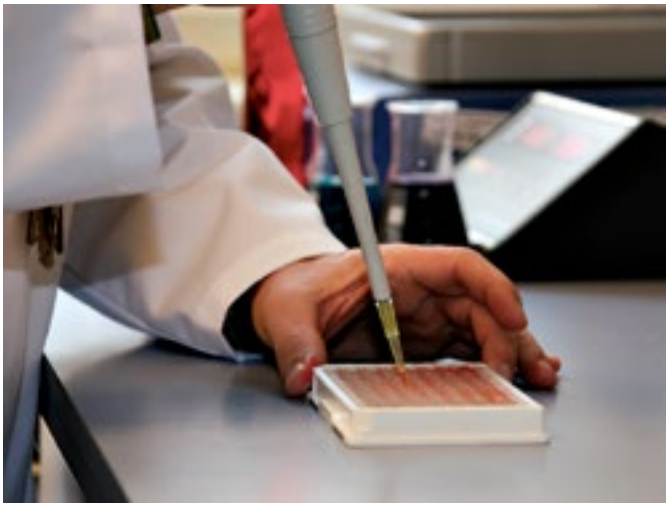
Optimum cancer therapy.

German Consortium for Translational Cancer Research
University CancerCentre Dresden

The University CancerCentre (UCC) guarantees optimum, multi-disciplinary and personalised state-of-the-art cancer therapy. UCC focusses on trans-disciplinary clinical care as well as advancing cancer research and teaching, a close interconnection that produces formative standards for high-quality oncological patient care. Many experienced UCC specialists not only work as physicians, but are also involved in university teaching and cancer research. This ensures that important scientific projects in Oncology are conducted at the highest level, based on the latest state of research.

The University CancerCentre Dresden was founded jointly in 2003 by the University Hospital and the Carl Gustav Carus Faculty of Medicine. It was one of Germany's first university Cancer Centres and the first of its kind in the eastern German states. Following an intensive evaluation, the German Cancer Association, *Deutsche Krebshilfe e.V.*, listed the Dresdner University CancerCentre as an "Oncological Centre of Excellence" for the first time in 2007.

UCC covers all oncological specialties: Daily tumor conferences for various types of cancer are held at which specialists from all the necessary disciplines synchronise each patient's individual therapy plan.



https://ucc.med.tu-dresden.de

German Consortium for Translational Cancer Research
University CancerCentre Dresden | Photos: University CancerCentre Dresden

Research at the Max Planck Institute of Molecular Cell Biology and Genetics. | Photo: MPI-CBG

“Insight must precede application” Max Planck

The Max Planck Society

Since its establishment in 1948, no fewer than 17 Nobel laureates have emerged from the ranks of the Max Planck Society's scientists, putting it on a par with the best and most prestigious research institutions worldwide. Max Planck Institutes are exclusively built up around the world's leading researchers. They themselves define their research subjects and are given free rein in selecting their staff. This is the core of the time-proven Harnack principle, which dates back to Adolph von Harnack, the first president of the Kaiser Wilhelm Society, which was established in 1911.

82 Max Planck Institutes with more than 17,000 employees, including 5,400 scientists, currently conduct basic research at the service of the general public in the Natural Sciences, Life Sciences, Social Sciences and Humanities. Max Planck Institutes focus on research fields that are particularly innovative, or that are especially demanding in terms of funding or time requirements.

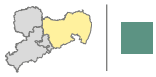
Since 1990, six institutions have been founded in the Free State of Saxony under the umbrella of the Max Planck Society, a strong basis for long-term excellence in fundamental research in the Life Sciences and Natural Sciences. The Max Planck Institute (MPI) for the Physics of Complex Systems was the first institution in Saxony, founded in Dresden in 1993. In 1994, today's Max Planck Institute for Human Cognitive and Brain Sciences was established in Leipzig, and in 1995, two additional institutions opened their doors, the Max Planck Institute for Mathematics in the Sciences (MIS) in Leipzig and the Max Planck Institute for Chemical Physics of Solids in Dresden. In 1997, the two latest additions opened up: the Max Planck Institute of Molecular Cell Biology and Genetics in Dresden and, in Leipzig, the Max Planck Institute for Evolutionary Anthropology. Saxony's Max Planck Institutes have continued to expand and maintain their research performance since 1997. One of the Max Planck Society's most important projects in the period up to 2017 is the development of a centre for Systems Biology at the Max Planck Institute of Molecular Cell Biology and Genetics in Dresden.

In 2009, the Free State of Saxony became the patron of one of five international Max Planck Society institutes, the Bibliotheca Hertziana in Rome, Italy, which dates back to 1913 and is now the Max Planck Institute for Art History. It is one of the oldest institutions within the Max Planck Society and explores Italian art in Roman post-antiquity.

www.mpg.de

Focus on Theoretical Physics.

Max Planck Institute for the Physics of Complex Systems



The institute researches the physics of complex systems from classical to quantum physics and focusses on three main areas, reflecting the research in its three permanent divisions. The Condensed Matter division studies quantum solid state physics whilst the Finite Systems division investigates the nonlinear dynamics of atoms, molecules and clusters with the help of semi-classical (micro-local) methods; the Biological Physics division explores dynamic processes in biological systems.

One permanent and six temporary research groups as well as five junior research groups strengthen and connect research on topics such as X-rays in Quantum Optics, Collective Dynamics of Cells, Computational Biology and Evolutionary Genomics or Complex Dynamics in Cold Gases. The institute has a large visitors' programme with about 60 post-doc positions for a maximum of two years as well as an extensive workshop and seminar programme averaging 20 annual events lasting from a few days to two months. The objective of these events is to showcase new research trends and familiarise junior researchers with rapidly evolving new research topics faster than has been the case in the past. Together with the university and the City of Dresden, the institute also organises "Science at the Town Hall", a series of sessions open to the citizens of Dresden, which have been held at the Town Hall since 1999.

Scientists at an international workshop. | Photo: René Gaens

www.mpipks-dresden.mpg.de

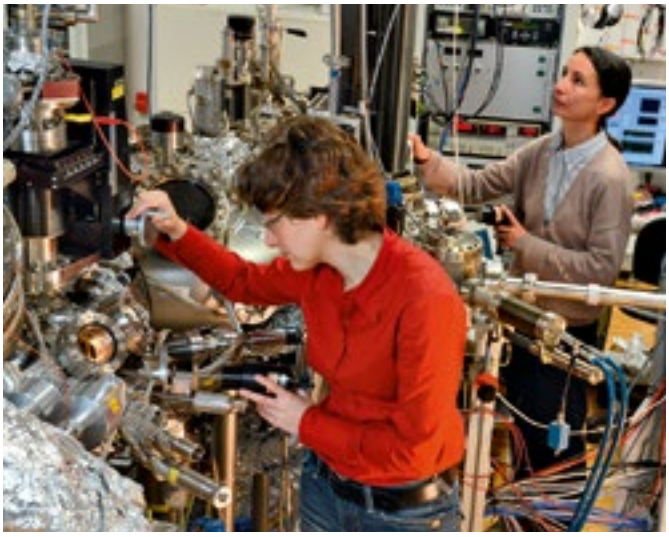
Searching for new phenomena.

Max Planck Institute for Chemical Physics of Solids

The aim of the Max Planck Institute for Chemical Physics of Solids is the experimental investigation of inorganic materials with novel chemical and physical properties. An international team of chemists and physicists uses the latest synthesis and analytical methods, in particular to explore the interplay between crystal and electronic structures and the properties of these materials.

The research focus lies on the design and synthesis of new compounds, investigating phase equilibration and phase transformations, and on searching for completely new phenomena under extreme conditions in materials in which electrons interact strongly. The institute also cooperates with partners from research and industry for its application-relevant research, for example in the development of what is called thermoelectric materials – which convert waste heat into electricity – or materials for spintronic devices which promise new functionality by exploiting the intrinsic spin of the electron in charge transfer.

www.cpfs.mpg.de



Ultrahigh vacuum facility for the production and study of thin layers.
Photo: Steffen Giersch

“Best place to work”.

Max Planck Institute of Molecular Cell Biology and Genetics

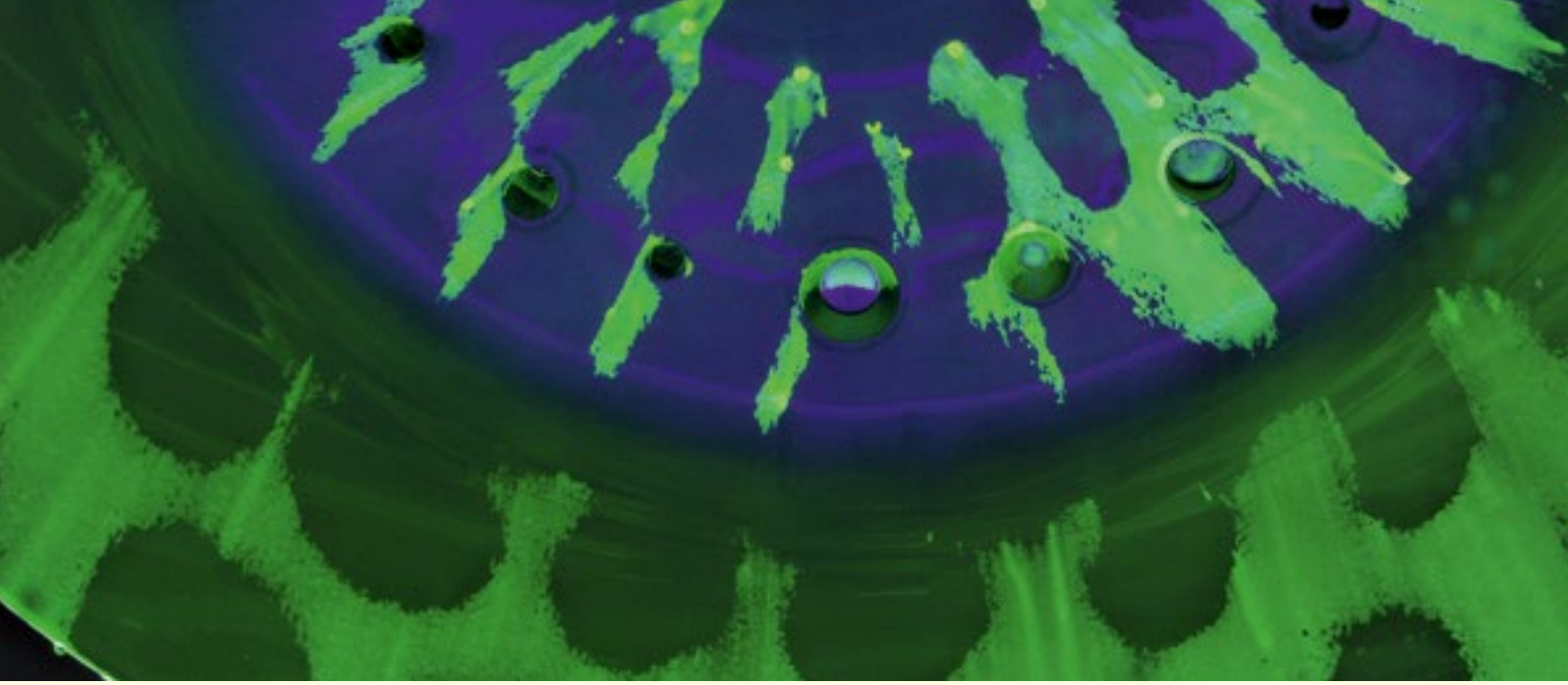
The Max Planck Institute of Molecular Cell Biology and Genetics (MPI-CBG) was founded in 1998 and started working in its new building in Dresden-Johannstadt in 2001. The institute combines Developmental, Cell and Systems Biology to investigate how cells form tissues. More specifically, researchers are interested in how the morphology of cells and tissues emerges from the interactions between individual molecules and cells. The research programmes span multiple scales of magnitude, from molecular assemblies to organelles, cells, tissues, organs and organisms. 25 research groups are currently searching for insights into basic cellular processes using model organisms such as nematodes, drosophila, zebrafish, and mice.

A special feature of the institute is its structure: There are no departments, but a network with a non-hierarchical structure that guarantees interactions and communication amongst the research groups. Half of the institute's total staff of 400 is international, representing 45 nations. In 2009, *The Scientist* voted the MPI-CBG the “Best place to work” for post-docs and academic staff. It was ranked number one amongst the top ten research institutions outside of the USA and is the only German institution in the top ten. In 2012, the institute received the Innovation Award of the capital city of Dresden as the city's “most family-friendly company”.

www.mpi-cbg.de

Pioneers at work: researchers at MPI-CBG reveal the barely visible. | Photo: MPI-CBG

The drosophila melanogaster fruit fly helps us understand human biology: it serves as a quick and easy reference for studying the impact of genetic defects. | Photo: MPI-CBG



"Cleaning test" at the Fraunhofer Institute for Process Engineering and Packaging IVV, business unit of Processing and Packaging Machinery in Dresden. | Photo: IVV

Research for practical applications.

Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.

It all began with an office with a staff of three in 1949. Today, Fraunhofer is a vital, large and influential player in Germany's business and science world. It owes its name to Munich-based scholar Joseph von Fraunhofer (1787–1826), who enjoyed equal success as a scientist, inventor and entrepreneur.

With more than 22,000 employees, today's *Fraunhofer-Gesellschaft* is Europe's largest organisation for applied research, currently operating 66 Fraunhofer institutes and independent research facilities. With its central mission of "research for practical applications", the *Fraunhofer-Gesellschaft* cooperates closely with private and public sector clients to drive innovation and the development of key technologies. Its research revolves around human need, in terms of health, safety, communication, mobility, energy and the environment.

Today, the Free State of Saxony is a geographic hub of the *Fraunhofer-Gesellschaft*. This success is due to the Free State's early and decisive commitment to making itself a welcoming location for application- and industry-related research institutions.

Since 2003, the number of Fraunhofer institutes and facilities in Saxony has increased from ten to currently 14. Dresden is home to 9 institutes, which makes it the city with the greatest density of Fraunhofer institutions in Germany. The broad spectrum of topics at Saxon Fraunhofer institutions ranges from biological research to materials research, traffic systems and manufacturing engineering to nano and microelectronics.

www.fraunhofer.de

Using clean bioenergy.

Fraunhofer Institute for Ceramic Technologies and Systems IKTS

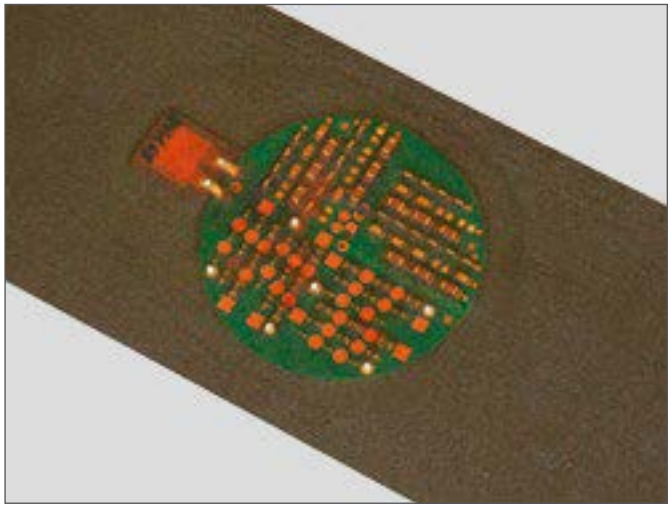
The Fraunhofer Institute for Ceramic Technologies and Systems IKTS with its two sites in Dresden and Hermsdorf (Thuringia) covers the entire spectrum of ceramic technologies from initial basic research to applications. At Fraunhofer IKTS scientists develop application-related, modern ceramic high-performance materials, powder metallurgical technologies and prototype components for industry. Research and development projects with collaborative partners work on concepts for materials for production and process innovation in many economic sectors.

The institute has core competence in the development of environmentally-friendly system concepts for the clean, economic production, storage and use of energy, particularly bioenergy. At the Bioenergy Application Centre (AZB) in Pöhl/Vogtland, Fraunhofer IKTS researchers run a biogas pilot plant exclusively on straw, a raw material with enormous energy potential. The biogas, which is purified using ceramic membranes, can be used to fuel vehicles, be fed into the natural gas grid and is suitable for the efficient, clean generation of electricity in high-temperature fuel cells (SOFC).

www.ikts.fraunhofer.de

Biomass fermentation plant at Fraunhofer IKTS.
Photo: IKTS

An eye to quality and durability.



Robust structural sensors and electronics. | Photo: IKTS-MD

At the beginning of 2014, the Dresden site of the Fraunhofer Institute for Nondestructive Testing IZFP, a branch of Materials Diagnostics MD, was integrated into the Fraunhofer Institute for Ceramic Technologies and Systems IKTS. Research and development activities focus on applied microelectronics and complex sensor systems.

In the field of device manufacturing and service for materials and component diagnostics, condition monitoring, nano-analysis and sensors as well as bio- and environmental technology, the quality and durability of customers' products are secured, and production technologies in connection with assembly and packaging are optimised.

At present, Fraunhofer IKTS-MD focusses, for example, on quality assurance in lightweight construction, the development of high-precision testing electronics for a variety of applications, multi-scale materials characterisation as well as life cycle management and reliability analysis.

Fraunhofer IKTS-MD coordinates a large number of research projects including the "Cool Silicon" cluster of excellence. This has generated new jobs in Saxon companies and advanced innovative technologies.

Partner for innovative coatings.

Fraunhofer Institute for Electron Beam and Plasma Technology FEP

The Fraunhofer Institute for Electron Beam and Plasma Technology FEP uses and develops efficient vacuum-coating and electron beam technologies to process materials. Sputtering technology, plasma-activated high-rate deposition, plasma-enhanced chemical vapour deposition (PECVD) using microwave or high frequency (HF) and electron beam technology are the core competencies, which are constantly being developed further for use in diverse branches of industry. In nearly all economic sectors, coatings and surface modifications are required for high-quality products. Mechanical engineering, solar energy, packaging, biomedical engineering and agriculture are just a few examples.

With its research and service portfolio, Fraunhofer FEP helps partners in industry, small and medium-sized enterprises as well as public sector clients to turn research into applications. The institute provides support from the drawing-board right through to industrial implementation, for instance in developing new technologies for coating and treating large surface areas and integrating them in appropriate systems engineering and existing production processes.

On 1 July 2014 Fraunhofer COMEDD and Fraunhofer FEP amalgamated.

www.fep.fraunhofer.de

Glass substrate with transparent, conductive titanium dioxide coating – the electrode material of the future? | Photo: Fraunhofer FEP

OLED – the light of the future.

Fraunhofer Research Institution for Organics, Materials and Electronic Devices COMEDD

Fraunhofer COMEDD was founded as a research institution in the *Fraunhofer-Gesellschaft* in order to transfer the results of research and development in the field of organic materials and systems to production. The institution combines research and development to produce electronic devices based on organic semiconductors. Fraunhofer COMEDD understands its mission to lie in the customised, applied research, development and pilot production of novel module concepts and manufacturing methods for these organic electronic devices, especially OLED lighting, organic solar cells, and OLED micro displays and sensors.

The institution is thus one of Europe's leading production-related research and development centres for organic semiconductors focussing on organic light-emitting diodes and vacuum technology. In a number of cleanrooms, the COMEDD infrastructure consists of a pilot line for the manufacture of OLEDs on 370 x 470 mm² substrates, two pilot lines for 200 mm wafers for OLED integration on silicon substrates as well as a research line for roll-to-roll manufacture on flexible substrates.

www.comedd.fraunhofer.de

OLED from the roll to roll process line. | Photo: COMEDD

Materials for the future.

Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM, Dresden Branch

The Fraunhofer Institute for Manufacturing Technology and Advanced Materials in Dresden specialises in basic and applied research to develop new sintered and composite materials as well as cellular metallic material based on innovative powder metallurgic technologies. The spectrum of activity includes the industrial implementation of research results as well as the construction of prototype components. Solid technological and materials expertise facilitate the development of cellular metallic and composite materials with customised properties. Special technologies underpin materials and component development with a focus on lightweight construction materials, metal-matrix composites, special materials for functional and structural applications, materials for thermal management as well as high-temperature materials and hydrogen storage materials for applications in traffic engineering, electronics, energy technology, medical technology and mechanical engineering.
The Accredited Powder Metallurgy Testing Lab characterises powders and tests sintered materials according to DIN/ISO standards.

www.ifam-dd.fraunhofer.de

Examples of materials, components and technologies developed at Fraunhofer IFAM Dresden. | Collage: IFAM

Properly packaged.

Fraunhofer IVV, Branch Lab for Processing Machinery and Packaging Technology Dresden

The Fraunhofer IVV – Branch Lab for Processing Machinery and Packaging Technology Dresden is a specialist provider of high-quality research and development services to industry, focussing on the processing of natural and synthetic materials, primarily for food and pharmaceutical production and the manufacture of packaging systems. Activities involve an integrated approach to all automatic processing steps, from the starting materials right through to customised product packaging applying resource-efficient processing.
Fraunhofer IVV concentrates on industrial, market-oriented R&D, examining in particular the needs of small and medium-sized enterprises as well as large concerns with the aim of transferring fundamental research knowledge into feasible solutions as quickly as possible. Research is conducted in fields such as thermal bonding processes for polymer and polymer-coated packing materials, easy open and close packaging, gentle and efficient forming of web-shaped packaging, development of special testing and diagnostic tools, hygienic design – especially the cleaning properties of machine surfaces and pipework systems, cleaning monitoring and the validation of cleanability (certificate that residues remain below a certain tolerance level).

www.ivv-dresden.fraunhofer.de

Foil running in the web transport test rig. | Photo: IVV

Applied microelectronics.

Fraunhofer Institute for Integrated Circuits IIS, Design Automation Division EAS

Working with the COSIDE® design environment. | Photo: Jürgen Lösel

The Fraunhofer Institute for Integrated Circuits IIS is one of Germany's most important research facilities for the development of microelectronic systems.
Scientists in the Design Automation Division EAS in Dresden develop methods and tools for the reliable design of ever more complex electronic and mechatronic systems. They thus optimise and accelerate the implementation of product requirements in circuits, devices and complex sensor systems. Another focus of activities involves original innovative developments in fields such as image sensor technology or building energy management systems. One of the key research objectives is to close the gap between novel production technologies and system design.
The institution is connected with other research institutions both nationally and internationally and is involved in a host of standardisation activities. The results of its work flow into areas like communications technology, automotive engineering and automation technology.

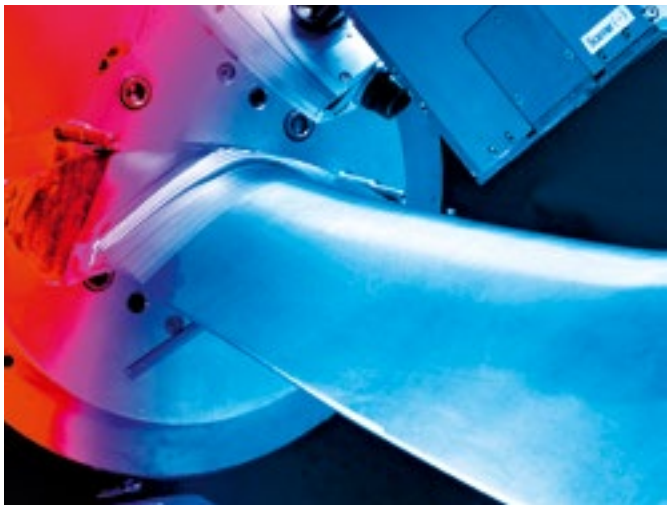
www.eas.iis.fraunhofer.de

Customised light.

Fraunhofer Institute for Material and Beam Technology IWS

Laser and surface technology are the focus of work at the Fraunhofer Institute for Material and Beam Technology IWS. The development of technologies and systems using tailored laser light and the production of functional surfaces are exciting research areas with great potential for the future.
The research and development conducted at Fraunhofer IWS is based on sound expertise in materials science combined with extensive technical capabilities for materials and component characterisation. Materials are a key element of today's manufacturing technology, whilst nanotechnology is increasingly gaining importance in both materials development and manufacturing. Fraunhofer IWS Dresden has established and expanded its core competence in both areas.
Fraunhofer IWS works closely together with equipment and system manufacturers to offer customers one-stop solutions that are usually derived from novel concepts, based on an integrated analysis of manufacturing systems, processes, materials and component performance. IWS continuously expands its facilities to guarantee efficient project execution utilising state-of-the-art equipment at the highest level.

www.iws.fraunhofer.de



Laser beam hardening of turbine blades. | Photo: Jürgen Jeibmann

Designing environmetally-friendly mobility.

Fraunhofer Institute for Transportation and Infrastructure Systems IVI

The Fraunhofer Institute for Transportation and Infrastructure Systems IVI is home of the world's longest bus and the octocopter HORUS, a flying sensor platform for photo and video recordings. The institute, founded in 1999, was originally a branch of the Fraunhofer Institute for Information and Data Processing in Karlsruhe, specialising in process control. With four departments and two research groups, the institute employs more than 80 researchers and cooperates with TU Dresden and *TU Bergakademie Freiberg*. It is equipped with efficient laboratory facilities, innovative test platforms and vehicles, state-of-the-art IT structures, and, since 2013, new technical facilities with an adjacent vehicle test track.

The institute's research and development topics range from electromobility, traffic planning, traffic ecology, and traffic information via vehicle propulsion, sensor technologies and traffic telematics to information and communication as well as disposition and logistics.

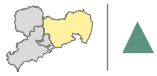
Fraunhofer IVI has attracted widespread interest with its electronic ticketing application, its mobile public transport navigation solution SMART-WAY and its cross-border disaster prevention system. Recently, the 30.7 m long AutoTram® Extra Grand – the world's longest bus – which is equipped with hybrid propulsion technology and an electronic multi-axle steering system, has been the particular focus of attention.

www.ivi.fraunhofer.de

AutoTram® Extra Grand. | Photo: Fraunhofer IVI/Elke Sähn

Where light is shaped.

Fraunhofer Institute for Photonic Microsystems IPMS



The 220 employees of the Fraunhofer Institute for Photonic Microsystems IPMS conduct research in electronic, mechanical and optical components and their integration into the tiniest 'intelligent' devices and systems. Fraunhofer IPMS's particular expertise lies in the use of light, i.e. the application of optical properties and components, and their developments are implemented in areas as diverse as semiconductor lithography, food control, medical technology and optical biometry.

The focus of the development and production services lies in the industrial application of unique technological know-how in the fields of (optical) micro-electromechanical systems and wireless microsystems. The portfolio of services ranges from idea via product development to serial pilot production in the in-house cleanroom – from a single component to a complete system solution. The Fraunhofer Institute for Photonic Microsystems IPMS has an annual research budget of 24 million Euro, more than two-thirds of which is covered by commissions from industry and publicly financed projects.

On 1 January 2013, the Fraunhofer Centre for Nanoelectronic Technologies CNT became a department of Fraunhofer IPMS. Some 50 scientists work on nano- and microelectronics in the fields of functional electronic materials, processes and systems, device and integration, maskless lithography and analytics. For this purpose, approx. 800 m² of cleanroom space has been made available on the Infineon site in Dresden.

Testing microsystem components in the cleanroom.
Photo: Fraunhofer IPMS

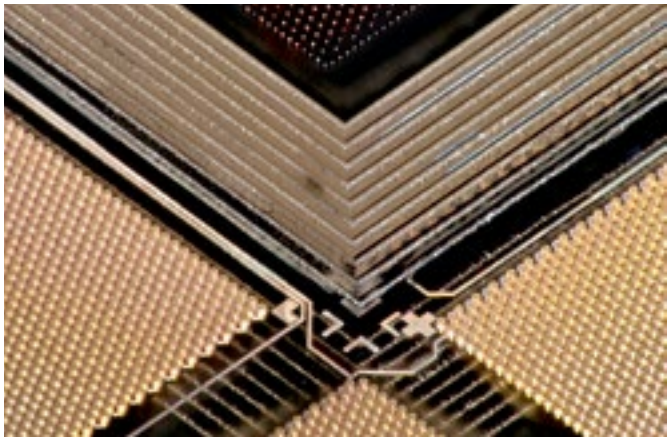
www.ipms.fraunhofer.de

Key to a smart world.

Fraunhofer Institute for Reliability and Microintegration – Centre “All Silicon System Integration Dresden – ASSID”

Whether for fast data processing in medical equipment or the energy-efficient steering of e-cars, microelectronic systems are required to be ever tinier and more energy efficient, to perform better and to combine even more functions. 3D system integration is a key technology which enables the three-dimensional assembly of the most diverse electronic components (sensors, ASICS, memories, etc.) in a miniaturised system in package (SiP).

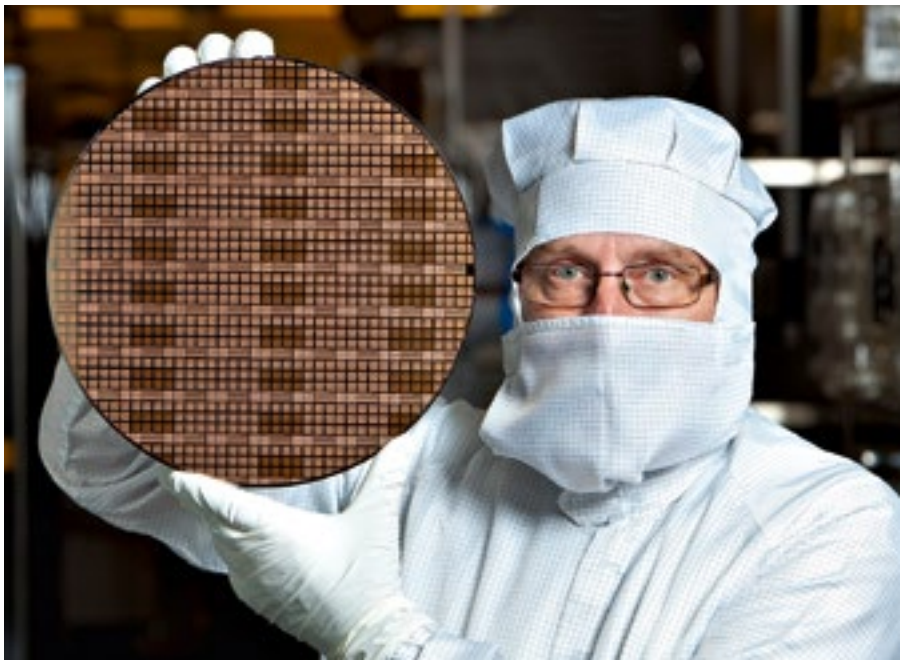
The centre “All Silicon System Integration Dresden – ASSID” has Germany’s first complete 300(200)mm process line for the development and prototype production of electronic 3D systems. The electrical connection is provided by copper-metalised through-silicon vias (TSVs). The line conception allows both the application-related development of processes and the qualification and prototype production, amongst others for 3D wafer level system in packages (SiPs), CSP under industrial conditions. Thus in projects, too, scientists at IZM-ASSID are able to elaborate customised solutions for the very different clients in industry and research, drive forward system solutions and develop innovative 3D systems in cooperation with other scientific institutions. It was in the context of the ENIAC JU-Project JEMSIP_3D, for example, that the first successful demonstration of 3D Cu-TSV technology on an active wafer (Co. NXP) was conducted in Germany.



3D TSV chip, tenfold

ASSID, as part of Fraunhofer IZM, and, since 2009, a regular feature of the Dresden research landscape, has established itself not only as a competent partner in networks and collaborations but also as a reliable service provider.

www.izm.fraunhofer.de/assid



Heterogeneous 3D system integration on 300mm wafers.
Photos: IZM-ASSID

Detail of microscope, Leibniz Institute of Polymer Research Dresden | Photo: Jürgen Jeibmann Photographik, Dresden

Combining basic research and applications.

The Leibniz Association

Gottfried Wilhelm Leibniz, who has the reputation of being perhaps the last universal genius, is the man after whom the Leibniz Association is named. A good choice, especially as the Leibniz Association incorporates the very quality of universality that has become the hallmark of scholars. The Leibniz Association connects 89 independent research institutions that range in focus from the natural, engineering and environmental sciences via economics, spatial and social sciences to the humanities. Leibniz institutes – which employ some 17,500 staff, including more than 8,000 researchers – conduct knowledge-driven and applied basic research (Figures/source: Leibniz Association Annual Report 2014). Leibniz institutions cooperate intensively with one another as well as with universities, institutes and other research organisations, private sector enterprises, state institutions and social organisations at national and international level.

The Leibniz Association institutes in Saxony are of supreme importance to the Free State due to their size, structure and focus. They help to shape the research landscape in the Dresden/Leipzig area by their potential in materials and environmental research. Thanks to the combination of basic and applied research they are important partners for universities and innovative companies.

Since 1 January 2009, the former State Natural History Collections in Dresden and the Natural History Museum in Görlitz have been part of the *Senckenberg Gesellschaft für Naturforschung* (with headquarters in Frankfurt/Main). As such, they are also members of the Leibniz Association.

www.wgl.de

For the quality of life in cities and regions.

Leibniz Institute of Ecological Urban and Regional Development

Sustainable environmental development and its concomitant global and local challenges are the issues addressed by the Leibniz Institute of Ecological Urban and Regional Development IOER Dresden. IOER investigates how cities and regions can be developed at a reasonable cost in order to offer the population a high quality of life and nature with the necessary scope to flourish. It also conducts research on the efficient use of resources, on reducing land use and on providing appropriate measures to prevent environmental risks.

Established in 1992, the institute has some 120 staff from different disciplines, which facilitates the analysis of urban, regional and environmental development from varying perspectives. IOER cooperates closely with practitioners, for example in drawing up an integrated climate change adaptation programme for the Dresden region. On the basis of its findings, the institute advises government and society.

IOER is actively involved in the DRESDEN-concept, an association of research institutes located in the Dresden region, and promotes young scientists. Together with TU Dresden it has established an international graduate school (DLGS) to examine issues relating to the resilience of cities and regions.

www.ioer.de

Research for the future: IOER's work is of major importance to future generations. During the Long Night of Science the institute therefore offers insights into ecological spatial development.| Photo: IOER/Ludewig

Top: Committed to ecology: the institute building was extended using passive building technology, which won IOER the European Commission's Green Building Award. It is certified as operating on the ECOPROFIT model.
Photo: IOER/Tramsen

Innovative materials and technologies.

Leibniz Institute of Polymer Research Dresden

Novel functional polymers are synthesized for hightech applications in medicine (e. g. transport and controlled release of drugs within the organism), organic electronics (e.g. polymeric transistors), or sensor technology.
Photo: Jürgen Jeibmann Photographik, Dresden

The Leibniz Institute of Polymer Research Dresden (IPF) is one of the largest polymer research facilities in Germany.
The institute's scientists and engineers work together closely both with one another and with partners in the local DRESDEN-concept as well as with research groups worldwide on fundamental innovations for materials, technology, and systems development. Fields such as medicine, sensor technology, communication technology, light-weight construction, mobility and energy all benefit from this research.
Car tires that provide comfort and safety as well as lower environmental impact during production and use; composite materials that enable significantly lighter and more energy-efficient construction components; 'smart' fibre-reinforced plastics und textiles with integrated sensors to monitor structural health; charged polymers for reliable, efficient, and environmentally-conscious separation processes and wastewater remediation; novel polymer structures for organic photovoltaics and electronics or for drug delivery systems; films that repel water or bacteria by mimicking structures found in nature; polymer layers for the construction of cell culture devices that allow lab-based tracking of biomolecular and physical signals of a cell's natural microenvironment - these are just a few examples that show the broad scope and high impact of research topics at IPF.

www.ipfdd.de

Searching for new materials.

Leibniz Institute for Solid State and Materials Research Dresden

Modern materials science based on fundamental physics and chemistry: research work at the Leibniz Institute for Solid State and Materials Research Dresden covers a wide range of activities from basic research in physics and chemistry to the technological development of new materials and products.
The research programme focusses on physical and chemical phenomena in solids that may and can be used for applications in new functional materials. In particular, it addresses materials that exhibit special physical or chemical properties due to quantum mechanical phenomena like superconductivity and magnetism, and nanoscale materials, such as metallic glasses, nanoparticle, nanotubes, nanowires and rolled-up nanomembranes,
The institute is also tasked with the advanced training of junior scientists and technical staff as well as transferring the institute's research outcomes to industry. IFW Dresden is a legally independent non-university research institute and a member of the Leibniz Association.

www.ifw-dresden.de

The electronic structure of new materials is investigated in a vacuum, at low temperatures and high magnetic fields. | Photo: IFW Dresden

6.5 million objects of research.

The Senckenberg Natural History Collections Dresden

The Senckenberg Natural History Collections Dresden form one of the oldest natural history museums in the world. Their roots can be traced back to the art and natural history collections of August, Elector of Saxony (1526-1586). With some 80 employees, the institute has been part of the *Senckenberg Gesellschaft für Naturforschung* since 2009 and thus a member of the Leibniz Association.

Approximately 6.5 million objects, covering most fields of organic and inorganic nature, are used for purposes of documentation, presentation and exploration of the geological and biological evolution and diversity of the Earth, as well as to conserve original items. These scientific collections are an essential element in addressing the most important challenges of the present day, such as biodiversity- and climate research, understanding relations and dependences in nature and for application as future life models.

The Museum of Zoology has nine departments and three special sections, a modern molecular genetic laboratory, and a preparation laboratory for large animals. With name-bearing types of more than 14,000 species, the collections are internationally relevant. Research centres on taxonomy, phylogeny, phylogeography, and population genetics of molluscs, insects, and vertebrates.

The research focus of the Museum of Mineralogy and Geology is geobiodiversity. Fossilised traces of life in the Earth's history are the research base for palaeozoology and palaeobotany. Isotope geochemical and sedimentary studies combined with basin analyses and palaeogeography, as well as mineral topography, specialised mineralogy, and gemmology, are also core themes. Modern methods such as isotope-based age determination of minerals (LA-ICP-MS techniques for U/Pb ages on zircon and other minerals) help to define sediment provenance areas and unravel uplift histories of rock complexes.

Reptile and amphibian collection. | Photo: Senckenberg

Collaborative projects with university and non-university institutions on six continents emphasize the international importance of the Senckenberg Natural History Collections Dresden. Involvement in university teaching and supervision (Bachelor's, Master's and doctoral students) ensures that junior scientific staff receive a solid academic education.

Research results are communicated to the public in an easily comprehensible form at exhibitions in the Japanese Palace as well as touring exhibitions.

www.snsd.de

An impression of the "Biodiversity Today" exhibition | Photo: Steffen Giersch

The fascination of nature. Research for the future.

The Senckenberg Museum of Natural History Görlitz

A scientist in the field collecting the droppings of Lusatian wolves to analyse their feeding habits. | Photo: Senckenberg

Predatory mammals, various groups of soil animals, ants, fossils, minerals, vascular plants, fungi and lichens: its extensive scientific collections with about 6.5 million objects form the basis of all research activities at the Senckenberg Museum in Görlitz. More than 40 scientists from around the world investigate the diversity of life – with one ambitious goal: to preserve biodiversity on Earth and develop strategies for the sustainable use of our planet. As the leading research institution in the border triangle between Germany, the Czech Republic and Poland, Senckenberg Görlitz is a driving force in natural history research and science communication both within and beyond national borders.

Natural history research has a long tradition in Germany's easternmost city: the people of Görlitz have been exploring the diversity of Earth since 1811. In 1860, they opened one of the oldest public natural history museums in Germany, and in 2009, the former State Museum of Saxony became part of a unique research institution, the Senckenberg Gesellschaft für Naturforschung, and thus a member of the Leibniz Association.

What makes Senckenberg Görlitz so special is its expertise in soil zoology. Using state-of-the-art technologies, biologists in seven departments study the biodiversity and ecological significance of soil organisms. Research also focusses, for example, on the speciation of ants, the evolution of mating behaviour and reproduction in slugs, as well as geological phenomena such as volcanism. The analysis of the feeding habits of central European wolf packs is of particular relevance to Saxony and Germany as a whole. Amongst other things, the museum's botanists investigate the impact of global change on the vegetation of Tibet.

Senckenberg Görlitz is particularly engaged in the education of young scientists – in academic teaching as well as in the mentoring of Ph.D. students. At the same time, modern exhibitions in the heart of the city of Görlitz showcase research results, ensuring the transfer of knowledge to a broad general public. The museum's touring exhibitions reach hundreds of thousands of people across Europe.

Children at the exhibitions: the most important visitors. | Photo: Andrzej Paczos

www.senckenberg.de/goerlitz

Unique collections – available online.

The Institute of Saxon History and Cultural Anthropology

Investigating the history and everyday life of Saxony is the aim of the Institute of Saxon History and Cultural Anthropology. The institute was founded in 1997, based on an act of the Saxon state parliament. Cultural exchange with its neighbours, Poland and the Czech Republic, is an important field of study. The focus of basic research lies in the documentation of sources, from the edition of documents on the mediaeval history of Saxony or the letters of Elisabeth of Saxony, dating from the Protestant Reformation, to currently collected data, such as interviews or photographs. The institute runs numerous conferences on the history and culture of Saxony to connect science and society. In addition, ISGV provides expert support for regional exhibitions in Saxony and Brandenburg as well as museum projects in Saxony and the Czech Republic. It also edits three publication series and two journals. Furthermore, ISGV publishes its outcomes on the internet: the *Sächsische Biografie,* the *Historisches Ortsverzeichnis von Sachsen,* the *Lebensgeschichtliches Archiv für Sachsen* and the digital image archive *Visuelle Quellen zur Volkskultur in Sachsen* are all freely available for download.

www.isgv.de

The "Sächsische Biografie" – the online encyclopaedia on Saxon history – includes information on more than 10,000 important figures from the Middle Ages to the present-day Free State of Saxony. In addition to a database with extensive research options a constantly increasing number of encyclopaedia entries on personalities from all walks of life – science and art, politics and administration, business and technology, trade and transport, schools, churches and social life – are available to download.

Sorbian culture, language, history.

The Sorbian Institute/Serbski institut, Bautzen/Budyšin

Photo: Archive TMGS/Rainer Weisflog

The language, history and culture of the Sorbs (Wends) in Upper and Lower Lusatia are the objects of study at the Sorbian Institute/*Serbski institut.* In the library and archive the relevant manuscripts and documents are collected, prepared for research purposes and made available to the public. The institute also actively records cultural and historical monuments. With its combination of scholarly research and practical support for preserving ethnic identity, the institute's strategy is unique.

The minority institute, based in Bautzen with a working section in Cottbus, was founded on 1 January 1992. It is an association, established by the Free State of Saxony and the State of Brandenburg, with antecedents in the *Institut für sorbische Volksforschung,* a research institute in the GDR Academy of Sciences, which was active from 1951 to 1991. Since 1993, the institute has received institutional funding from the Foundation for the Sorbian Nation. The staff teach at universities and institutions of higher education, especially in Saxony and Brandenburg. Every two years, the institute hosts a renowned international summer school for Sorbian language and culture.

www.serbski-institut.de

Investigating dictatorships.

Hannah Arendt Institute for Research on Totalitarianism at TU Dresden

Shortly after German reunification and the foundation of the Free State of Saxony, the Saxon parliament decided to establish the Hannah Arendt Institute for Research on Totalitarianism (HAIT). The name was chosen in honour of the German-Jewish emigrée philosopher and political scientist, Hannah Arendt (1906–1975), whose works vividly demonstrate that dictatorships with a totalitarian intention destroy the very meaning of politics, which is freedom.

The Institute devotes itself to the systematic research of Communism and National Socialism, ideological dictatorships which crucially shaped the 20th century and still have an impact to the present day. In addition to the interdisciplinary analysis of the political and social structures of the two dictatorships in Germany, the institute's statutes also stipulate that it should investigate the resistance against tyranny and pay tribute to the victims. Comparative perspectives of other fascist and socialist state systems complement research on dictatorships in Germany.
Other fields of research include comparative studies of post-socialist transformation processes from dictatorship to democracy in eastern Central Europe since 1989/90. Critical scrutiny of political extremism in the past and present is also an important activity at the Hannah Arendt Institute.

www.hait.tu-dresden.de

HAIT's specialist library comprises some 48,500 volumes and is open to the public.
Photo: Steffen Giersch

Future nanoelectronic products.

NaMLab (Nanoelectronic Materials Laboratory) gGmbH

The Nanoelectronic Materials Laboratory gGmbH (NaMLab), an institute affiliated to TU Dresden, conducts application-related research in material sciences for electronic applications in the nanometer range. The institute focusses on the development of materials for reconfigurable and energy-efficient semiconductors of the future. Ever smaller structures in the semiconductor industry, which, in just a few years, will be found in the range of just a few atomic layers, need new, dedicated materials. NaMLab develops these materials, integrates them in components and investigates their electrical and structural properties. The discovery of ferroelectricity in hafnium oxide, for example, was used to make the world's smallest storage device in this field. By using silicon wires with a diameter of just 30 silicon atoms universal transistors can be manufactured.
In October 2013, the Saxony GaN Research Centre was opened in Freiberg. At this branch of NaMLab gGmbH, the institute works together with the Freiberg Compound Materials GmbH and the TU Bergakademie Freiberg on gallium nitride and its potential as one of the semiconductor materials of the future. To this end, power transistors are fabricated and characterised on GaN substrates produced by this Saxon manufacturer.

www.namlab.com

Coating silicon wafers in the NaMLab cleanroom.
Photo: Uwe Schröder/NaMLab

Expertise in radiation protection.

VKTA – Radiation Protection, Analytics & Disposal Rossendorf Inc.

Starting in 1992, the VKTA – Radiation Protection, Analytics & Disposal Rossendorf Inc. was commissioned by the Free State of Saxony to decommission the old nuclear power plants at the Dresden-Rossendorf research facility. This includes the safe disposal of residues and radioactive waste. As well as its decommissioning activities, VKTA is also responsible for radiation protection at the Dresden-Rossendorf research site.

In addition to the dosimetric monitoring of people and facilities (dosimeters measure exposure to radiation), VKTA operates an incorporation measuring point. Another important task is the monitoring of radioactive emissions and immissions in and around the Rossendorf research site. In this process, flue exhaust air and wastewater are continuously monitored and documented to ensure they comply with specified limits for the discharge of radioactive substances.

VKTA's experts also regularly take part in national and international studies and research projects on security-related topics. On top of these various tasks, the staff – currently a team of approximately 100 highly qualified scientists, engineers, lawyers, laboratory assistants, technicians and students – are involved in intensive professional education and training.

For specific tasks and advanced measurement methods and analytical processes there is an accredited laboratory for environmental and radionuclide analysis.

www.vkta.de

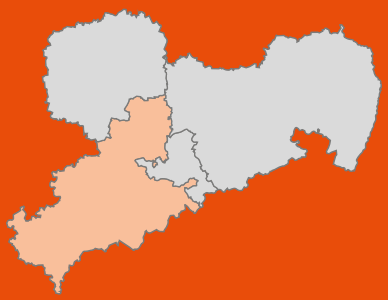
The facilities, measuring and technical equipment are specifically designed to determine radio activity.

Radiation protection measurement: decommissioned waste at the Rossendorf interim storage facility. | Photos: Jan Gutzeit

Institutions in the Dresden Science Region

Universities, colleges and research institutions	Internet	
Universities and colleges		
Technische Universität Dresden	http://tu-dresden.de	p. 26
Dresden Academy of Fine Arts	www.hfbk-dresden.de	p. 30
Carl Maria von Weber University of Music Dresden	www.hfmdd.de	p. 32
Palucca Hochschule für Tanz Dresden	www.palucca.eu	p. 33
Dresden University of Applied Sciences	www.htw-dresden.de	p. 34
Zittau/Görlitz University of Applied Sciences	www.hszg.de	p. 36
University medical institutions		
Carl Gustav Carus Faculty of Medicine and University Hospital Carl Gustav Carus	http://tu-dresden.de/med | www.uniklinikum-dresden.de	p. 29
University of Cooperative Education		
University of Cooperative Education Dresden	www.ba-dresden.de	p. 18
University of Cooperative Education Bautzen	www.ba-bautzen.de	p. 18
University of Cooperative Education Riesa	www.ba-riesa.de	p. 18
United Nations University		
UNU-FLORES	www.flores.unu.edu	p. 16
Helmholtz institutions		
Helmholtz-Zentrum Dresden Rossendorf	www.hzdr.de	p. 39
Sites of German Centres for Health Research		
The German Centre for Neurodegenerative Diseases (DZNE) – Dresden site	www.dzne.de/standorte/dresden.html	p. 17, 40
German Centre for Diabetes Research – Paul Langerhans Institute Dresden	www.dzd-ev.de/partner/tu-dresden/index.html www.plid.de	p. 17, 40
German Consortium for Translational Cancer Research - University CancerCentre Dresden	https://ucc.med.tu-dresden.de	p. 17, 41
Max Planck institutes		
Max Planck Institute for the Physics of Complex Systems	www.mpipks-dresden.mpg.de	p. 43
Max Planck Institute for Chemical Physics of Solids	www.cpfs.mpg.de	p. 43
Max Planck Institute of Molecular Cell Biology and Genetics	www.mpi-cbg.de	p. 44
Fraunhofer institutes and establishments		
Fraunhofer Institute for Ceramic Technologies and Systems IKTS	www.ikts.fraunhofer.de	p. 46
Fraunhofer Institute for Electron Beam and Plasma Technology FEP	www.fep.fraunhofer.de	p. 47
Fraunhofer Research Institution for Organics, Materials and Electronic Devices COMEDD	www.comedd.fraunhofer.de	p. 47
Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM, Dresden Branch	www.ifam-dd.fraunhofer.de	p. 48
Fraunhofer IVV, Branch Lab for Processing Machinery and Packaging Technology Dresden	www.ivv-dresden.fraunhofer.de	p. 48
Fraunhofer Institute for Integrated Circuits IIS, Design Automation Division EAS	www.eas.iis.fraunhofer.de	p. 49
Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS	www.iws.fraunhofer.de	p. 49
Fraunhofer Institute for Transportation and Infrastructure Systems IVI	www.ivi.fraunhofer.de	p. 50
Fraunhofer Institute for Photonic Microsystems IPMS	www.ipms.fraunhofer.de	p. 50
Fraunhofer Institute for Reliability and Microintegration – Center "All Silicon System Integration Dresden - ASSID"	www.izm.fraunhofer.de/assid	p. 51

Universities, colleges and research institutions	Internet	
Leibniz institutes and Senckenberg museums		
Leibniz Institute of Ecological Urban and Regional Development	www.ioer.de	p. 53
Leibniz Institute of Polymer Research Dresden	www.ipfdd.de	p. 54
Leibniz Institute for Solid State and Materials Research Dresden	www.ifw-dresden.de	p. 54
The Senckenberg Natural History Collections Dresden	www.snsd.de	p. 55
The Senckenberg Museum of Natural History Görlitz	www.senckenberg.de/goerlitz	p. 56
Ifo Institute – Leibniz Institute for Economic Research at the University of Munich; (Dresden)	www.cesifo-group.de/de/thum-m	
Free State financed research institutions		
The Institute of Saxon History and Cultural Anthropology	www.isgv.de	p. 57
The Sorbian Institute/Serbski institut, Bautzen/Budyšin	www.serbski-institut.de	p. 57
Hannah Arendt Institute for Research on Totalitarianism at TU Dresden	www.hait.tu-dresden.de	p. 58
NaMLab (Nanoelectronic Materials Laboratory) gGmbH	www.namlab.com	p. 58
VKTA – Radiation Protection, Analytics & Disposal Rossendorf Inc.	www.vkta.de	p. 59
Affiliated institutes at universities / TU Dresden		
Institute of dendrochronology, Tree Maintenance and Wood Management Tharandt	www.dendro-institut.de	
German Institute of Direct Democracy in Factual Cases	www.disud.de	
Dresden International University GmbH	www.dresden-international-university.com	
Europäisches Institut für postgraduale Bildung	www.eipos.de	
Institut zur Erforschung und Erschließung der Alten Musik in Dresden e.V.	www.musikschaetze-dresden.de	
SMM Structure and Material Mechanic Research GmbH Dresden – Technical University Dresden Affiliated Institute	www.swm-dresden.de	
Institute for Research and Development of Musical Instruments	www.ifm-zwota.de	
Life Science Inkubator Sachsen GmbH & Co. KG	www.life-science-inkubator.de	
Hannah Arendt Institute for Research on Totalitarianism) at TU Dresden	www.hait.tu-dresden.de	p. 58
NaMLab (Nanoelectronic Materials Laboratory) gGmbH	www.namlab.com	p. 58
Institut für Holztechnologie Dresden gemeinnützige GmbH	www.ihd-dresden.de	p. 58
Research Centres at Universities of Applied Sciences		
Centre for Applied Research and Technology at Dresden University of Applied Sciences	www.zaft.htw-dresden.de	p. 35
Cluster of Exzellence		
Center for Advancing Electronics Dresden – TU Dresden (cfaed)	www.cfaed.tu-dresden.de	p. 13, 27
DFG-Research Center for Regenerative Therapies Dresden – Cluster of Exzellence (CRTD)	www.crt-dresden.de	p. 13, 22, 27
International Graduate School for Biomedicine and Bioengineering (DIGS-BB)	www.digs-bb.de	p. 13, 27
Saxon Excellence Initiative		
European Centre for Emerging Materials and Processes Dresden – TU Dresden	http://ecemp.tu-dresden.de	p. 22
OncoRay – National Center for Radiation Research in Oncology – TU Dresden	www.oncoray.de	p. 22



1 Number of institutions

Universities

Universities of Applied Sciences

University of Cooperative Education

Fraunhofer institutes

Leibniz institutes

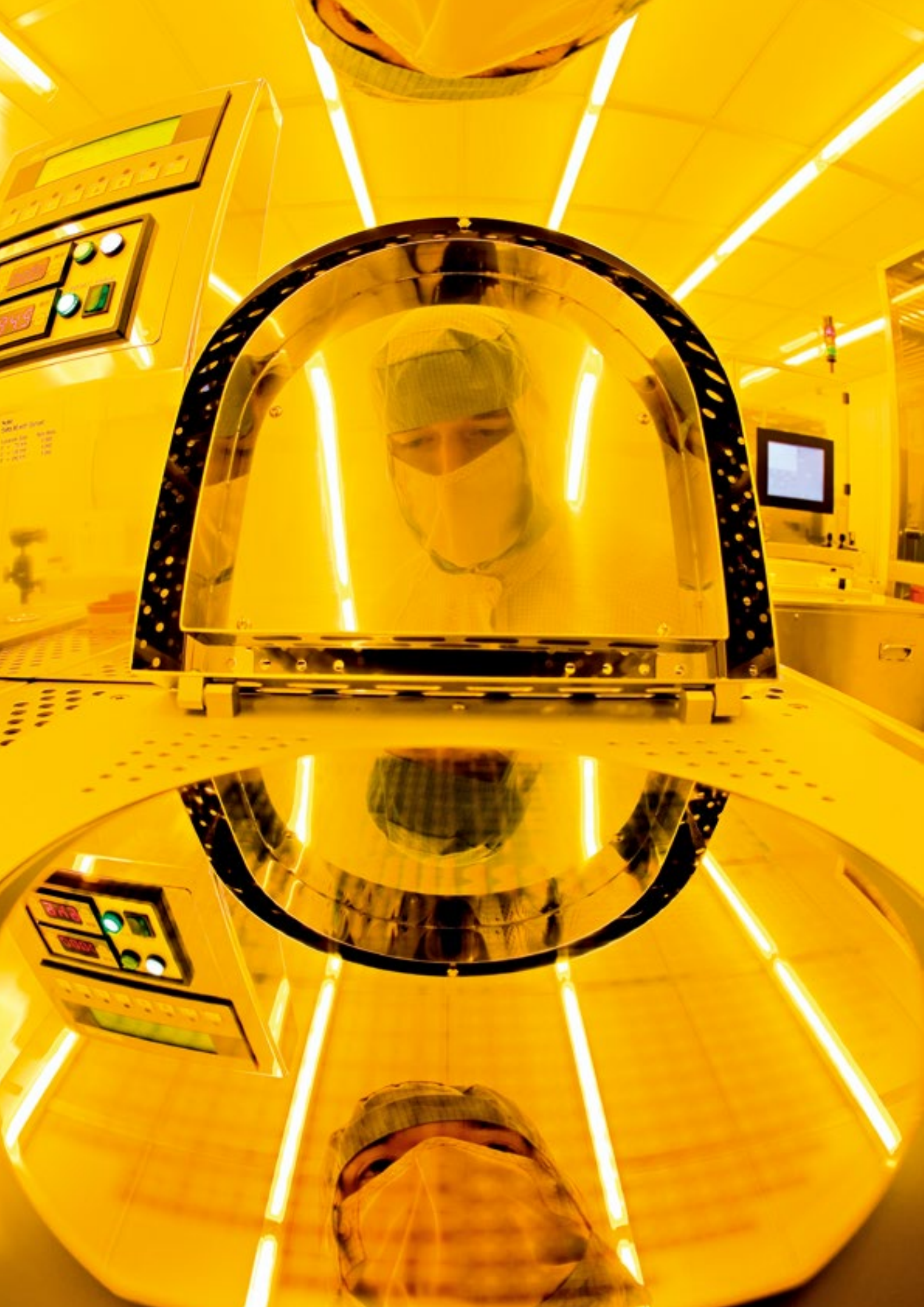
Free State financed research institutions

Affiliated institutes at universities

For an overview of the institutions in the Chemnitz Science Region, please refer to p. 72 ff.

» Chemnitz Science Region

The Department of Lightweight Structures and Polymer Technology at TU Chemnitz and the Fraunhofer Institute for Electronic Nano Systems cooperate on research in the field of mechanical sensor and actor systems. | Photo: Hendrik Schmidt



Top researchers from Germany and abroad work within the Federal Cluster of Excellence "Technology Fusion for Multi-Functional Lightweight Structures" | Photo: Hendrik Schmidt

Excellent in many ways.

Technische Universität Chemnitz

Situated in the heart of the metropolitan science region of Chemnitz, *Technische Universität (TU) Chemnitz* is home to more than 11,000 students from 75 countries. With some 2,000 academic, technical and administrative staff, TU Chemnitz is one of the leading employers in the region. Today, TU Chemnitz stands for distinctly-profiled, top-level research. The scientists in its key research areas, such as Energy-Efficient Production Processes, Smart Systems and Materials and Human Factors in Technology, work on solutions for the challenges of tomorrow. The central topic in economic and social developments is added value, which is particularly influenced by momentous changes in globalisation, demographics and the availability of resources. By interconnecting these key research areas, TU Chemnitz has created a constellation of expertise that spans all of its eight faculties and is unique in Germany. Chemnitz is now on its way to becoming an internationally highly competitive research hub for future value creation processes.

The Federal Cluster of Excellence Merge Technologies for Multifunctional Lightweight Structures (MERGE) undertakes fundamental research in the key research area of Energy-Efficient Production Processes. With funding of 34 million Euros, this Cluster of Excellence is the only one in Germany dedicated to the trend-setting technology field of Lightweight Engineering. The breeding ground for this great success story was provided by the Saxon State Cluster of Excellence Energy-efficient Product and Process Innovations in Production Engineering (eniPROD), which was established jointly with the Fraunhofer Institute for Machine Tools and Forming Technology (IWU). Three DFG-funded Collaborative Research Centres on intelligent materials and energy-efficient production technologies complement this field.

Within the key research area "Smart Systems and Materials", scientists at TU Chemnitz are also involved in the Federal Cluster of Excellence "Center for Advancing Electronics Dresden" (cfAED). Further input is provided by the Niño System Integration Network of Excellence (Nanett), funded by the Federal Government, as well as by the high-performance cluster COOL SILICON "Energy Efficiency Innovations from Silicon Saxony". Several DFG Researcher Groups are working in this field. In addition, TU Chemnitz will be the home of the "Center for Materials, Architectures and Integration of Nanomembranes" (MAIN), which is unique in Europe.

Exploring scenarios with digital human models in the Virtual Reality Lab in the Department of Computer Graphics and Visualisation at TU Chemnitz.
Photo: Wolfgang Thieme

p. 64: The "cleanest room" at TU Chemnitz is located in the Centre for Microtechnologies.
Photo: Jürgen Lösel

The Central Lecture Hall and Seminar Building at TU Chemnitz provides space for 2,576 people in eight lecture halls and ten seminar rooms.
Photo: Dirk Hanus

Transdisciplinary cooperation is one of the main features of *Technische Universität Chemnitz,* and that is also true for the key research area "Human Factors in Technology", represented for example by the Competence Centre "Virtual Humans" and the DFG Graduate School "Connecting virtual and real social worlds".
Junior researchers enjoy excellent support and career opportunities in several (international) junior research groups. For instance, TU cooperates with Chinese partners in its international Graduate School "Materials and Concepts for Advanced Interconnects and Nanosystems".

Another future-oriented feature of TU Chemnitz are its increasing connections with businesses and extramural research institutions in the Chemnitz metropolitan science region. In close cooperation with non-university research institutions and TU-affiliated institutes as well as the City of Chemnitz and business partners, the university provides an ideal environment that combines practice-related training with basic and applied research. The start-up network of TU Chemnitz, SAXEED, and the Technology Centre Chemnitz provide advice and support services to young entrepreneurs in order to facilitate a smooth transition from the lecture hall to operating their own business. So far, 168 start-ups have been launched, generating about 800 new jobs, which has earned TU Chemnitz its reputation as one of Germany's leading universities for prospective entrepreneurs.

Networking is crucial for TU Chemnitz. One example is the Smart Systems Campus, which was built very near the university campus and is now the location of the newly-constructed Institute of Physics, including a cleanroom at the Centre for Microtechnologies, as well as the Fraunhofer Institute for Electronic Nanosystems ENAS, a "start-up" building and commercial spaces.
On the international level, TU Chemnitz cooperates with 126 partner institutions in 39 countries, including the 20-member international university network Academic Consortium for the 21st Century (AC21).

About 2,500 students were enrolled in Bachelor's or Master's programmes for the first time in the winter semester 2013/2014. The university offers a total of 35 Bachelor's and 50 Master's programmes, which have a strong transdisciplinary focus. A new course of study leading to a *Staatsexamen* degree has been introduced to train teachers at primary/elementary level.

TU Chemnitz is determined to provide ideal general conditions for its students. For this reason its development agenda includes a comprehensive action plan to further strengthen its success- and demand-oriented teaching by a distinctive graduate profile. An extensive quality campaign has been launched to achieve this goal with the support of the Federal Ministry of Education and Research within the project "Quality Pact for Teaching" as well as the Saxon Centre for Teaching and Learning in Higher Education, which is funded by the Saxon State Ministry for Higher Education, Research and the Arts.

In order to further enhance the attractiveness of the city of Chemnitz as "the place to learn, live and work", the *Alte Aktienspinnerei* (Old Spinning Mill) will be transformed into the new Central University Library and other university institutions will be located along the tram route included in the "Chemnitz Model", a plan for reorganising public transport in Chemnitz. Finally, TU Chemnitz was certified as a family-friendly university for the third time in 2012.

www.tu-chemnitz.de

The State Cluster of Excellence Energy-efficient Product and Process Innovations in Production Engineering (eniPROD) investigates the visualisation of energy flow as a milestone towards an emission-neutral factory.
Photos: Wolfgang Thieme/Jürgen Lösel

The electric racing cars of the WHZ Formula-Student Team rank third in the world. | Photo: Westsächsische Hochschule Zwickau

Producing engineers with research expertise.

Westsächsische Hochschule Zwickau

The beginnings of the *Westsächsische Hochschule Zwickau* (WHZ) date back to the 15th century. Today, it still enjoys an excellent reputation, not only as a factory for engineers, but in general as a university of applied sciences in the fields of Technology, Business and Quality of Life.

In summer 2012, WHZ celebrated its 20th anniversary as a university of applied sciences. These two decades may seem like a very short time in Zwickau's 150-year history as a centre for student education, but they were years of rapid growth. Never before has there been such a wide range of courses, never have there been so many students from so many different countries enrolled at the university, and never has the income from third-party funding been higher. In 2013 the university conducted research in third-party projects to the tune of 7.21 million Euros. This makes WHZ one of the strongest research universities of applied sciences in Germany.

WHZ offers science-based, practice-related education to about 5,000 students in 40 courses of study. A sophisticated infrastructure featuring state-of-the-art facilities and equipment, as well as excellent relations between students and teaching staff guarantee a maximum level of personal guidance and a friendly, warm atmosphere. New courses of study, newly-founded institutes, and ultimately, the construction or refurbishment of numerous university buildings have reshaped the university's image in the past few years and extended its academic range even further.

WHZ conducts application-related research in order to secure the long-term sustainability of its capabilities in teaching and learning and to make its own contribution to the development of the region by taking on research and development contracts for business partners. Traditionally, the hallmark of research in Zwickau were innovative solutions for the development and construction of motor vehicles. Recent years have seen this research spectrum grow tremendously, with key areas in applied engineering.

An important factor in university research is the Research and Transfer Centre e.V. (FTZ), established in November 1994. FTZ operates as an independent institution, cooperating closely with WHZ on the basis of a collaborative agreement and contributing independent, practice-related, flexible and market-related development work and transfer to practical applications. FTZ caters specifically to the region's small and medium-sized enterprises, which usually cannot afford either the costly R&D or the sophisticated lab and test field technology required for innovative product and process development themselves. **www.fh-zwickau.de/ftz**

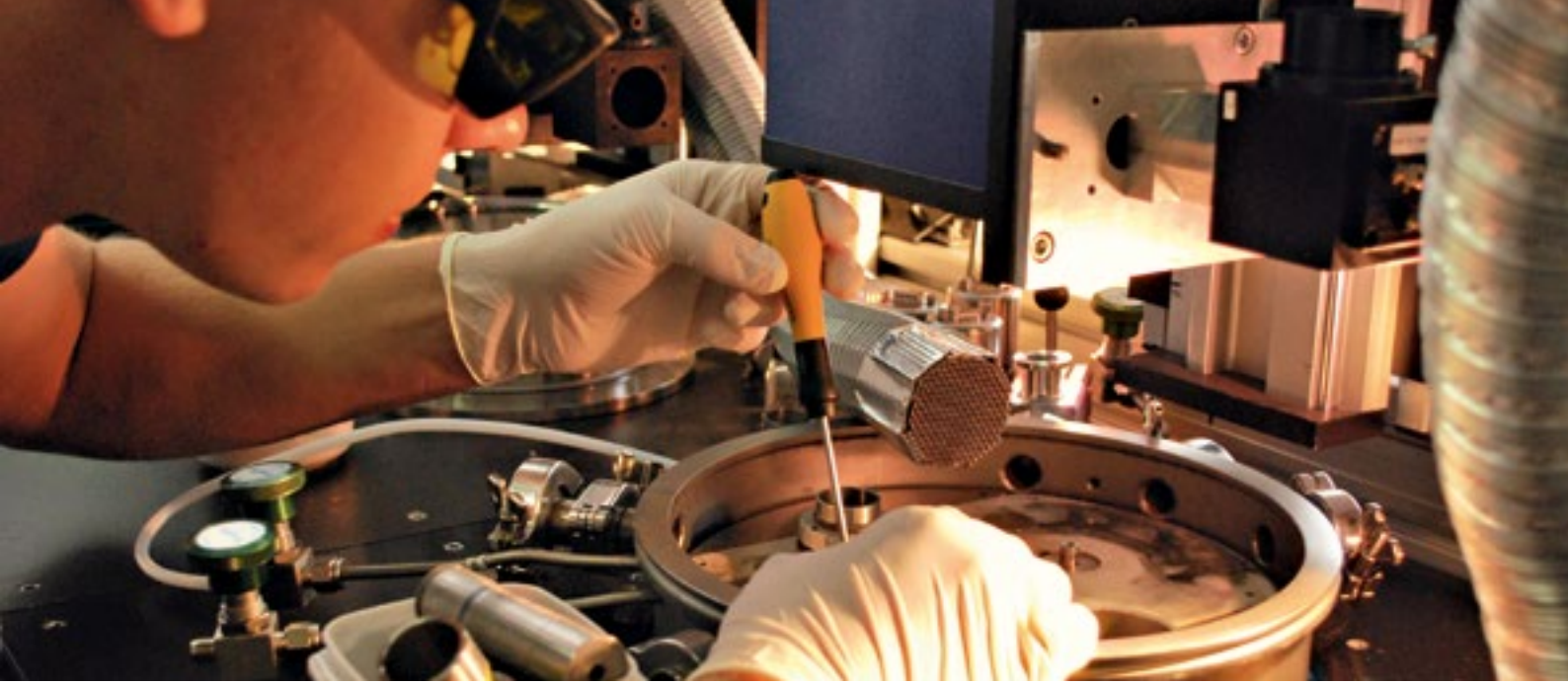
Engine test bench in the Department of Automotive Engineering. | Photos: WHZ

The following research areas have been established at the university: Innovative Automobile and Mechanical Engineering, Smart Technologies, Products and Services; Development of Surface Technologies, Microsystems and Materials, Intelligent Solutions for Electrical Engineering and Computer Science, Management and Information Concepts for Network Systems, Health, Social Work and Nursing; Architecture, Applied Arts and Manufacturing Musical Instruments, as well as Creating Economic Development Potential with a Regional Focus.

Three research profile lines have been created in order to further sharpen the research profile in the medium term: mobility and vehicles under the motto "Innovation Meets Tradition"; making energy-efficiency climate-friendly and affordable; and securing health care from a technological, social and economic perspective.

www.fh-zwickau.de **www.studiere-in-zwickau.de**

Physical Technology course, focus area: Energy and the Environment (Department of Physical Technology/ Computer Sciences).



Working at the laser micro-sintering machine in the Laser Institute at the Hochschule Mittweida. | Photo: Mittweida University

High energies – small structures.

Hochschule Mittweida – University of Applied Sciences

Hochschule Mittweida – University of Applied Sciences combines a tradition that spans three centuries with a clear, future-looking focus through its interdisciplinary courses of study, its close cooperation with industry in the region, and its strong emphasis on research. Mittweida University is one of the universities of applied sciences with the strongest research focus. Its field of excellence is laser technology.
Engineers and physicists in the university's Laser Institute, amongst them many Bachelor's and Master's students of Laser Technology, investigate possible uses of laser radiation in rapid micro-tooling for the fast manufacturing of microstructures in diverse applications, such as tool manufacturing, or in microsystems technology. Mittweida University conducts research in pulsed laser deposition of super-hard thin layers for application in anti-wear- and anti-slip-protection, or in high-rate, high-productivity laser processing. Apart from this, nano- and micro-laser processing will also gain momentum using Spintronics, which can accurately deposit magnetic layers on the nanometre scale, create precise structures with ultra-short laser pulses, and selectively magnetise them in a novel laser radiation procedure. Further key focus areas are the development of laser components and fibre lasers as well as computer simulation. At present, more than 30 laser facilities are available. From 2016, the new building of the Laser Research Centre will further improve the teaching and research environment.

The Excellence Area of laser research at Mittweida University is based in the Faculty of Mathematics/Natural Sciences/Information Technology. Just as in the other five Faculties – Electrical and Information Technology, Mechanical Engineering, Economics, Social Work and Media – research and teaching are closely interlinked. At an early stage, students can become practically involved in small study groups within their courses, many of which are interdisciplinary. Individual mentoring, modern equipment and close contact between students and professors ensure that students can personalise their learning and research according to their own interests and talents. Students and business both benefit from the school's close cooperation with companies in the region.

The campus at the heart of the university town of Mittweida will expand considerably in 2014 with the new Centre for Media and Social Work, and in 2016 with the new Laser Research Centre.

www.hs-mittweida.de

Over the past few years, the University has consistently developed and extended its application-related, interdisciplinary research profile: 1. Laser Technologies, Product and Process Development; 2. Smart Systems in Technology and the Natural Sciences; 3. Innovative Media Technologies 4. Challenges of Economic and Social Change.

From idea to tested prototype.

Fraunhofer Institute for Electronic Nano Systems ENAS

Wafer inspection on a 200mm wet bench. | Photo: ENAS/Lösel

The Fraunhofer Institute for Electronic Nano Systems ENAS in Chemnitz focusses on research and development in the field of smart systems integration using micro and nano technologies. Today, smart systems are integral parts of many products. Applications range from semiconductor technologies via medical engineering, mechanical engineering, the automotive industry and logistics to aerospace.
Fraunhofer ENAS offers comprehensive research and development services from the idea to the tested prototype. The institute's product and service portfolio covers high-precision sensors for industrial applications, sensor and actuator systems with control units and evaluation electronics, printed functionalities such as antennas or batteries, 3D integration, as well as material and reliability research for microelectronics and microsystems technology. The focus of development is on micro and nano sensors, methods and technologies for system integration, as well as new sensor and system concepts based on innovative material systems.

www.enas.fraunhofer.de

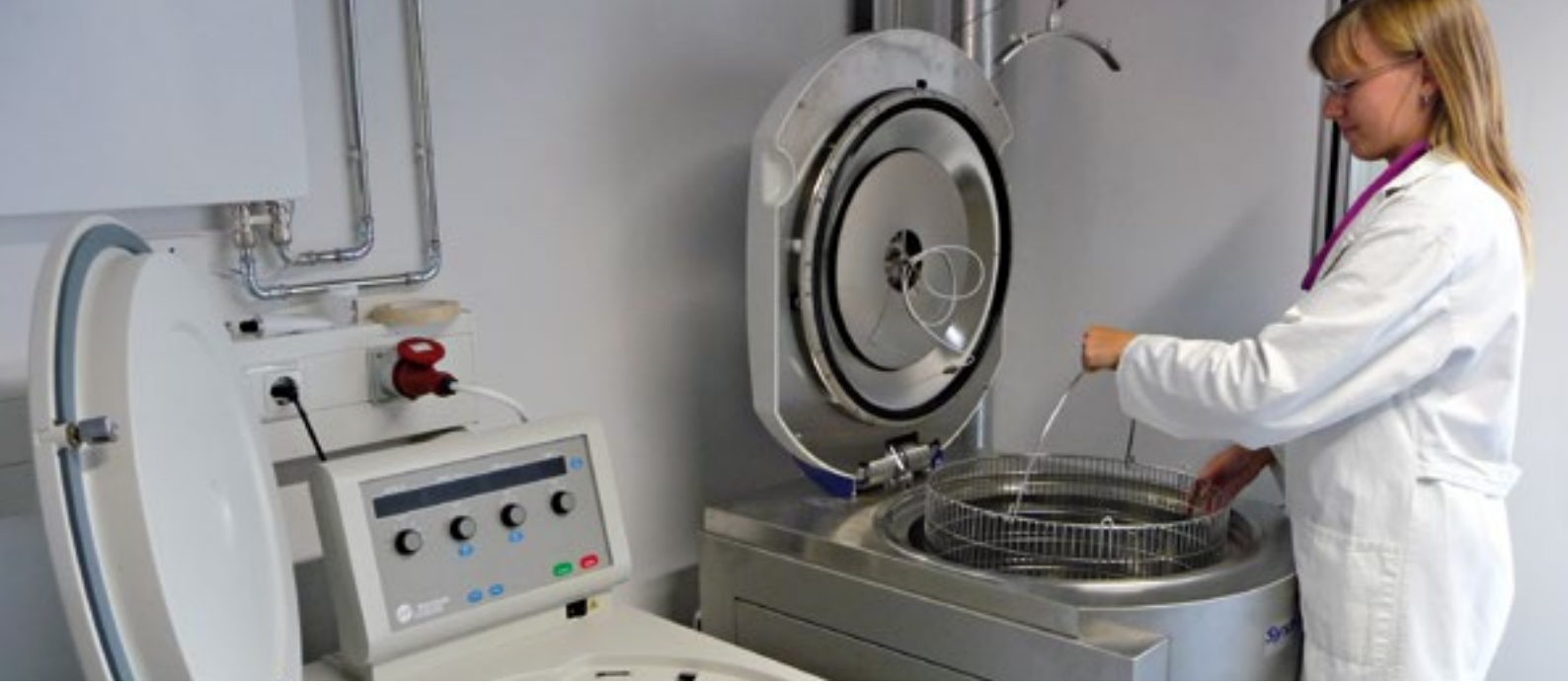
Efficient and sustainable production.

Fraunhofer Institute for Machine Tools and Forming Technology IWU

Developing new technologies for cost- and resource-efficiency in mechanical and plant engineering as well as automobile production.
Photo: Fraunhofer IWU

"Research for the Future" is the creed of the Fraunhofer Institute for Machine Tools and Forming Technology IWU. For more than 20 years, it has successfully conducted application-oriented research and development in production technology for automotive and mechanical engineering. With a highly qualified staff of over 590, Fraunhofer IWU is recognized as one of the leading research and development institutes in the field of production engineering today.
The research expertise at the locations Chemnitz, Dresden, Zittau and Augsburg ranges from machine tools, forming technology, mechatronics, precision engineering to virtual reality and medical engineering. As the leading institution for resource-efficient production processes, Fraunhofer IWU cooperates closely with the Institute for Machine Tools and Production Processes (IWP) at TU Chemnitz to find solutions for improving resource efficiency and in order to prepare them for practical implementation. At the "E3 Research Factory Resource-Efficient Production", opened in May 2014, researchers explore and test new concepts for energy and resource efficiency as well as for integrating the human factor into production.

www.iwu.fraunhofer.de



State-of-the-art technology for the preparation of biosensors in the new innovation lab. | Photos: KSI

Expertise and years of experience.

Kurt Schwabe Institute for Measuring and Sensor Technology e.V. Meinsberg

The Kurt Schwabe Institute for Measuring and Sensor Technology e.V. Meinsberg is operated by the Free State of Saxony. Its long history of proven experience in modern sensor research has included solid electrolyte sensor technology and planar thick-film sensor technology.

Manufacturing miniaturised sensors with the help of screen-printing technology at KSI Meinsberg.

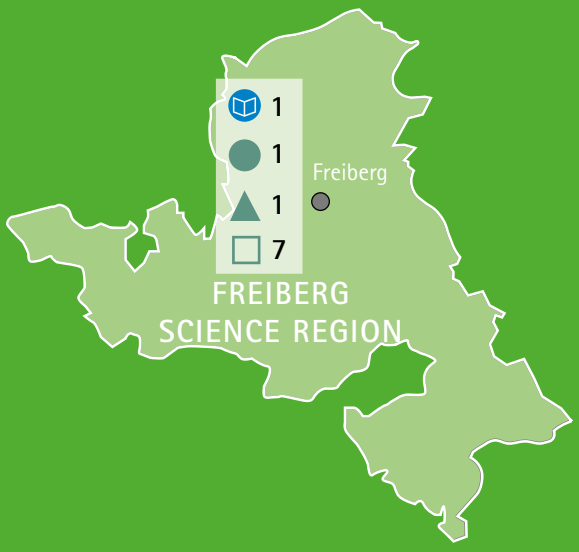
Over the past few years, the institute has established new, future-oriented research fields by strategically building labs that are equipped for biotechnology, analysis and lithography. These facilities allow it to meet the growing international demand for miniaturised on-site sensor technology. The institute combines electrochemical and biological sensor principles in order to develop process and analytical technologies which are applied in the ever-more sophisticated fields of environmental analysis and biochemical process control. Another work focus, in addition to basic research on the development of new sensor materials and principles, is applied research in sensor technology. The objective is to transfer research outcomes to commercial application as fast as possible. The Kurt Schwabe Institute for Measuring and Sensor Technology e.V. Meinsberg cooperates closely with a large number of domestic and international research institutions and industrial corporations.

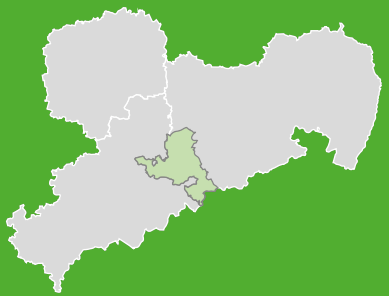
www.ksi-meinsberg.de

Institutions
in the Chemnitz Science Region

Universities, colleges and research institutions	Internet	
Hochschulen		
Technische Universität Chemnitz	www.tu-chemnitz.de	p. 64
Westsächsische Hochschule Zwickau	www.fh-zwickau.de	p. 67
Hochschule Mittweida – University of Applied Sciences	www.hs-mittweida.de	p. 69
University of Cooperative Education		
University of Cooperative Education Glauchau	www.ba-glauchau.de	p. 18
University of Cooperative Education Plauen	www.ba-plauen.de	p. 18
University of Cooperative Education Breitenbrunn	www.ba-breitenbrunn.de	p. 18
Fraunhofer institutes		
Fraunhofer Institute for Electronic Nano Systems ENAS	www.enas.fraunhofer.de	p. 70
Fraunhofer Institute for Machine Tools and Forming Technology IWU	www.iwu.fraunhofer.de	p. 70
Leibniz institutes		
Leibniz Institute for Solid State and Materials Research Dresden (Chemnitz)	www.ifw-dresden.de	p. 54
Free State financed research institutions		
Kurt Schwabe Institute for Measuring and Sensor Technology e.V. Meinsberg	www.ksi-meinsberg.de	p. 71

Universities, colleges and research institutions	Internet	
Affiliated institutes at universities / TU Chemnitz		
Cetex Institut für Textil- u. Verarbeitungsmaschinen gemeinnützige GmbH	www.cetex.de	
KVB Institut für Konstruktion und Verbundbauweisen gemeinnützige GmbH	www.kvb-chemnitz.de	
Institute of Mechatronics	www.tu-chemnitz.de/ifm	
TUCed - TU Chemnitz Education Institute for Continuing and Distance Education	www.tuced.de	
Sächsisches Textilforschungsinstitut e. V.	www.stfi.de	
Affiliated institutes at universities / Zwickau		
mi GmbH – Zentrum für angewandtes Management	www.psp-consulting.eu	
Campus Concept - Non-Profit Institute of education for medical and social care professions Westsachsen registered association	www.campusconcept-zwickau.de	
Affiliated institutes at universities / Mittweida		
Laserinstitut Mittelsachsen e. V.	www.laserinstitut-mittelsachsen.de	
Management Institut Mittweida e. V.	www.htwm.de/mim	
Sensorikzentrum Mittelsachsen e. V.	www.institute.hs-mittweida.de/?id=szms	
Research Centres at Universities of Applied Sciences / Zwickau		
FTZ – Research and Transfer Centre	www.fh-zwickau.de/ftz	p. 67
Cluster of Exzellence		
Merge Technologies for Multifunctional Lightweight Structures – TU Chemnitz	www.tu-chemnitz.de/MERGE	p. 13, 65
Saxon Excellence Initiative		
Energy-efficient Product and Process Innovations in Production Engineering (eniPROD) – TU Chemnitz	www.eniprod.tu-chemnitz.de	p. 22, 65





1 Number of institutions

Universities

Helmholtz institutions

Fraunhofer institutes and establishments

Affiliated institutes at universities

For an overview of the institutions in the Freiberg Science Region, please refer to p. 80.

» Freiberg Science Region

Photo: TU Bergakademie Freiberg

Sustainable, shiny, new.

Technische Universität Bergakademie Freiberg

Above: The research and teaching mine Reiche Zeche not only provides hands-on training for students, it is also an underground research facility with a detonation chamber to study new materials, as well as many other test areas. In addition, Freiberg is planning other projects such as a wind tunnel and devices to extract high-tech metals with the help of bacteria, which are hoped to be a key to "green" mining. | Photo: Detlev Müller

As Germany's leading resource university *Technische Universität Bergakademie Freiberg* has its sights set on securing raw materials along the entire value creation chain. Its portfolio covers the whole range from exploring new repositories via environmentally-friendly extraction of raw materials or developing alternative energy technologies and efficient materials to recycling. All its activities are guided by the principle of sustainable development. TU Bergakademie Freiberg is thus laying the foundations for meeting society's resource needs ecologically, which is indispensable for global economic growth.

TU Freiberg's unique resource profile stems from its research and teaching, which is geared towards the sustainable economy of materials and energy, as well as its four key areas Geo, Materials, Energy and the Environment. Founded in 1765, it is the world's oldest University of Mining Engineering. It conducts practice-related research in intensive cooperation with Saxon industry and international corporations. In terms of income from third-party funding, Bergakademie is one of Germany's top ten universities and actually heads the field amongst the eastern German *Länder*.

In order to establish the guiding principle of sustainable development as a core component of academic training on an international level, *Bergakademie* founded the Freiberg World Forum of Resource Universities for Sustainability in 2012. This goal of embracing the challenges facing contemporary society has been the hallmark of TU Freiberg for some 250 years: It was at *Bergakademie* that Ferdinand Reich and Theodor Richter discovered the element indium, and Clemens Winkler found the element germanium in ores around Freiberg; Abraham Werner founded the academic discipline of Mineralogy and Geology in the Silver City whilst Wilhelm Lampadius developed Continental Europe's first gas lighting in Freiberg.

The lab in the Institute for Deep Drilling Technology analyses, amongst other things, bores and core samples. Scientists are searching, for example, for alternative methods of breaking hard rock, which would not only facilitate the production of oil or gas, but could also a become pathway to harnessing geothermal energy at several thousand metres depth as an energy source of the future. | Photo: Wolfgang Thieme

Today, TU Freiberg embraces numerous projects in applied resource research. For instance, researchers at TU Freiberg are working on novel manufacturing techniques to combine steel and ceramics to make higher-performance, more energy-efficient materials. At the German Centre for Energy Resources Freiberg, researchers from the Resource University are developing technologies for a post fossil fuel world.

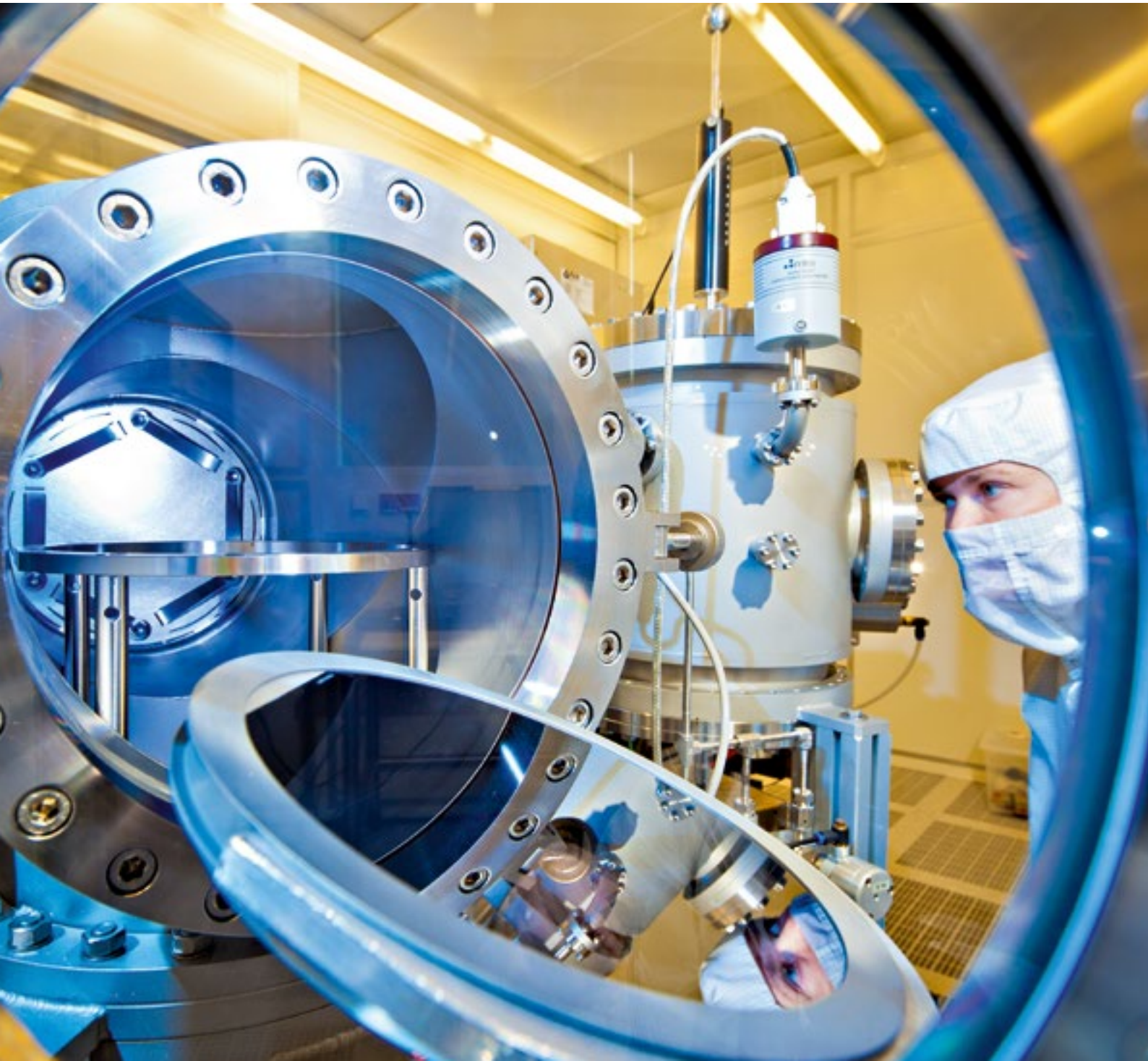
TU Bergakademie Freiberg cooperates with the Helmholtz Institute Freiberg for Resource Technology, which is part of the *Helmholtz-Zentrum Dresden-Rossendorf* and which explores new ways of exploiting high-tech metals such as gallium or indium.

Lastly, the objective of the Biohydrometallurgical Centre – funded exclusively by the private Krüger Foundation, Germany's largest state university-based foundation – seeks to herald in an age of 'green' mining with the help of bacteria.

www.tu-freiberg.de

Indispensable for research and teaching, and fascinating to visitors, are the 40 or so scientific collections belonging to TU Bergakademie Freiberg. In 2004, the university was donated one of the largest and most significant private collections of minerals to add to its famous mineralogical collection. The most beautiful exhibits are on display at Schloss Freudenstein in the permanent exhibition "terra mineralia". In October 2012, in the immediate vicinity, the exhibition "Mineralogical Collection of Germany" opened in the restored Krügerhaus. Bergakademie has thus established a museum complex for minerals in the Silver City which is unique in Europe.

A clean thing: The magnetron sputtering facility in the central cleanroom lab at TU Bergakademie Freiberg produces thin layers of just a few nanometers for micro-electronic storage devices. The cleanroom lab is used for both teaching and research and is operated jointly by the Departments of Physical Sciences and the Department of Electronics and Sensor Materials. | Photo: Jürgen Lösel



Crystal aggregate of copper pyrite, galena, sphalerite and calcite, containing indium, germanium, silver and others. | Photo: Jürgen Jeibmann

New technologies for important industrial raw materials.

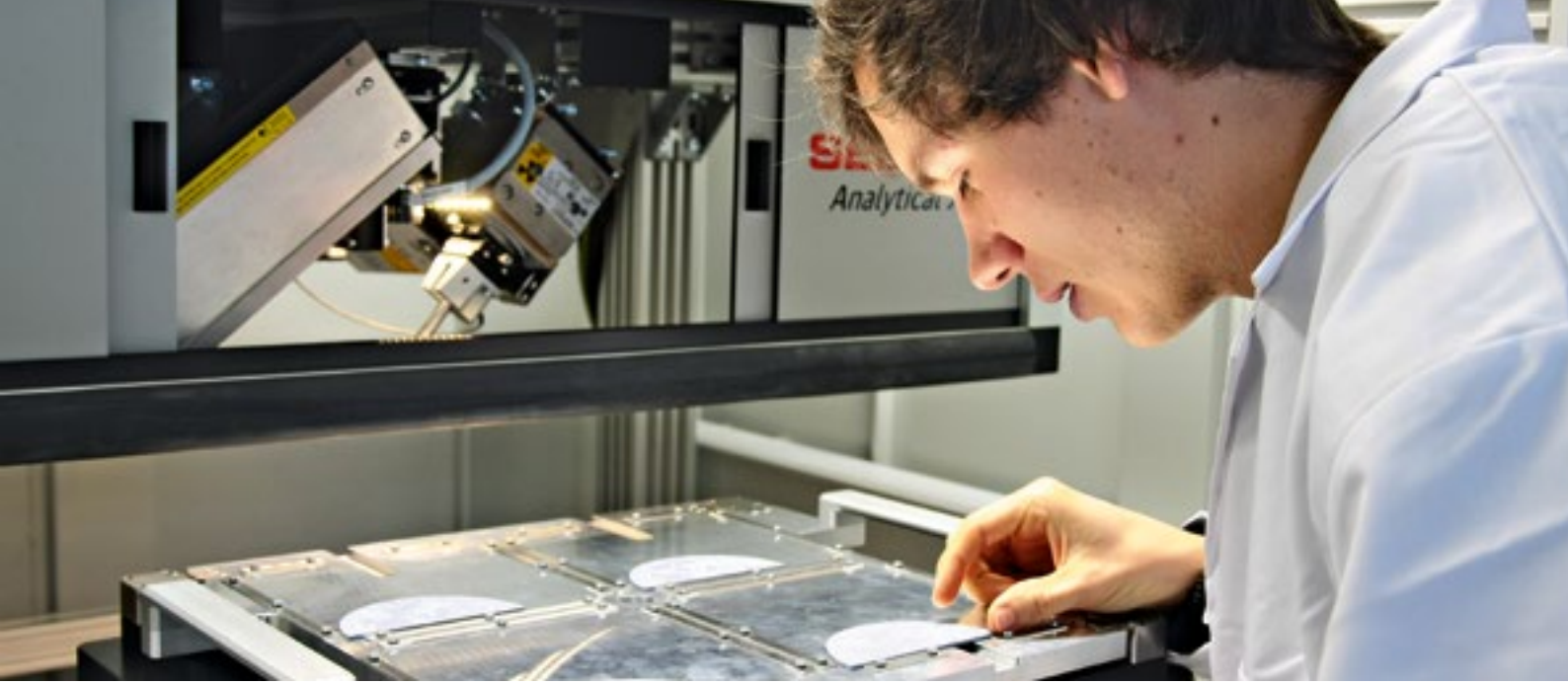
Helmholtz Institute Freiberg for Resource Technology

How can both industry and society be supplied with strategically important industrial raw materials in the long term? Research at the Helmholtz Institute Freiberg for Resource Technology (HIF), one of the *Helmholtz-Zentrum Dresden-Rossendorf's* (HZDR) research sites, strives to answer such questions. Research at HIF involves elements like germanium, gallium, indium, and the rare earth metals – all of which are integral to many modern-day electronic devices and facilities, from mobile telephones, screens, and energy saving light bulbs to solar cells and wind turbines. But global demand for these resources far exceeds their supply, intensifying global competition for these elements.

These coveted natural resources are found in their primary state as mineral deposits in the Earth's crust and in their secondary state in worn-out technology products. The recycling process, in particular, needs to be developed significantly. HIF currently investigates geo-bio-technological processes involving bacteria, which could prove to be a very promising approach. Bacteria-based methods are also being considered for application in metal processing. To optimise the recycling process, HIF scientists are exploring alternative options: Working closely with their colleagues at *TU Bergakademie Freiberg,* they are searching for valuable resources in Saxony's old mine tailings. In addition, the institute coordinates the networking, evaluation, and transfer of research findings as part of a nationwide research alliance with a special focus on the recycling of and alternatives for natural resources. The Helmholtz Institute Freiberg for Resource Technology also operates at the very beginning of the metallurgic supply chain and, along with its Saxon and national partners, drives the search for natural resources in the deeper layers of the Earth – right on the institute's doorstep, in Saxony's Ore Mountains.

In an effort to develop new technologies for the extraction, utilisation, and recycling of mineral or metalliferous raw materials, the German federal government founded the Helmholtz Institute Freiberg for Resource Technology in 2011. HIF's mission is to make an important contribution to the national natural resource strategy. The Institute uses HZDR's unique large-scale equipment and collaborates closely with *TU Bergakademie Freiberg.* Its competencies and projects strengthen Freiberg's status as a natural resource hub.

▮ **www.hzdr.de/hif**



Loading the Laue XRD scanner to determine the properties of semiconductor materials. | Photo: THM

For affordable, innovative materials.

Fraunhofer Technology Centre for Semiconductor Materials THM

The Fraunhofer Technology Centre for Semiconductor Materials THM is operated as a joint department of the Fraunhofer Institute for Integrated Systems and Device Technology IISB in Erlangen and the Fraunhofer Institute for Solar Energy Systems in Freiburg. On the one hand, research at Fraunhofer THM focusses on reducing the manufacturing costs of semiconductor substrates and developing new types of energy storage and energy conversion materials. On the other, it also addresses the analysis of material-related effects in solar modules and storage systems as well as the further development of separation technologies for the PV and semiconductor industries.

In addition to optimising materials for micro-, opto- and power electronics, Fraunhofer THM actively contributes to the energy transition by increasing the use of renewable energies through the application of innovative materials and technologies. THM's achievements are impressive, as evidenced by the Georg Weber Innovation Prize, which it was awarded by the *Förderverein für die Mikroelektronik* (Association for the Promotion of Microelectronics) in 2009 and the 2010 Solarworld Junior Einstein Award, which THM won for its outstanding achievements.

www.thm.fraunhofer.de

The Wafering research group at the Technology Centre for Semiconductor Materials THM Freiberg concentrates on the sawing process in the production of wafers. For this purpose, it has two saws on site, a slurry wire saw and a saw that has been specifically modified for diamond wire. The main focus is on basic research into the sawing process and on comparing the two technologies. | Photo: THM

Institutions
in the Freiberg Science Region

Universities, colleges and research institutions	Internet	
Universities and colleges		
Technische Universität Bergakademie Freiberg	www.tu-freiberg.de	p. 76
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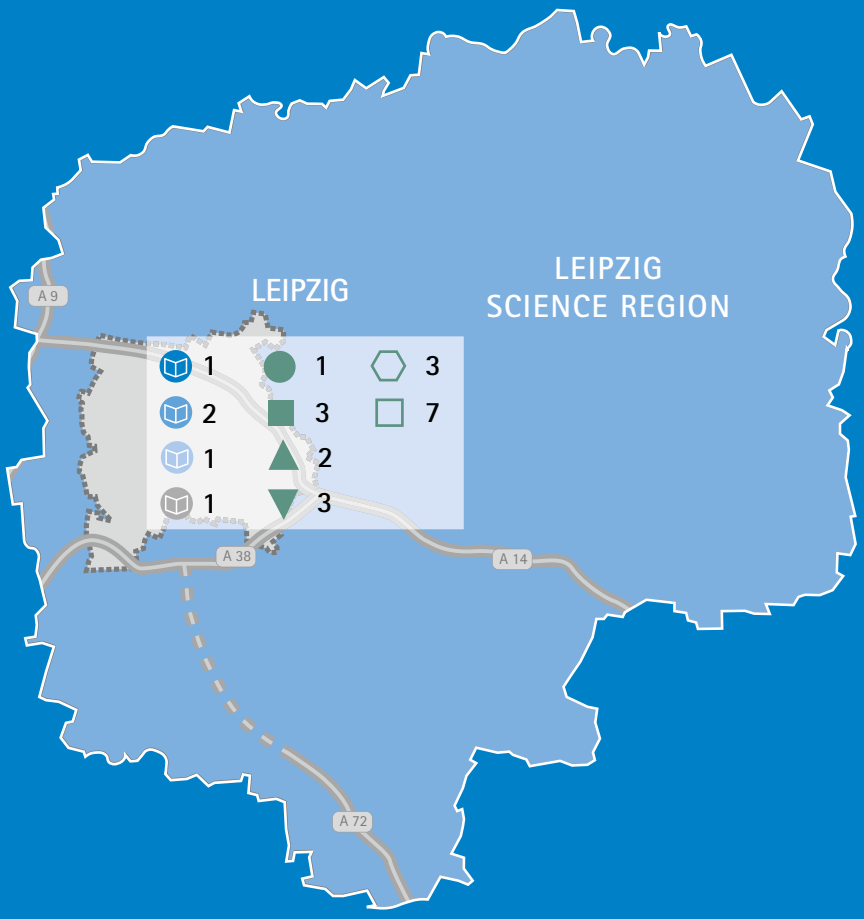
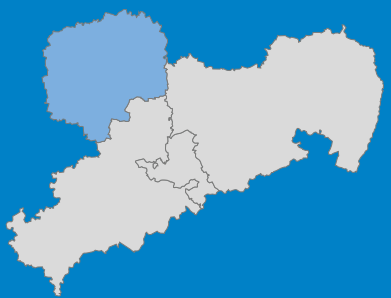
Fraunhofer institutes und establishments		
Fraunhofer Technology Centre for Semiconductor Materials THM	www.thm.fraunhofer.de	p. 79
Affiliated institutes at universities / TU Freiberg		
IBExU Institut für Sicherheitstechnik GmbH	www.ibexu.de	
Research Institute of Leather and Plastic Sheeting	www.filkfreiberg.de	
Stahlzentrum Freiberg e. V.	www.stahlzentrum-freiberg.de	
Institute for Corrosion Protection (IKS) Dresden GmbH	www.iks-dresden.de	
UVR-FIA GmbH (Verfahrensentwicklung, Umweltschutztechnik und Recycling – Forschungsinstitut für Aufbereitung)	www.uvr-fia.de	
DBI – Gastechnologisches Institut gGmbH Freiberg	www.dbi-gti.de	
HAVER ENGINEERING GmbH	www.haverengineering.de	
Saxon Excellence Initiative		
Functional Structure Design of New High-performance Materials by Atomic Design and Defect Engineering (ADDE) – TU Bergakademie Freiberg	http:// tu-freiberg.de/ze/adde/	p. 22





1 Number of institutions

Universities

Universities of Fine Arts

Universities of Applied Sciences

University of Cooperative Education

Helmholtz institutions

Max Planck institutes

Fraunhofer institutes and establishments

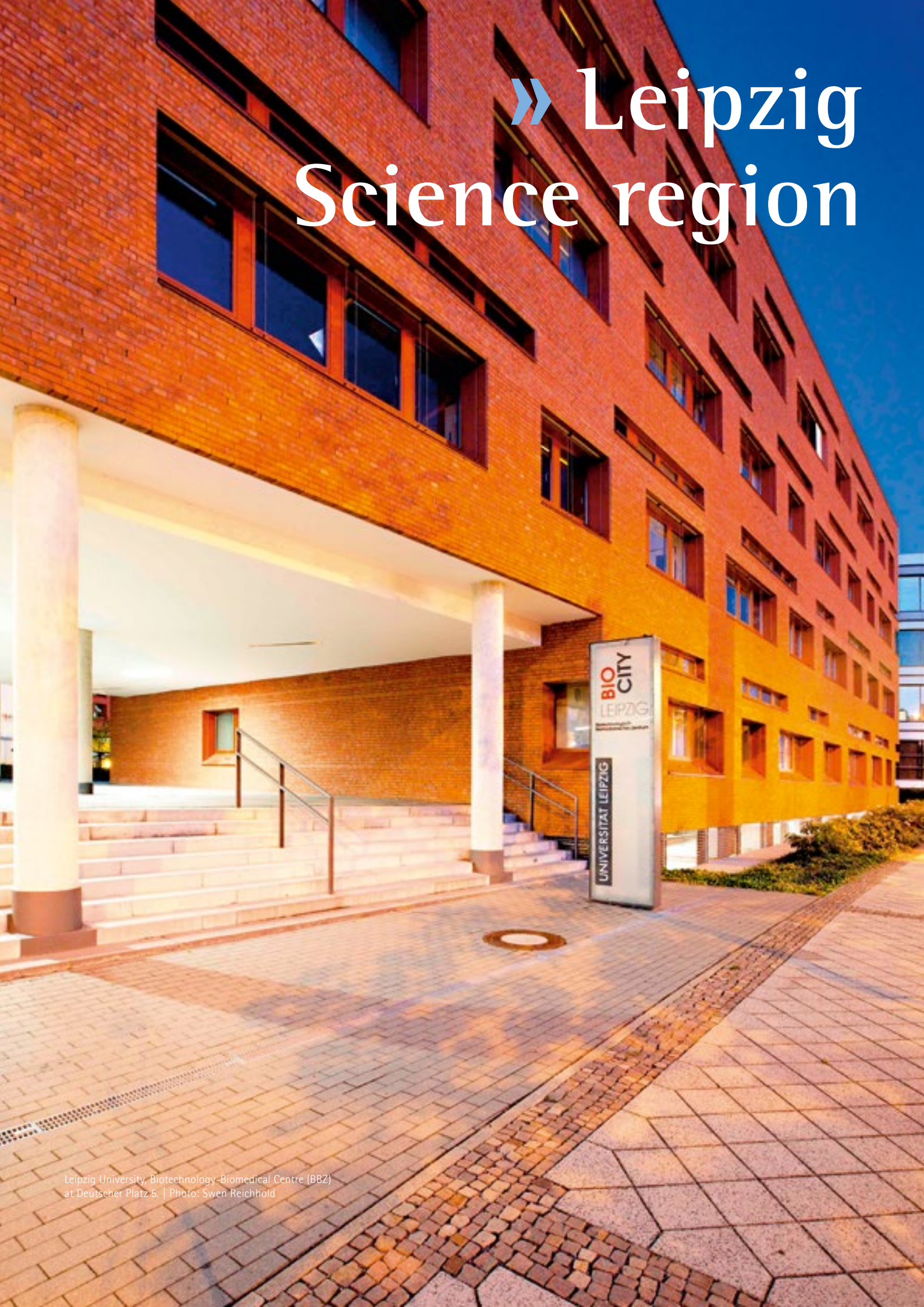
Leibniz institutes

Free State financed research institutions

Affiliated institutes at universities

For an overview of the institutions in the Leipzig Science Region, please refer to p. 102 ff.

» Leipzig Science region



Leipzig University, Biotechnology-Biomedical Centre (BBZ) at Deutscher Platz 5. | Photo: Swen Reichhold

University Library "Bibliotheca Albertina". | Photo: Jan Woitas

A tradition of crossing boundaries.

Leipzig University

Leipzig University has been the academic home of scholars of global repute such as Christian Thomasius, Wilhelm Wundt, Wilhelm Ostwald, Ernst Bloch and Werner Heisenberg. Amongst the students recorded in its registers are famous names like Thomas Müntzer, Gottfried Wilhelm Leibniz, Johann Wolfgang Goethe and Robert Schumann. The list of eminent alumni continues with Hans-Dietrich Genscher, Angela Merkel and Uwe Tellkamp – the university has a total of 150,000 alumni around the globe.

Founded in 1409, Leipzig University is the second oldest university in Germany with an unbroken history of teaching and research. As a traditional university, it embraces nearly all academic fields with a special focus on the Humanities, Natural Sciences and Medicine. Committed to the idea of a *universitas litterarum,* it unites a broader range of academic disciplines than most younger universities. Under its guiding motto, "A Tradition of Crossing Boundaries", Leipzig University seeks to reassert its place at the forefront of Europe's leading universities.

Today, more than 450 professors and approximately 2,500 academic staff teach and conduct research in 14 faculties and more than 150 institutes. Some 28,500 students are enrolled in courses of study ranging from A, as in African Studies, to Z as in *Zahnmedizin* (Dentistry).

The broad and diverse research spectrum at Leipzig University ranges from basic via applied research right through to contract work for industry. Research at the university is particularly excellent in the fields of Biodiversity, Digital Humanities, Global Interaction, Biomedicine (metabolic and lifestyle diseases), Materials Science and Biotechnology as well as Mathematics – areas in which the university is well connected in national and international research alliances. In cooperation with non-university research institutions in Leipzig, which include three Max Planck Institutes, the Fraunhofer Institute for Cell Therapy and Immunology, three Leibniz institutions, the Helmholtz Centre for Environmental Research, UFZ and innovative businesses in the BioCity Leipzig, the university has developed profile areas that generate internationally competitive research and make Leipzig a great place for doctoral studies.

Excellent learning environment at the Institute of Anatomy, Histology and Embryology.
Photo: Swen Reichhold

p. 84: Photo: Waltraud Grubitzsch

On the nature trail – Biodiversity research at the German Centre for Integrative Biodiversity Research (iDiv). | Photo: Swen Reichhold

Campus Augustusplatz: The Neues Augusteum and the Paulinum – Auditorium and University Church of St. Pauli. | Photo: Swen Reichhold

The Research Academy Leipzig, opened in 2006, is dedicated to supporting junior researchers and combines all post-graduate programmes at Leipzig University right across the departments. Doctoral candidates, a third of whom come from abroad, work under excellent conditions, have access to a dense network of international collaborations and opportunities to obtain a bi-national doctorate from Leipzig and a partner university abroad.

There are also numerous research alliances that have gained an international reputation for their research performance, such as the German Centre for Integrative Biodiversity Research (iDiv), the Centre for Biotechnology and Biomedicine (BBZ), the Translational Centre for Regenerative Medicine (TRM), the Leipzig Research Centre for Civilization Diseases (LIFE), the Integrated Research and Treatment Centre Adiposity Diseases and the Centre for Area Studies (CAS).

Academic excellence at Leipzig University also stems from a large number of small, internationally renowned projects in 'exotic' subjects, mainly in the Humanities and Social Sciences. The Alexander von Humboldt Professorship in Digital Humanities is also a crucial component of the university's Humanities profile.

The university is currently in the process of strategically refining its research profile, with a special focus on networking at the research location Leipzig. In addition to its status internationally, the university wants to strengthen its position as a partner for knowledge and technology transfer in central Germany as well.

The university's activities in various areas of life-long learning are also gaining momentum, such as continuing academic education for postgraduates. Diverse partnerships with universities around the world, as well as internationally focussed courses, make Leipzig an appealing choice for prospective students and researchers worldwide. Numerous international contacts, high mobility rates and internationally connected research and teaching are the university's traditional hallmarks. Leipzig University operates student exchange programmes with more than 350 ERASMUS partner universities in 150 European cities. In addition, it has concluded nearly 100 bilateral agreements at university and faculty level, more than two thirds of them with partner universities outside of the European Union. It also fosters particularly close research ties to Stellenbosch University, South Africa, and Vanderbilt University in Nashville, TN (USA).

For centuries, today's Augustusplatz at the heart of Leipzig has been home to the university's main buildings. Two particular buildings not only provide an ideal learning environment, but also house artistic gems from more than six centuries of university history: the *Neues Augusteum* with the main hall and the *Paulinum,* currently being built as a tribute to the University Church of St. Pauli, which was demolished in 1968. The *Paulinum* – auditorium and University Church of St. Pauli will be used for various purposes in the life of the university, such as functions, concerts and conferences, as well as religious and other external events.

The university itself enriches the city of Leipzig in its role as an important cultural institution, preserving and making its treasures accessible to the public in three museums (Egyptian Museum, Museum of Classical Antiquities, Museum of Musical Instruments), its more than 450-year-old University Library, the University Archives, the Art Collection of the University *(Kustodie)* and in Germany's oldest Botanical Garden, as well as numerous teaching collections. It fulfils its role as an intellectual motor for the city of Leipzig by holding lecture and event series, such as Studium Generale, "Talk on Sunday", a Book Fair Academy, a TransferMeeting and the Long Night of Science. The 24-hour library on Augustusplatz is open to the public. And last but not least, the presence of thousands of students and academics from Germany and beyond give Leipzig a special flair: they concurrently enjoy and generate Leipzig's diverse and cosmopolitan cultural scene and have thus left their mark on the city and its spirit for generations.

www.uni-leipzig.de

Photo: Stefan Straube

First-rate medical training and care.

Faculty of Medicine and University Hospital Leipzig

Outstanding research, excellent teaching and optimum healthcare are the hallmarks of Leipzig University Medicine. To achieve this level of quality the University Hospital and Leipzig University's Faculty of Medicine work together closely. The daily efforts of more than 6,000 staff revolve around just one thing: human health.

At the heart of the welcoming, cosmopolitan city of Leipzig, the Medical Campus in Liebigstraße has some of Europe's most advanced architectural and technological infrastructures: minimally invasive surgery methods, computer-assisted planning and performance of medical interventions, unique diagnostic possibilities, development and application of innovative therapies and optimum interdisciplinary networking between the individual medical fields ensure full-range healthcare of the highest quality, providing in- and out-patient services to more than 350,000 people every year.

The close connections between the University Hospital and Leipzig University's Faculty of Medicine, as well as other institutes and research institutions, facilitate the rapid and efficient transfer of the latest insights in research to medical practice.

Education, too, is of a very high standard and amongst the best Germany has to offer. More than 3,000 medical and dentistry students enjoy innovative teaching concepts and immediate practical application from the very start, preparing them for their future role as physicians or researchers. Moreover, Leipzig University Hospital is one of the region's largest teaching facilities for the caring professions. A total of 800 students and apprentices train for various occupations in healthcare.

www.medizin.uni-leipzig.de

The "Learning Clinic Leipzig" at the Faculty of Medicine gives students the opportunity to practise their skills on more than 200 human simulators. Photos: Ines Christ

The University Symphony Orchestra at its annual concert at the Gewandhaus Leipzig. | Photo: Gert Mothes

Highest international standard.

University of Music and Theatre “Felix Mendelssohn Bartholdy” Leipzig

Students at the University of Music and Theatre "Felix Mendelssohn Bartholdy" Leipzig in their opera production of "The Magic Flute". Photo: Siegfried Duryn

When the Leipzig Conservatory opened its doors on 2 April 1843, on the initiative of Felix Mendelssohn Bartholdy – the then musical director of the *Gewandhaus* – and other fine-arts-minded citizens, it was the first institution of higher education for musicians within the boundaries of today's Germany. During its first 40 years, it was housed in the courtyard of the Old Gewandhaus, before moving to the Conservatory building designed by Hugo Licht at Grassistraße 8 on 5 December 1887.

The university's academic range expanded significantly in 1992 when it merged with the Academy of Theatre "Hans Otto", which had been founded in 1953, to create the University of Music and Theatre "Felix Mendelssohn Bartholdy" (HMT) Leipzig. The Great Hall, destroyed in World War II, was rebuilt, dedicated in 2001, and awarded a prize by the Saxon chapter of the Association of German Architects in 2004. In 2002, about half of the thirteen departments and institutes moved into the second central building at Dittrichring 21.

With 700 events a year, HMT is the most prolific of the comparable training institutions. Its symphony concerts, operas, organ recitals, jazz gigs, theatre productions and competitions are staples of Leipzig's cultural scene. The university cooperates with the city's major cultural institutions in the fields of music and performing arts (*Gewandhaus Leipzig,* the Leipzig Opera, Leipzig Musical Comedy Theatre, the municipal theatre, the MDR Symphony Orchestra).

About 1,000 students are currently enrolled at the university. The core mission of HMT is to train professional musicians, music teachers and actors at the highest international level. Many famous teachers and alumni of the university have left a permanent mark on the international cultural landscape.

www.hmt-leipzig.de

Viewing the 2013 HGB exhibition, class for photography in contemporary art.

Internationally renowned.

Academy of Visual Arts Leipzig

Founded by Saxon Elector Friedrich Christian together with the Dresden Academy of Arts and a school of drawing at the Meissen porcelain factory as an "Academy for Drawing, Painting and Architecture", the Academy of Visual Arts Leipzig (HGB) is one of Europe's oldest art academies, celebrating its 250th anniversary in 2014.

About 600 students are enrolled in the Academy's four *Diplom* courses in Painting/Graphic Arts, Book Art/Graphic Design, Photography, and Media Art. A Master's programme in "Cultures of the Curatorial" was added in summer 2009.

HGB's Institute for Theory teaches and conducts research in Philosophy, Art History, Visual Studies, Media Theory, History and Theory of Photography, Graphic Design and Book Art. In 2008, HGB obtained the right to grant doctorates.

It lives up to its ambition to be innovative whilst honouring tradition with its excellently equipped workshops for Xylography and Woodcut, Artistic Off Set Printing, Lithography, Etching, Silk-Screen Printing, Book Printing, Book Binding and manual typesetting as well as its audio-visual lab and 3-D studio.

The university's equally time-honoured Institute for Book Art produces refined, unusual and highly innovative publications which routinely earn citations and awards in national and international competitions.

HGB opened its own gallery in 1980. With its remarkable exhibitions, the gallery and the Institute for Book Art are an important interface between the Academy and the public.

www.hgb-leipzig.de

HGB's silk-screen printing workshop.
Photos: HGB/Marion Herzberg

Students in Leipzig's Karl-Liebknecht-Straße with the distinctive tower of HTWK Leipzig's Geutebrück Building in the background. | Photo: HTWK Leipzig

Knowledge connects.

Leipzig University of Applied Sciences

Interdisciplinary research at HTWK Leipzig: capillary pressure sensors for the aftertreatment of concrete, developed jointly by engineers at the Faculties of Civil Engineering and Electrical Engineering and Information Technology, help to prevent early damage. | Photo: Stephan Thomas

Leipzig University of Applied Sciences (HTWK Leipzig) with its seven departments is only twenty years old, yet the traditions of many of its precursors reach back much further – for instance, the Royal Saxon Building School, founded in 1838, the Book Printing Academy (1869), the Municipal Trade School (1875), or the Specialist School for Library Technology and Administration (1914).
Today, HTWK Leipzig offers an exciting and diverse range of application- and future-oriented courses of study in Engineering, Economics and Social Studies, Computer Sciences and Mathematics as well as Applied Media, Information and Cultural Studies. Networking is paramount: in teaching and research and through interdisciplinary cooperation within the university and with numerous external partners. Third-party funding amounting to approximately 8.4 million Euros in 2012 testifies to the strength of HTWK Leipzig's research. More than 80 ongoing collaborative PhD projects contribute their share to this successful record, which is significantly boosted by the HTWK Leipzig Research and Transfer Centre, founded in 1997.

Whilst its strategy of utilising multi-layered interconnections has shaped HTWK Leipzig's development goal of becoming a top university for applied sciences for a number of years, its university strategy 2020 has defined and refined its academic profile: the focus areas are "Energy-Building-Environment", "Software and Media Technologies", "Life Science Engineering" and "Engineering & Business", bundling its activities across all disciplines and departments. This involves closely interconnected teaching, research and technology transfer. In each of its profile areas, HTWK Leipzig tackles pressing social challenges – the issues of ever-scarcer resources or how to deal with information overflow in a knowledge society, the question of health in our ageing society, or the task of handling economic processes efficiently and responsibly with a view to future generations.

At the time it was founded, HTWK Leipzig was scattered all over the city, but now a unified university campus is emerging and claiming a distinct space south of the city centre. University life gravitates more and more towards a host of university buildings housing state-of-the-art facilities. They bear the resounding names of famous scholars: the Geutebrück, Zuse or Lipsius Buildings, for instance. The university library and media centre – which both opened in 2009 – are award-winning architectural highlights in the cityscape. The Faculty of Mechanical and Energy Engineering will move from Markkleeberg to a new site, setting another accent in urban development.

The past and future are bridged at two historic locations with modern uses: The historic building of the former Municipal Trade School in Wächterstraße will continue to be the home of the Department of Electrical Engineering and Information Technology. And in the historic buildings of the former Leipzig Children's Hospital, HTWK Leipzig has established a centre for priority research on highly-topical issues of Health and Medical Technology.

For students, the *KarLi,* as the Karl-Liebknecht-Straße is affectionately known, represents both the geographical centre and the essence of their lifestyle. This is where student life and applied scientific work often fuse. Every other year, students and staff in the Media Faculty captivate audiences with their spectacle "Phänomedia", which transforms surfaces, such as the media centre façade, into a gigantic screen. The football robots of Team Nao score great successes in competitions at home and abroad; the Leipzig Marathon is all about getting involved: Year after year, HTWK Leipzig competes with the largest team.

www.htwk-leipzig.de **www.ftz-leipzig.de**

HTWK Leipzig Research and Transfer Centre (FTZ) works at the interface between the university's research expertise and practical application – its mission being to bring innovations to the marketplace. To achieve this, the centre cooperates closely with businesses and research institutions from the region and beyond. FTZ conducts its own research and development projects, manufactures functional samples and low-volume product lines, carries out technical testing and writes reviews. It focusses on Construction, Energy, Electrical Engineering and Electronics, Media and Health Care.
www.ftz-leipzig.de

Scientists at HTWK Leipzig are developing a "sensitive machine" which automatically adapts its movements to the workpiece being processed. | Photo: Stephan Thomas

Tackling environmental problems.

Helmholtz Centre for Environmental Research

As an international competence centre for the environmental sciences, the Helmholtz Centre for Environmental Research (UFZ) explores how global change impacts the complex interactions between man and nature. In close cooperation with decision-makers and social stakeholders, scientists at UFZ develop system solutions to improve the management of complex environmental systems and to tackle environmental issues.

UFZ works, for example, on water resource management, the impact of changing land use on human environments and biodiversity, the effects of chemicals on the environment and on human health as well as strategies to adapt to climate change. But successful solutions require more than a solid scientific basis. Environmental research, which is usually dominated by the natural sciences, must be more closely connected with the humanities, social sciences and law.

Environmental research should be guided by the environmental issues at hand, and must learn to deal with complexity, uncertainty and practical relevance. This means sharing knowledge, developing a common understanding and communication, pooling different skill sets and fields of expertise, integrating decision-makers and stakeholders from politics, industry and the general public – in short, the highest possible level of integration. The aim is to strike a balance between economic and social progress on the one hand and the long-term preservation of the very foundations of human life on the other.
Founded in 1991, UFZ currently employs more than 1,100 staff from more than 40 countries at its Leipzig, Halle and Magdeburg sites. Approximately 250 PhD candidates are studying for their doctorates in the framework of international cooperation whilst some 55 apprentices are being trained for eleven different trades and vocational academy degrees. ▮ **www.ufz.de**

The portfolio of UFZ research also includes developing modern remedial technologies. Scientists are, for example, experimenting with radio waves which might be of great use in soil rehabilitation and building restoration or in the processing of biogas.
Photos: André Künzelmann/UFZ

p. 92 top: The Visualisation Centre (Vislab) at UFZ allows scientists to gain new insights into complex environmental systems by using realistic and graphical visualising 3-D models.

Bottom: Decisions on environmental policy cannot be made without reliable data on environmental conditions or changes. With the help of direct push technologies samples can be taken rapidly and cost-effectively.

Studying the bone fragment of a Neanderthal in the institute's ultra-clean room. | Photo: Frank Vinken

Tracing history in the bones.

Max Planck Institute for Evolutionary Anthropology

Founded in 1997, the five departments of the Max Planck Institute for Evolutionary Anthropology study the history of mankind with the help of comparative analyses of genes, cultures, cognitive abilities, languages and social systems of past and present human populations as well as those of other closely related primates.

The Department of Evolutionary Genetics thus investigates the genomes of Neanderthals and their close relatives, the Denisovans. Researchers in the Department of Human Evolution analyse the fossil remains of hominins in order to reconstruct their biology, behaviour and cultural evolution. The Department of Primatology studies primates in their natural habitats whilst the Department of Developmental and Comparative Psychology focusses on topics like cooperation. According to studies, children prefer solving tasks together rather than alone – in contrast to primates. The Department of Linguistics investigates the diversity of human languages in terms of their common properties and differences.

www.eva.mpg.de

Researchers obtained the majority of the DNA used in their study from the bone fragments of three female Neanderthals who were excavated in the Vindija Cave in Croatia. | Photo: Max Planck Institute for Evolutionary Anthropology

The wonderful world of Mathematics.

Max Planck Institute for Mathematics in the Sciences

Founded in Leipzig in 1996, the Max Planck Institute for Mathematics in the Sciences works at the interface of mathematics and the sciences. Today, it is one of the world's leading research institutions in mathematics, excellently connected with partners at local level – like Leipzig University –, but also with outstanding institutions at national and international level.

Mathematical models and methods play an increasingly important role in today's society. They form the basis for fundamental processes, whether in economics, production, medicine or politics. Yet fundamental questions arising from the sciences have also always inspired mathematicians to search for new mathematical methods and structures. It is the mission of the institute to promote this interaction between mathematics and the sciences. Researchers at the institute address a broad spectrum of questions in the fields of pure and applied mathematics, for example the efficient treatment of huge amounts of data, the mathematical analysis of materials, the investigation of complex biological systems and economic processes, topics in geometry and theoretical physics as well as in information theory of cognitive systems.

The shape of independence. | Photo: Stephan Weis
Reading room in the institute library. | Photo: Gunter Binsack

www.mis.mpg.de

Language – emotions – behaviour.

Max Planck Institute for Human Cognitive and Brain Sciences

Preparing a 4-year-old study participant for an MRT scan.
Photo: Max Planck Institute for Human Cognitive and Brain Sciences

Research at the Max Planck Institute for Human Cognitive and Brain Sciences in Leipzig revolves around human cognitive abilities and cerebral processes, with a main focus on the neural bases of higher brain functions, such as language, emotions and human social behaviour, music, and action. Researchers also investigate plastic changes in the brain and their influence on various cognitive abilities as well as the neuronal and hormonal basis of "lifestyle diseases" like high blood pressure and obesity. Another focal point of research at the Institute is the advancement of imaging methods for the neurosciences.

About 160 staff work in the Departments of Neuropsychology, Cognitive Neurology, Neurophysics and Social Neurosciences. Especially in the light of Leipzig's long-standing tradition of psychological and neuroscientific research, the Institute's state-of-the-art technical equipment underlines the appeal and innovative power of the research fields explored there.

www.cbs.mpg.de

Strategies for global action.

Fraunhofer-Zentrum für Mittel- und Osteuropa MOEZ

Fraunhofer MOEZ studies and designs internationalisation processes at the intersections between industry, science, politics and society. On behalf of both private business clients and public institutions, the institute develops solutions to position corporations and regions in the global knowledge economy. Fraunhofer MOEZ thus opens up the potential for generating added value, competitiveness and prosperity. The service portfolio of Fraunhofer MOEZ is organised in five business fields that address complex challenges and correspond with the real-life economic and political players in internationalisation processes. For instance, Fraunhofer MOEZ works together with small and medium-sized enterprises to access international markets. Its political consultancy focusses on knowledge and technology transfer. With its economic and sociological expertise and its firm international outlook, Fraunhofer MOEZ's mission is to complement the technological institutes in the *Fraunhofer Gesellschaft*.

www.moez.fraunhofer.de

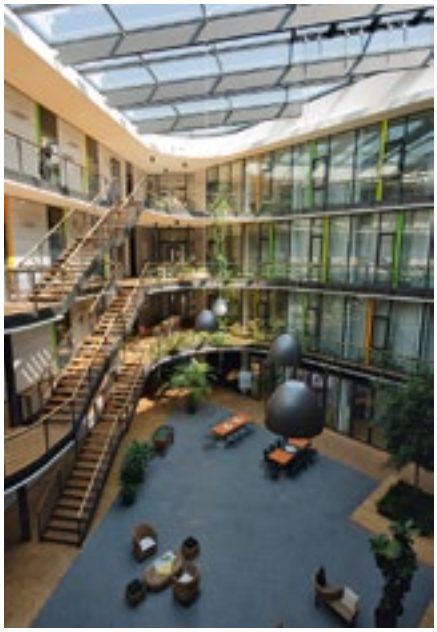
Fraunhofer MOEZ headquarters in the Städtisches Kaufhaus, Leipzig, workplace of an international and interdisciplinary team of 40 researchers.
Photo: Fraunhofer MOEZ

Focussed on clinical practice.

Fraunhofer Institute for Cell Therapy and Immunology IZI

The Fraunhofer Institute for Cell Therapy and Immunology IZI studies and develops specific solutions to problems at the interface of medicine, life sciences and engineering. The institute conducts contract research for biotechnological, pharmaceutical and medical-technological companies, hospitals, diagnostic laboratories and research facilities.
Fraunhofer IZI develops, optimises and validates methods, materials and products in the fields of Drugs, Cell Therapy, Diagnostics and Biobanks. Its core competencies are regenerative medicine, in particular in the therapeutic areas of oncology, ischemia and autoimmune, inflammatory and infectious diseases. The institute has a focus on clinical practice, conducts quality checks and manufactures clinical test samples in compliance with Good Manufacturing Practice (GMP) guidelines to ensure quality in production processes and environments for pharmaceuticals and their ingredients. Moreover, the institute helps its partners obtain manufacturing licences and approvals for new therapies.
The institute currently employs a staff of more than 300.

www.izi.fraunhofer.de



The foyer of Fraunhofer IZI
Photo: Fraunhofer IZI

p. 96: Scientists manufacture and develop cell-based therapeutics for clinical studies in the cleanroom facility at Fraunhofer IZI. | Photo: Fraunhofer IZI

Worldwide field studies – and a cloud lab.

Leibniz Institute for Tropospheric Research

The Leibniz Institute for Tropospheric Research (TROPOS) focusses on tiny airborne particles called aerosols and on clouds. The TROPOS research profile is unique in the world: It explores the troposphere, the layer of the atmosphere affecting weather and climate, which stretches from the ground to an altitude of about 7 to 18 kilometres and contains the bulk of aerosol and cloud particles.

Human activity causes system changes, which themselves then affect humans, not only through regional and global climate and water cycle changes, but also directly in the form of health effects caused by inhaling fine dust particles and fog droplets. To shed light on these processes and develop strategies to curb them, TROPOS conducts field studies in polluted regions around the globe and develops its own analytical procedures for aerosol and cloud research. These tools are also applied in extensive lab studies, which are another work focus at the institute. For this purpose, TROPOS operates a cloud lab that simulates basic cloud processes and the impact of humans on clouds. In addition to field studies and lab experiments, the institute has a third important research pillar: numerical models, from process models to simulations of the regional formation, transformation and effects of tropospheric multiphase systems.
TROPOS belongs to the Leibniz Association, employs a staff of over 140 and is financed by the Free State of Saxony and the Federal Government with institutional funding of about four million Euros per year. In addition, the most recent figures for third-party funding were also in the region of four million Euros.

www.tropos.de

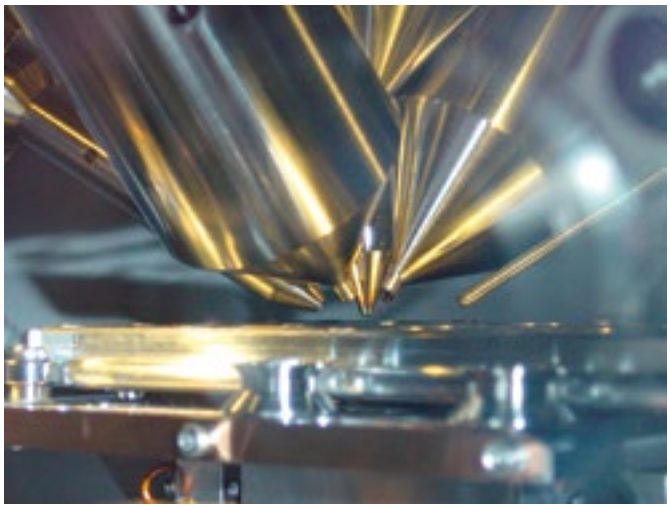
Top: Studying ice clouds at the high alpine research station Jungfraujoch (3,580 m altitude) in January/February 2013 as part of the measurement campaign "INUIT JFJ."
Photo: Tilo Arnhold/TROPOS

The Leipzig Aerosol Cloud Interaction Simulator (LACIS) at the Leibniz Institute for Tropospheric Research (TROPOS).
Photo: Patric Seifert/TROPOS

Ultra-precise surface modification.

Leibniz Institute of Surface Modification

The Leibniz Institute of Surface Modification (IOM) was founded in 1992 to conduct application-related fundamental research on the interaction of radiation with matter, and to translate its insights into technological applications. The institute, currently with a staff of 150, uses ions, plasma, electron and laser radiation to modify surfaces and areas near the surface specifically for different applications. Researchers focus on ultra-precise surface modification, structuring at the micro- and nano-metre-level, synthesising thin layers and nano structures, manufacturing scratch- and wear-resistant surfaces and applying bio-compatible implants. In 2012, the *Leipziger nanoAnalytikum* (LenA), which is financed by the EU and the Free State of Saxony and features state-of-the-art equipment such as electron microscopes, was launched at the institute. Research and development at IOM is undertaken in close collaboration with businesses in the optical, chemical and semiconductor industries as well as mechanical engineering. This type of cooperation has led, for instance, to Carl Zeiss Jena und JENOPTIK GmbH endowing a professorship at IOM Leipzig and TU Dresden.



View into the Ultra-High Vacuum Chamber of a Surface Analysis System. Photo: IOM

www.iom-leipzig.de

Geography between basic research and transfer of knowledge.

Leibniz Institute for Regional Geography

Demographic change, urban development, return migration of Eastern Germans to their original home – the palette of research themes is broad at the Leibniz Institute for Regional Geography (IfL), Germany's only non-university research institution for Geography. It ranges from spatial structures and current developments that have a spatial impact in Europe to the theoretical and historical foundations of Regional Geography. Under the heading "New Geographies of Europe", IfL researchers conduct transnational comparative studies to analyse current trends, in particular in Central and Eastern Europe.

Research at the institute focusses on three areas: the Production of Space, History of Geography and Geovisualisation. IfL thus makes a significant contribution to our understanding of spatial organisation and social development. It also provides a transdisciplinary platform for scientific discourse on space and spatiality in the humanities and social sciences.

Another section of the institute is devoted to presenting research outcomes to specialist as well as to general audiences. For this purpose, it continuously develops traditional media such as maps and atlases, but also creates and tests innovative ways of visualising geographical knowledge and geographical information online. IfL developed the National Atlas of Germany, for instance, which presents examples of exhaustive, academically valuable research findings in a comprehensible form.

At IfL, maps are an important medium for knowledge transfer. | Photo: IfL

www.ifl-leipzig.de

Discourse across disciplines.

Saxonian Academy of Sciences and Humanities in Leipzig

Ever since it was founded as the "Royal Saxonian Society of Sciences and Humanities" in 1846, the Saxonian Academy of Sciences and Humanities has been committed to the academy tradition conceived by Leibniz at the turn of the 18th century – a learned society that brings together leading scholars of very different disciplines for regular discourse and long-term research. Former and current members of the Leipzig Learned Society include famous Nobel laureates such as Theodor Mommsen, Wilhelm Ostwald, Max Planck, Gustav Hertz and Karl Alexander Müller.

In its catchment area of Saxony, Saxony-Anhalt and Thuringia, the Academy is currently conducting more than 20 research projects. They are part of the Academies' Programme, Germany's largest humanities research programme, which is coordinated by the Union of the German Academies of Sciences and Humanities with an agenda for long-term academic research that is unique in the world. The Saxonian Academy of Sciences and Humanities, for example, is producing annotated editions of the complete works of Felix Mendelssohn Bartholdy, dictionaries and editions of correspondence, such as those of Schumann and Gottsched, and more. The Academy also facilitates intense public debate on key issues affecting the future of society.

www.saw-leipzig.de

Villa Klinkhardt, at the gateway to Leipzig's Musikviertel at Karl-Tauchnitz-Straße 1, has been the home of the Saxonian Academy of Sciences and Humanities since 1995.
Photo: Dirk Brzoska

Top: The Academy Forum and the Academy Colloquium are two event series that gather together experts from academia and politics in order to advance public debate on current issues in society and science policy – a dialogue which is continued in the Academy's own journal, Denkströme. | Photo: Dirk Brzoska

Unearthing historical structures.

Leipzig Centre for the History and Culture of East Central Europe

The Centre for the History and Culture of East Central Europe (GWZO) is a research institute associated with the University of Leipzig (as an "An-Institut"). Its basic financing is provided by the Federal State of Saxony (Saxon State Ministry for Higher Education, Research and the Arts) and the current research program is financially supported mostly by the Federal Ministry of Education and Research. The Centre's scientific interest focuses on a historically evolved region between the Baltic, the Black and the Adriatic Sea that was constituted by states behind the Iron Curtain, the majority of which are members of the European Union today. The GWZO discloses the historical structures of a linguistic, cultural and national diversity of this region that had been even greater before the military conflicts of the 20th century.

Researchers of various academic disciplines in the centre's 16 project groups analyse historic developments while covering a period from the early Middle Ages to the present. Their research objects range from archeological finds to written documents and artwork, to print material and digital media. A highlight of their work was the international exhibition "Europa Jagellonica. Central European Arts and Culture under the Reign of the Jagiellonians 1386-1572" which was shown in Kutna Hora, Warsaw and Potsdam in 2012 and 2013.

www.uni-leipzig.de/gwzo

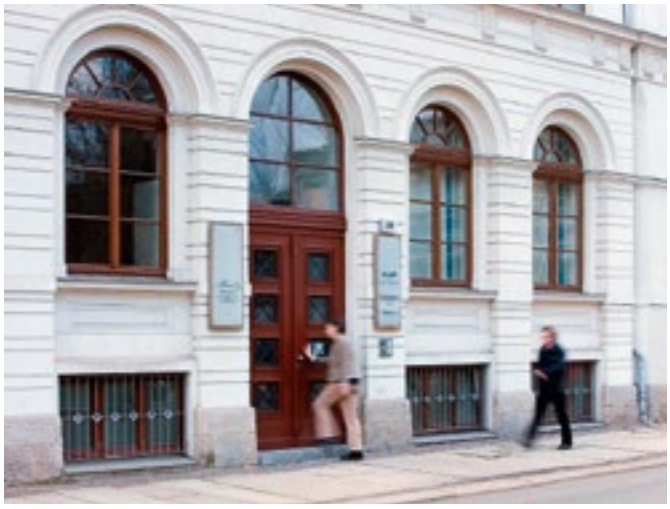
A glimpse at the exhibition "Europa Jagellonica. Central European Arts and Culture under the Reign of the Jagiellonians 1386 –1572" in Kutná Hora, Galerie Středočeského kraje/Gallery of the Central Bohemian Region. | Photo: GWZO

Elucidating Jewish contexts.

Simon Dubnow Institute for Jewish History and Culture

The Simon Dubnow Institute for Jewish History and Culture at Leipzig University, named after the Russian-Jewish historian Simon Dubnow (1860–1941), was established in 1995 on the basis of a resolution by the parliament of the State of Saxony. As an independent affiliated institute, it is associated with Leipzig University by a cooperation agreement. From the perspective of Cultural Sciences in the broadest sense, the institute explores Jewish contexts in Central and Eastern Europe in their interaction with non-Jewish environments, from the Middle Ages to the present day. Using interdisciplinary approaches, the institute explores universal Jewish history: religious, intellectual and political currents within Judaism, the emancipation of the Jews, economic and social history, and migration movements from the East and West. The institute's research into the cultural interaction of Jews with one another and with their environment also incorporates languages, literature and art. As a research facility, the institute helps define and intellectualise the academic field of Jewish Studies through its programme of publications, international cooperation, scientific events and conferences, and the exchange of visiting scholars.

www.dubnow.de



Headquarters of the Simon Dubnow Institute at Goldschmidtstraße 28 in Leipzig. Photo: Simon Dubnow Institute

Institutions in the Leipzig Science Region

Universities, colleges and research institutions	Internet	
Universities and colleges		
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Bach-Archive Leipzig	www.bach-leipzig.de	
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