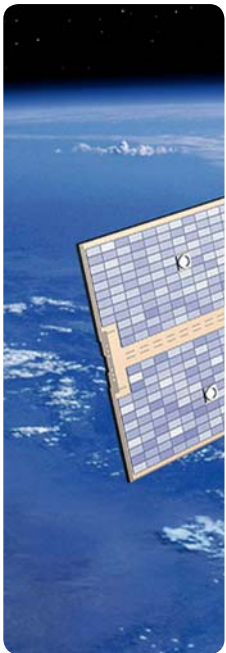




Braunschweig

Die Löwenstadt

from Gauß to Galileo



Braunschweig:

The lion among research cities

A Region Promotes Mobility:

The region of excellence in transport technologies presents itself

Modelled on Nature:

Modelling instead of experimenting

Precision on the Smallest Scale

Innovations in the fields of optical and metrological technologies

On the Same Wavelength:

Information and communication technologies of tomorrow

Using Green Energy:

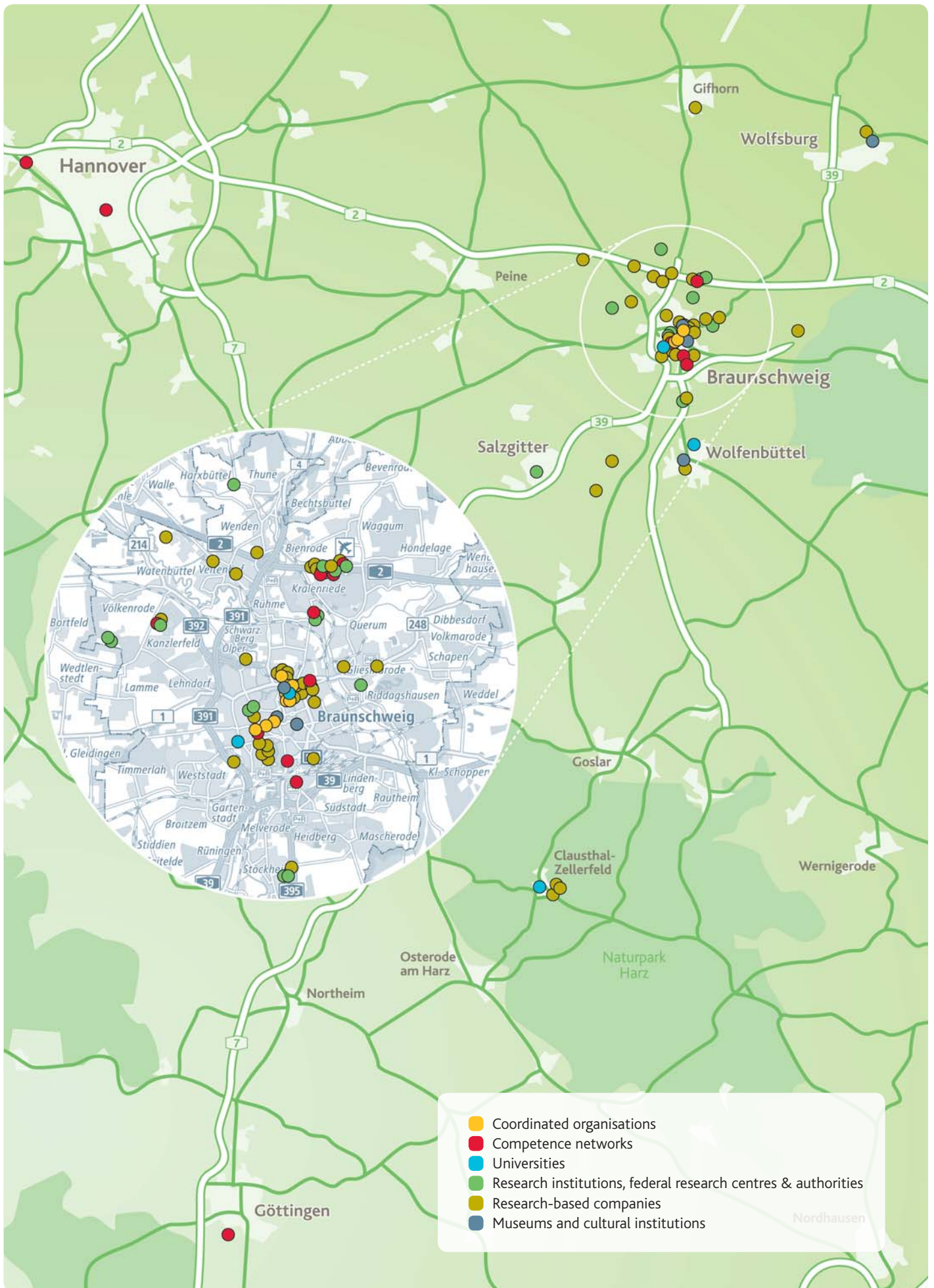
Agriculture and renewable resources

Promoting Dialogs:

Culture and communication

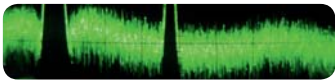
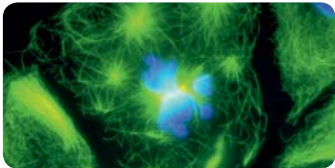
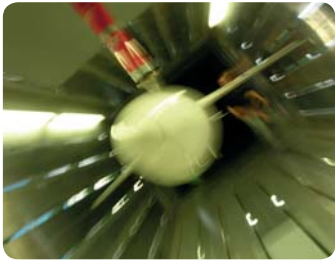
Europe's most research intensive region

■ **Kitchen of Ideas Braunschweig**



Europe's Most Research Intensive Region

Kitchen of Ideas Braunschweig



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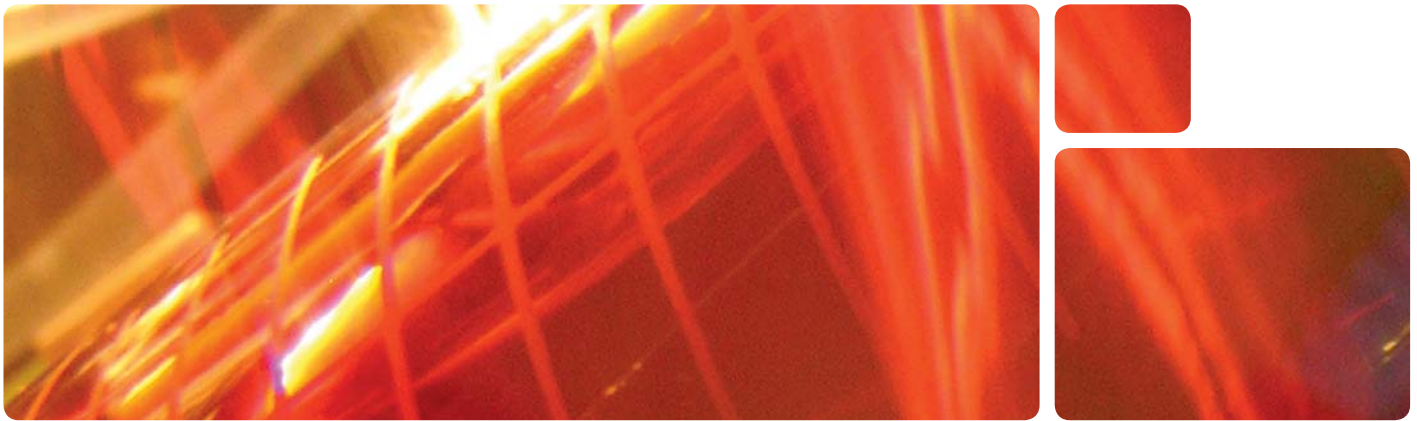
Service Section:

Research Region Braunschweig – In Brief

The enclosed service brochure of the research region Braunschweig is meant as an introduction to its diverse research landscape which includes numerous internationally renowned research establishments and scientific research-based companies. Here, you will find the details of expert contact partners for each area of expertise who can provide you with information regarding your specific research and education topics. The service brochure features following categories: Coordinated Organisation, Competence Networks, Universities, Research Institutions, Federal Research Centres & Authorities, Research-based Companies, Museums and Cultural Institutions.

To download this brochure "From Gauß to Galileo", please visit:
www.braunschweig.de/wissenschaft.

Photo 1, 2: Braunschweig Stadtmarketing GmbH / okerland-archiv, Photo 3: heirmoltz-hz.de, Photo 4: okerland-archiv / PTB, Bild 5: NASA / JPL, Photo 6: mtsokaco / Fotolia, Photo 7: phaeon / Lars Landmann



Dear Reader,

With this brochure we would like to invite you to learn more about the research region Braunschweig. It will give you an insight of the many facets of the research landscape and its core competencies: aviation and aerospace, road and rail technology, optical and metrological technologies, microproduction, communication technology and the use of renewable resources. The brief portraits of research institutions based at Braunschweig demonstrate the international importance of research and science in this region.

Being the centre of the most research intensive region in Europe puts Braunschweig in an excellent position. Not only EU-statistics underline this outstanding position, but it is also confirmed again and again by studies and rankings. We primarily owe these advantageous conditions to the large number of scientific institutions, which are linked together in the ForschungRegion Braunschweig e. V. (Research Region Braunschweig e. V.). Furthermore, our city is the heart of the most important industry region of Lower Saxony: more than 500 high tech companies are based in this region and provide an innovation potential which is second to none. Amongst them are global companies such as Volkswagen or Siemens, who are cooperating closely with local research institutions.

Such a high degree of dynamism and future viability has been enhanced even further by the impetus given over the last few years. Braunschweig was named Germany's "City of Science 2007", a title which has contributed lastingly to Braunschweig becoming even more distinguished as a research location. Thanks to this distinction, the dialog between science, industry, culture, city and public could be intensified and existent networks could be strengthened further.

These successes have motivated us to expand our activities. The extension of the research airport, the Automotive Research Centre Niedersachsen and the Centre of Systems Biology embody the expansion of research institutions. The "Haus der Wissenschaft" (House of Science) has been developed in cooperation with science, industry and city. Its objectives are to initiate the development of new contacts between researchers and entrepreneurs, as well as to strengthen existing ones, in order to create even better conditions for the technology transfer and develop new future initiatives.

The enclosed service section "Research Region Braunschweig – In Brief" will give you a detailed overview of the research institutions and scientific research companies based in the Braunschweig region. It also provides details of expert contact partners who can give you information regarding your specific research and education topics.



Dr. Gert Hoffmann
Mayor of Braunschweig



Prof. Dr.-Ing. Dr. h. c. Jürgen Hesselbach
Chairman of ForschungRegion
Braunschweig e. V. and President of the
Technical University of Braunschweig

Prof. Bernd Meier
Chief Executive of the Chamber of Commerce
and Industry (IHK) Braunschweig

Braunschweig

The lion among research cities

A proverb says "I can prove anything by statistics except the truth". But how does someone who is pictured in a good light by the statistics deal with this? The present EU-study granted Braunschweig the title of "Most research and development intensive region in Europe". The fact that Braunschweig spends 7.1 percent of its gross domestic product on research and development just documents this. Investments of this scale put the region of Braunschweig into the leading position within Europe, and even in the global scheme of things Braunschweig can be found amongst the front-runners. In comparison, California with its prestigious research location Silicon Valley only spent 3.8 percent of its gross domestic product on research and development in 2001. (Source: Eurostat-Statistic and DB Research)

Information

"There is hardly any other region which has as many first-class research institutes as Braunschweig"
(WirtschaftsWoche, January 8, 2007)

50 major German cities have been compared in the latest city ranking carried out by the "Initiative Neue Soziale Marktwirtschaft" in cooperation with the "WirtschaftsWoche" in 2009. Overall, Braunschweig is ranked in sixteenth position. What is particularly noticeable is that in Braunschweig the percentage of highly qualified employees has increased significantly more than in any other city: the percentage of the working population with a university or polytechnic degree has risen by 2.2 percent between 2003 and 2008. This puts Braunschweig nationwide into first place. Braunschweig is also ranked in second place in the sector of "cost awareness". According to a survey conducted by IW Consult and the University of Bonn, 65.6 percent of the interviewed entrepreneurs described Braunschweig as business-friendly.

It is therefore evident that the region offers excellent conditions for research, science and associated business sectors. However,

critically-minded scientists remain kind of sceptical as soon as the buzzword "statistics" is being mentioned. Every scientific finding – especially a result as outstanding as this – needs to be proven. Let us bring those dry figures to life. Which people, institutions and (future-)projects are behind the gross domestic product of 7.1 percent? What investments are made? And, all importantly, what is the motor behind it all?

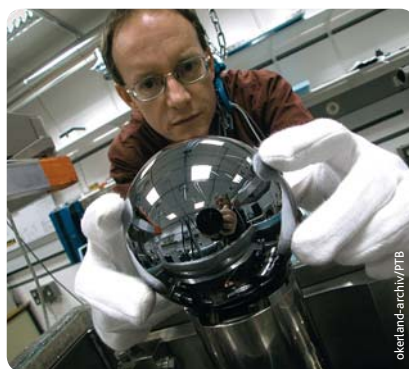
Research in Braunschweig – A partnership with a history and a future

Braunschweig's good reputation in research and science has a rich tradition. In 1745, the Collegium Carolinum was founded, which has been the forerunner of the current **Technical University Carolo-Wilhelmina** and has the longest-standing tradition in Germany. Carl Friedrich Gauss, the "Princeps mathematicorum", was born in Braunschweig in 1777 and studied at the Collegium Carolinum. As early as 1932, Agnes Pockels was the first woman in Germany to receive an honorary doctorate

of the University of Braunschweig for her autodidactic research work in the field of surface tension and interfacial surface tension. She developed a measuring device for the quantitative analysis of surface films which is still used today. The device was developed further by Irving Langmuir, who received the Noble Prize for this work in 1932.

During the 20th century, more and more scientific institutions were drawn to Braunschweig, so that nowadays 24 research institutions are based in the city. More than half of these institutions are not only of nationwide importance, but also have an excellent reputation well known beyond the German borders. Just take a moment to consider that the time signal which is used worldwide is measured at the "Physikalisch-Technische Bundesanstalt" (the National Metrology Institute providing scientific and technical services).

Likewise, global travel is continuously increasing in today's society and with that, as we know, the spread of pathogenic germs. Staff at the **Helmholtz Centre for Infection Research, HZI**, is standing up to the challenge by developing new antibiotics and vaccines. It is also interesting that, due to international co-operation, knowledge is increasingly exchanged so that, for instance, traditional African medicinal plants or specific forms of bacteria are used more and more in research.



As our world is becoming evermore densely populated, maybe even precisely those countries where food is plentiful will have to confront issues concerning strategies for securing food and nutrition worldwide. As one of four federal research institutes under the auspices of the Federal Ministry of Food, Agriculture and Consumer Protection the **Johann Heinrich von Thünen Institute (vTI)** in Braunschweig provides fundamental scientific information as decision-making tools for the policies of the German Federal Government, and with its application-oriented and praxis-related research it also serves the development of tomorrow's society. The Johann Heinrich von Thünen Institut was established on January 1, 2008, merging the German Federal Research Centre for Fisheries, the German Federal Research Centre for Forestry and Forest Products and part of the German Federal Agricultural Research Centre (FAL).

Particularly closely involved with this issue is the Biological Research Centre for Agriculture and Forestry, which, on January 1, 2008, has been merged with the Federal Centre for Breeding Research on Cultivated Plants (BAZ) and part of the German Federal Agricultural Research Centre (FAL) and renamed as **Julius Kühn Institute, Federal Research Centre for Cultivated Plants**. As a departmental institution, the Julius Kühn Institut (JKI) is responsible for the protection objective "Cultivated Plant" in its entirety. This responsibility comprises the areas of plant genetics, crop production, plant nutrition and soil science, as well as plant protection and plant health and enables the JKI from now on to develop holistic concepts for the whole spectrum of crop production, plant production and plant

care. The list of research institutions based at Braunschweig is long. And behind each name a fascinating world of subjects, questions and projects opens up not only to the scientist but also to any interested layperson.

Information

"Unnoticed by the general public, Braunschweig has established itself as prime location for leading international research". (WirtschaftsWoche, January 8, 2007)

Focus of attention – making the best use of Braunschweig's potential

One of the crucial qualities defining Braunschweig as a prime research or business location is the existence of close links between scientific research and industry. The **ForschungsRegion Braunschweig e. V.** pools the know-how and expertise of currently 27 research institutions in Braunschweig and its surrounding region, amongst them universities, federal research institutions, Helmholtz institutes, Fraunhofer institutes, research institutions of the Leibniz Association, museums, academic libraries, the Clinical Centre Braunschweig and other institutions which are highly respected and internationally recognised for their research work. This consortium is growing continuously as it is joined by new partners from the research and the business sectors, thus forming an effective network for successful knowledge transfer. In addition, the position of the Braunschweig region within the excel-

lence initiative and clusters of excellence will be strengthened further by the merger of the universities of Braunschweig, Hannover and Clausthal in the Lower Saxony Technical University, whose aim it is to reorganise the disciplines of engineering and natural sciences, which have so far been competing with one another, by coordinating development planning in the future. The overall aim is to combine, strengthen and improve the visibility of strategic key research areas in an interdisciplinary manner.

Another construction site can be found on the campus of the TU Braunschweig. The Technical University of Braunschweig and the Helmholtz Centre for Infection Research are in the process of establishing the new **Integrated Centre for Systems Biology – BRICS**. At this centre, biologists, mathematicians, computer scientists and engineers will be working together on ways to better understand, model and simulate complex biological processes in their entirety. Biomedical research will consequently become significantly more efficient.

Information

"The days when research took place in an ivory tower are long gone. 'Networking' has become the buzzword of our times. And Braunschweig is particularly well-positioned in this context. The close integration of science with science, science with business and even culture has been particularly successful in the City on the Oker". (VDI-Nachrichten, March 23, 2007)



Technology transfer as lived reality

The chip manufacturer Intel has also realised this early on and, having based its European operational research at Braunschweig, is now benefiting from it. "Ultimately, we realised that Braunschweig is an extraordinarily attractive city. On the one hand, our team here has the necessary know-how, and on the other there is an interdisciplinary environment which allows the acquisition of highly talented personnel. We are funding a foundation professorship at the Technical University of Braunschweig. Its main purpose is to convey knowledge on chip design within the master's programme", says Nikolaus Lange, Head of Intel Research Braunschweig.

Unique in Europe – The Research Airport Braunschweig, a cluster of expertise

One particular characteristic defining the unique position of Braunschweig is the high number of companies, research institutions and authorities located in the region which are working in the mobility sector, specifically in aviation technology, air traffic safety, aerospace industry and transport. The region follows its tradition in the aviation engineering sector with the research airport

Braunschweig-Wolfsburg, whereby the immediate industrial surrounding facilitates the extension of these areas of expertise onto other sectors. This research cluster offers superb development prospects for avionic- and traffic engineering-oriented companies or institutions. Research, product development and services provided by more than 20 companies and institutions are combined in a centre of excellence at the research airport.

The internationally oriented application centre for the European satellite project Galileo is currently being built with support from the Federal State of Lower Saxony and is just one successful example for the continuous development of the research airport as a centre of excellence. Traffic applications are being simulated, tested and certified at the Galileo Centre for the whole of Europe. Through the **current investment of almost 40 mill. EUR**, the internationally recognised Research Airport Braunschweig experiences another growth spurt, giving Braunschweig the possibility to raise its profile as technology hotspot in Europe even further. In November 2009, the **Campus Forschungsflughafen** (Campus Research Airport) was inaugurated. Modern teaching and research at the highest level are combined under the umbrella of the Campus. Here, the German Aerospace Centre and the Technical University of Braunschweig, in close collaboration with the industry sector, are developing new technologies for a "people-friendly aircraft", where attention is focused on safer, less noisy and environmentally friendlier flying. Funded by the federal and state governments, 23 mill. EUR has been invested in the construction of a new research facility featuring a test hangar, an engine test bed and office buildings. The most modern high-performance computer for aeronautics will be housed at this centre which will become home to Europe's largest research aircraft.

The intelligent car of the future comes from the region of Braunschweig

The development of communication systems between different vehicles is one of the main research areas at the Research Airport Braunschweig. Unmanned aircraft and standardized safety features and equipment for Europe's rail network are in the focus of research here. Research on "autonomous driving" and autonomously driving robot vehicles is particularly well advanced. In the world championship for robot vehicles, the DARPA Urban Challenge 2007 in California, the team of the Techni-

cal University of Braunschweig with their vehicle "Caroline" took 7th place on their very first attempt. Stanford University's vehicle "Junior", which has been developed in cooperation with the Volkswagen AG, Wolfsburg, came second. Researchers are currently working intensely on the follow-on project "City Pilot", with the plan that next year Caroline's little sister "Leonie" will be driving autonomously amongst regular urban traffic on Braunschweig's city ring.

Information

"The interdisciplinary team of the City Pilot Project is made up of the Institute of Control Engineering, the Institute for Flight Guidance, and the Institute of Operating Systems and Computer Networks of the TU Braunschweig and works at the Automotive Research Centre Niedersachsen (NFF) located at the MobileLifeCampus in Wolfsburg. The City Pilot Project is designed as long term research project intended to bring real benefit to the mass-production vehicles of the future". (Heise-Online, March 20, 2009)

It may well be that in the future this constellation could look entirely different, as the TU and VW have decided to take their collaboration to an entirely new level with the foundation of the Automotive Research Centre Niedersachsen. Attention is focused on interdisciplinary research projects in the field of automotive engineering in close collaboration with partners of the industry and science sector. Research spans the whole spectrum from **autonomous driving**, to sustainable propulsion concepts and **safety systems**, to **automotive industry** and **transportation design**. The first site is based at the MobileLifeCampus in Wolfsburg, a second site is being established at the Research Airport Braunschweig. The effects are manifold: ultimately, the research airport will become the national Campus for transport research with significant international influence.

Despite all the science and technology involved, these examples show that the energy behind the research and science location Braunschweig are its people who show initiative and bring forward new ideas: all those involved – representatives of the city, science or industry – are always focusing on developing this network further and finding new synergy effects while never resting on their laurels. "It is not know-



ledge, but the act of learning, not possessing, but the act of acquiring, not being, but the act of getting there which grants the greatest enjoyment." It seems as if those words by Carl-Friedrich Gauß have been tailor-made for these people.

The technology park creates the necessary leeway for young scientists

Braunschweig provides new opportunities to encourage this kind of learning and striving: the Technology Park Braunschweig is run by the business development agency Braunschweig Zukunft GmbH and offers business premises to young, technology-oriented businesses. The technology park is open to entrepreneurs striving to develop and market innovations within their own company. Attractive rental rates and an existing office infrastructure help to ease the start-up and beginning phase considerably. In **September 2007 as the first founder centre in Lower Saxony, the technology park has set up a training network.** Together with young companies based at the founder centre, apprentices are trained in information technology and office communication.

Since 1986, over 100 successfully operating businesses have been based at the technology park, in which far more than 1.000 highly skilled engineers and technicians find employment.

Design and research – Area of tension with practical relevance

The newly founded **Institute for Transportation Design (ITD)** of the Braunschweig University of Visual Arts represents a particularly interesting example of the collaboration between business, science and culture. The institute researches the future of mobility. In research and education, the ITD reaches far beyond the product design of transport systems as such, and is also working on the design of mobility services as well as the research into novel mobility systems.

The prerequisite for this lies in the interdisciplinary structure of the ITD, which in the frame of research, training and project work does not only rely on design technologies, but also includes findings of transportation and engineering sciences, economic research and futurology as well as sociology and psychology.

In numerous third party funded projects the ITD, together with representatives of the mobility sector, has succeeded in realising praxis-oriented and marketable designs and with that it has sparked growing interest from the industry.

City of Science – A region on the move

The decision and explanation of the Association for the Promotion of Science and Humanities in Germany to award Braunschweig with the distinction of being named "City of Science" in 2007 was therefore only a logical consequence. "The initiators of science, industry and the city passionately promote their cause", underlines Andreas Schlüter, general secretary of the association. "It was clearly noticeable from Braunschweig's application that the entire region is on the move and identifies itself with the candidature", he explains the reason for the decision of the jury.

Information

„The brain of the nation ... this year's laureate of the award 'City of Science' stands out from the crowd by its excellence in the fields of aviation safety, infection protection and life science". (Süddeutsche Zeitung, November 15, 2007)

It was the ultimate aim of the organisers, "to strengthen the identification of the region with its research, to link science and industry even more closely and to make the region more attractive for young scientists". Judging by the interest in the media and the general public, the concept has been a success. This spirit of optimism and momentum amongst the people of the region has been embedded through two institutions in the City of Science and will remain beyond the year 2007. Prof. Dr. Sebastian Thrun was the first person to be awarded **the Braunschweig Research Prize** in the Year of Science 2007. The prize is awarded every two years for interdisciplin-

ary and internationally outstanding research achievements in technology and engineering sciences, life sciences and cultural sciences.

The **"Haus der Wissenschaft"** was established on the premises of the former Kant University next to the Natural History Museum and is the central meeting point of the research location Braunschweig. It is a venue where temporary exhibitions, public lectures and discussion events for the interested general public and professional audiences alike are being hosted.

The "Haus der Wissenschaft" promotes the dialog between industry, science and ordinary people. It is a meeting place where scientists and business people have the opportunity to exchange views, ideas and information, and in line with the spirit of "Kitchen of Ideas", develop new projects, cooperations and "concepts for the future".

Information

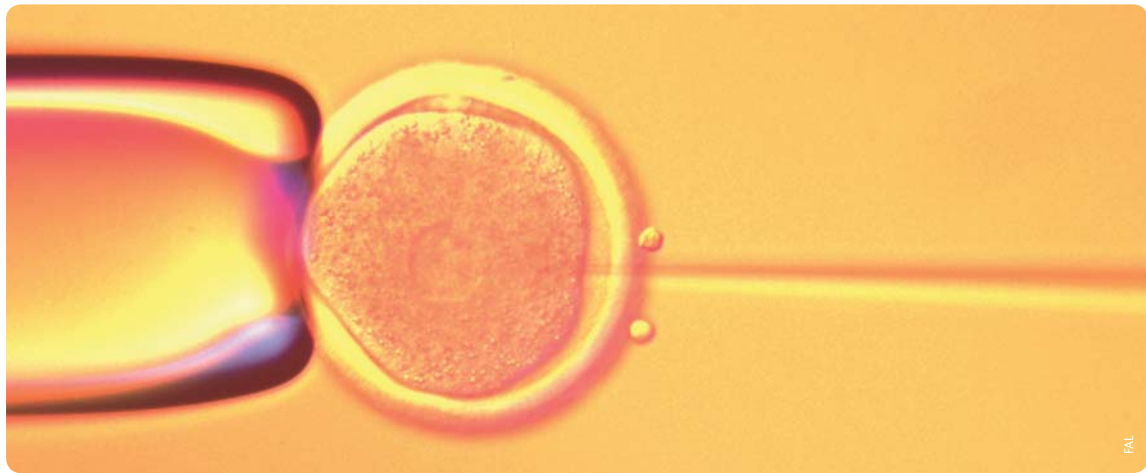
The Braunschweig Research Prize is awarded by the City of Braunschweig und ForschungRegion Braunschweig e. V., and carries a cash prize of 30.000 Euro. In 2009, Dr. Bertrand Piccard and André Borschberg of the company SOLARIMPULSE have been awarded the research prize for their development of an aircraft solely powered by solar energy and giving new research impulses to sustainable energy systems.

A charming city offering a high quality of life

Braunschweig's outstanding economic and scientific position is embedded in the livable and loveable surroundings the city and



Braunschweig Stadtmarketing GmbH/Oderland-archiv



FAL

its region has to offer. With some 245.000 inhabitants, Braunschweig is a compact major city. Even when living in the green surroundings, the lively pedestrian area with many shops and coffee bars is within cycling distance and can be reached in 10 minutes. Since 2007, Braunschweig's Ducal Palace also attracts visitors. Its impressive facade has been rebuilt using many original parts of the Guelph Castle built in the middle of the 19th century. The palace houses the municipal library, the town archive and the cultural institute of the city. On the portico of the Ducal Palace is Europe's biggest quadriga with "Brunonia" the town's goddess, as charioteer.

Braunschweig also has a vibrant and lively arts and culture scene. Throughout the year, it features a host of festivals and events such as the Braunschweig Classix Festival, the Culture Night, the CityJazzNight, the International Film Festival or the opera open-air of the State Theatre. They all provide a platform for artists of regional, national and international fame as well as unknown, young talents.

The "Volkswagen Halle" Braunschweig is a venue for large-scale events of international standing. Orchestras like the New Yorker Philharmonic perform there and sporting events such as the horse show "Löwen Classics" or the World Ballroom Dance Championship, in which the dancers of the "Braunschweig Tanzsportclub" have previously won seven times, take place at this venue.

One of the outstanding museums in Braunschweig is the Herzog Anton Ulrich-Museum, which has been founded more than 200 years ago and was the first art museum in Germany and large parts of Europe which was open to the public. The art collection of the museum includes works of French, Dutch and German Masters, such as Jan Vermeer van Delfts' "The Girl with a Wine

Glass" and Rembrandt's "Family Portrait ". Work on the long overdue expansion measures for a modern presentation of the internationally renowned collection has begun in spring 2008 and becomes now visible. On three floors with some 2.617 m² of floor space, the museum will have modern rooms available to accommodate restauration workshops, storerooms, libraries, the "Kupferstichkabinett" (collection of prints), administration offices, an education centre and visitor programmes. Restauration works are scheduled to be completed in 2013, the 300th anniversary of the museum founder, Herzog Carl I, and will put the museum into a position where it can meet the high standards required to conserve, restore, present and convey an appreciation of art treasures in the 21st century, turning a visit to the museum into an unique experience. The Municipal Museum Braunschweig is currently closed due to ongoing restauration works. The Municipal Museum is one of the most important community museums of Northern Germany as it has an extensive collection on the art and cultural history of the City of Braunschweig. Furthermore, the museum is in possession of the prestigious "Bönsch" collection with some 3.500 paintings, sculptures and graphics. Visitors can view the "Bönsch" collection which is focusing on classical modern art in the annex of the museum. The main building of the Municipal Museum will be reopened in 2011 for its 150th anniversary and will present its art treasures in the newly refurbished rooms in the Location "Löwenwall".

As a nature reserve and one of Europe's bird sanctuaries, Riddagshausen offers ample local recreation opportunities and leisure activities and contributes to the high quality of life. You can circumnavigate almost the entire city centre by boat on the Oker. And last but not least, the lion city is within easy reach of the "Lüneburger Heide" (Luneburg Heath) and the "Harz" (Harz Mountains)

which makes it the perfect base for touring this remarkable cultural region. You do not need to think like Carl Friedrich Gauß, as in this case it is not so much the act of getting there as the act of being there which grants the greatest enjoyment. The German capital Berlin can be comfortably reached by train in 1.5 hours.

Information

The history of Braunschweig is closely linked to Henry the Lion, who turned the city into a centre of power for the House of Guelphs in the 12th century. Today, the bronze lion statue is still the emblem of the City. Between the 13th and 17th century, Braunschweig was an important trading place and as such it was a member of the Hanseatic League. From 1753 to 1918 the ducal residence was in Braunschweig.

Can a town embody its emblem? Braunschweig certainly does – the lion symbolises focus, courage and energy. Braunschweig focuses on its strengths, establishing strong links between science, industry and culture. Courageous decisions have been taken and are still being taken to set the course in order to create ideal conditions for research and businesses. Everyone involved pursues the expansion of networks and the use of synergy effects with energy. ■

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Carl Friedrich Gauß – Genius born in Braunschweig

Gauß is considered the greatest German scientist of his time in the fields of abstract and applied mathematics. He was born on April 30, 1777 in Braunschweig. His pioneering scientific successes distinguish him as an exceptional German scientist with an outstanding international reputation. Following his studies in Göttingen, he was a private scholar in Braunschweig and earned a doctorate at the University of Helmstedt. In 1807, Gauß became Professor for Astronomy and director of the observatory in Göttingen. The Law of Error ("Gaussian normal distribution"), discovered by Gauß, is among those achievements which are still widely known today. The invention of the first electro-magnetic telegraph is also owed to him. Carl Friedrich Gauß was made an honorary citizen of Braunschweig in 1849.

Braunschweig tops The League Table

Business-friendly Braunschweig

In the latest city ranking 2009 carried out by the "WirtschaftsWoche" and "Initiative Neue Soziale Marktwirtschaft", Braunschweig is ranked amongst the top 20 German cities. Braunschweig is also ranked in second place in the sector of "cost awareness". According to a survey interviewed entrepreneurs agreed that public finances were well managed by the city administration. Businesses also described Braunschweig as an exceptionally business-friendly city.

7th place in the European Innovation Scoreboard

But Braunschweig also leaves a good impression in the international league table. The Directorate-General for Enterprise and Industry of the European Commission has published the latest European Innovation Scoreboard – EIS 2006 on February 22, 2007 which includes a comparative analysis of innovation performances of different European countries, the US and Japan. Braunschweig came in seventh place and is together with Stuttgart and Karlsruhe among the top 10. (2006 EUROPEAN REGIONAL INNOVATION SCOREBOARD (2006 RIS))

The Lion City is among the best in Northern Germany

In the latest scientific city ranking 2009 carried out by the "WirtschaftsWoche" in cooperation with the "Initiative Neue Soziale Marktwirtschaft" (INSM) and IW Consult GmbH, Braunschweig was ranked third after Hamburg and Osnabrück in the regional scoreboard for Northern Germany. In the nationwide comparison Braunschweig was ranked in second place, closely behind Stuttgart.

"Braunschweig-Europe's hottest R&D region"

According to a recent EU study, Braunschweig is the most research intensive region in Europe, boasting the highest density of

scientists (4% of the working population in the European comparison). In exact figures this means: An outstanding 7.1% of Braunschweig's gross domestic product was spent on R&D projects. Investments on this scale are remarkable even on an international level. In comparison, California with its prestigious research location Silicon Valley only spent 3.8% of its gross domestic product on research and development in 2001. (Source text: Eurostat-Statistic and DB Research)

More and more highly qualified people work in Braunschweig

The percentage of highly qualified people amongst the working population of Braunschweig has increased more rapidly than in any other major German city included in the "WirtschaftsWoche" ranking. Between 2003 and 2008 the percentage of the working population with university or polytechnic degrees has risen by 2.2 percent. This puts Braunschweig nationwide into first place.

"City of Science 2007"

In 2007, Braunschweig was selected by the Association for the Promotion of Science and Humanities in Germany as the "City of Science" after beating Aachen and Freiburg i. B. in the final. "It was clearly noticeable from Braunschweig's application that the entire region is on the move and identifies

itself with the candidature. It became clear that the initiators of science, industry and the city passionately promote their cause (...) Braunschweig's concept thrives on the idea of using inventive formats to build bridges to those members of the general public who have no close ties to science", says Andreas Schlüter, general secretary of the association, chairman of the jury. The science year has been bearing fruit beyond the title "City of Science 2007": for instance, the the "Haus der Wissenschaft" has been opened in Spring 2009, it is a platform for perpetuating the intensive contact between science, industry and culture. The Braunschweig Research Prize, which is awarded every two years, has been redesigned in the same year. ■



A Region in Motion

Mobility and transport technology, aviation and aerospace

Research in the name of aviation

More than 110 years ago, Otto Lilienthal had futuristic visions of flying. Compared to airplanes of the 21st century, his first flying machines were environmentally friendly since they were emission-free, and in regard to material consumption and "fuel" (manpower) also cost-efficient from a present day perspective. In terms of safety and economy, however, his gliders would be in no way able to compete as means of transport. What would an aircraft, which was safe, environmentally friendly, economic, easy to use and easily reachable look like in the future?

Researchers at the Technical University of Braunschweig and at the German Aerospace Centre (DLR) are dedicating their efforts to this issue. They pool the strengths and skills of their respective competence areas. Together, they have founded a new institution – the "Campus Research Airport"

Aviation research at the research airport should focus on meeting the demand for mobility arising within society in the future. Today's traffic systems are already complex and the only way this can work is if funda-

mental and strategically important research projects of different partners are tied in and coordinated with one another. In a coordinated effort the German federal government and state government, Helmholtz society and Technical University Braunschweig are investing in new research complexes with state of the art equipment: the best possible conditions have been created for the research infrastructure in Braunschweig to achieve a leading international position within the next few years. ■



Flughafen Braunschweig GmbH



Flughafen Braunschweig GmbH

Can Cars think?

Of course, they can't, but they become "more intelligent" in any case. In 2007, "Caroline", the experimental vehicle of the Technical University of Braunschweig, has already taken part in a race in the US – and in this case that means driving autonomously without a driver or remote controlled. Packed with high-performance-GPS-receivers, the VW-Passat competed in the "Urban Challenge 2007" and had to prove itself in situations simulating vehicle traffic in an urban environment. Performing complex manoeuvres such as parking, merging into the traffic flow and following traffic rules were part of the task. Today, the "fathers" of Caroline are one step further: the aim of the follow-on project "City Pilot" is an autonomous ride in regular urban traffic. In the foreseeable future, "Leonie" – their experimental vehicle is to drive autonomously amongst regular urban traffic on Braunschweig's city ring – of course this will be done under supervision, but the vehicle itself will still be driving entirely autonomously. With this project, researchers do not intend to shift responsibility away from the human drivers in the future, but instead, above all, they aim at improving driver assistance systems which have the purpose of making mobility, in particular in the cities, safer and more comfortable for us.

In the immediate vicinity of the Campus Research Airport another new research complex is being built: the Automotive Research Centre Niedersachsen, NFF in short. At the NFF, research pursues a clear vision: to develop the "Metropolitan" Car, a car for the city of the future – Leonie is one of the outcomes of this major project. Cars should become intelligent, flexible and have low emissions in order to become widely accepted on urban roads in future. The objective of the NFF is to work on interdisciplinary research projects in the field of automotive engineering in close collaboration with partners of the industry and science sector. In addition, training programmes are to be offered with the purpose to train highly qualified young researchers for the automotive industry. The Federal State of Lower Saxony, the Volkswagen AG and the Technical University of Braunschweig are investing in the NFF together with other partners with top-level international research. ■

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Linking Europe's Rail Systems

Train control systems developed by the Siemens Mobility Division at Braunschweig

Travelling by train along the major European rail routes Rotterdam – Genoa, Naples – Stockholm, Antwerp – Basle/Lyon, Seville – Ljubljana, Dresden – Budapest and Duisburg – Warsaw. Time-consuming changeovers of train engines at every border and other measures necessary to adapt to the

requirements of different national rail systems are a thing of the past along these corridors, which are being equipped with the latest technology, the ETCS. Tracks and train cab are communicating with each other, for instance, via contactless installed units, which look similar to large pieces of Lego. These units transmit information on applicable speed limits and other track conditions to the passing train.

The modular concept of the Trainguard/ETCS – system offered by Siemens Mobility Division at Braunschweig allows modernising Europe's rail traffic system by introducing the latest train control systems step by step. The novel technology can so fulfil one of the most important requirements. Individual components must be interoperable in order to facilitate the standardisation of Europe's rail traffic. As a whole, but also in its details the newly developed technical solutions are compatible with systems already on the market as well as new products offered by competitors. All elements of the new Trainguard technology can be tested and demonstrated with a diesel fuelled test engine along a test track set up specifically for this purpose. ■



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Searching for the Car of the future

Wind, water and sun – in the long run these regenerative energy sources should ideally be used to power the cars of the future. This is how the future of mobility is described in the research reports of the Volkswagen AG. However, it is likely that it will still take decades before all those questions worrying us today – ranging from sufficient production and supply of regenerative fuels to a battery technology fit for the use in vehicles – can be solved. Despite these facts, the Lower Saxony car manufacturer is certain that the electric motor will be the central power plant of the future.

But until then, primarily biomass energy will have to be increasingly used to supplement conventional fuel. Biofuels produced from straw and wood, rather than food, are referred to as "Sunfuel" at Volkswagen. Due to their optimisable physical and chemical properties as synthetic fuels, biofuels offer great oppor-

tunities where the improvement of engines is concerned. Alongside manifold own research projects covering the entire spectrum of modern drive systems, Volkswagen also collaborates with national and international research institutions which are focusing on the development of innovative battery technologies for energy storage or energy conversion or the research of fuel production from renewable resources. ■

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Mission:

Eco-friendly Flying

Something can be done to reduce aircraft noise – scientists of the German Aerospace Centre are sure about this. They are determined to, not quite reinvent, but significantly improve the conventional aircraft design technically and in particular aerodynamically. For all the fascination the dream of flying may hold, there has always been one unpopular downside to it – aircraft noise. Perhaps this was not relevant in Lilienthal's time, but ever since engines and turbines were invented, flying has inevitably been accompanied by droning noise. When the German songwriter Reinhard Mey sings about "wet asphalt shuddering" it might still sound romantic, but anyone living in the immediate vicinity of an airport, will only ever love to hear the sound of a starting jumbo jet, when they themselves are travelling on board the aircraft – most likely less so any other time. The aircraft of the future should therefore be quieter! Oh yes, and fuel consumption should be more economic, too!

And this is where the dilemma, which the aerodynamic expert Heiko Freiherr Geyr von Schweppenburg is determined to solve, begins. Together with his colleagues at the DLR in Braunschweig, he is working on aircraft configurations which should be significantly quieter and additionally more economic to fly. This presents a dilemma as such since technically the solution to this scientific challenge entails reconciling conflicting requirements. One possible

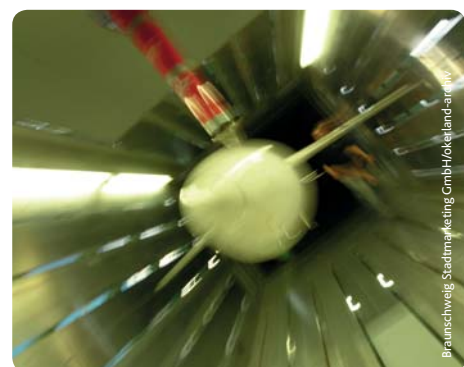
approach in this direction would be to install engines above the wings, wherein the downwards reflection of sound could be avoided. The aircraft would fly with a sort of integrated noise barrier. This sounds ingenious!

By 2020, noise exposure and fuel consumption should be reduced by 50%. The European aircraft manufacturer Airbus commissioned this series of research projects and is therefore particularly interested in learning how the aerodynamic experts at the DLR in Braunschweig want to shape the air traffic of tomorrow. "Conventional aircraft configurations cannot serve this purpose", say the engineers and project a three dimensional display of the new designs on a special screen. Futuristic shaped models glide through virtual space." There is only little chance that such aircrafts will ever come onto the market without pressure from the German legislature, as their realisation requires enormous investments. Assembly lines need to be converted and the interior of the aircraft will see considerable change", notes Geyr von Schweppenburg, and yet he is convinced that this will be the future of aviation tests are carried out in wind tunnels to see to which extend technical designs are fit for purpose.

The adjustable arm holding the aircraft into the simulated airstream allows that any aircraft bank angle or angle of inclination can be tested. Test runs are recorded by com-

puter and camera, visualising the aerodynamic characteristics of the aircraft in each situation. But already in the virtual wind tunnel, which is a computer simulation of the airstream of the aircraft, countless calculations are carried out determining the exact form of the aircraft, such as for instance the form on the wings. And this is real basic research which does not only include designing new models, but also programming software suitable for calculating the data for the configurations. At the DLR it goes without saying that wind tunnels cannot be ordered and delivered just like other equipment, but instead they have to be elaborately constructed in painstaking detail and continuously adapted to new research areas. This task is carried out at the European DNW foundation (German-Dutch Wind Tunnels).

Some 6.200 staff members are working for the DLR in 29 institutions at 13 locations, focusing on issues concerning aviation and aerospace, energy and traffic. Around 1.000 members of staff are working in Braunschweig, on premises in the immediate vicinity of the Braunschweig-Wolfsburg airport. Different research aircraft can take off and land at the airport, and contribute to resolving numerous issues in flight tests. The research aircraft ATTAS (Advanced Technologies Testing Aircraft System) is particularly versatile. With the aid of sophisticated technology, this aircraft can simulate any required aircraft in the air, up to an airliner





five times its size. Thus every now and again and virtually unnoticed by the public, large airliners take off at the small airport in Braunschweig.

Apropos airliner! – What is more likely to awaken the urge to get away than those white vapour trails in the sky left behind by a holiday plane? But despite appearing seemingly harmless, those wake turbulences, which is the correct term for this phenomenon, are causing considerable difficulties for air traffic. Pilots of following aircraft are not always able to compensate the effects of those dreaded turbulences through pure manoeuvring skills. But luckily, planes are usually flying at different attitudes. However, on the ground this phenomenon sets clear boundaries to the utilisation of an airport. Safety margins must be observed for take-off and landing in order to prevent an aircraft from getting caught in the wake turbulences of a previous plane. At the DLR institutes in Braunschweig and Göttingen, experts are working on solutions to keep safety margins to a minimum. Wind speed is one factor which helps to disperse wind turbulences more quickly. If waiting times between starts were to be adapted according to prevailing weather conditions, then aircraft could take-off in more rapid suc-



Braunschweig Stadtmarketing GmbH / okerland-archiv

cession than generally valid regulations allow. Any airport operator would be grateful for a few extra take-offs per hour.

And driving safely

The man-machine interface is one aspect which is not just interesting in regard to aeronautical issues. The DRL not only undertakes research on aviation and aerospace, aircraft-, helicopter-, and airport technology, on the same premises teams of scientists are also working on problems of road and rail transport.

Driver assistance systems are for instance developed with the assistance of psychologist-specifically focusing on human factors. For the person behind the wheel is still considered the number one reason for car accidents. Assistance systems may provide relief and support to the driver and consequently contribute to increasing road safety. The evaluation of psychological tests with test subjects of all age groups demonstrated which type of assistance serves the driver best in certain situations. For instance, a warning symbol lighting up, a bleeping audio warning or an active brake assistance system. In order to provide a basis, the normal driving behaviour of a test driver was analysed at the beginning of a test. Test drivers drive along real roads

in a test vehicle while cameras are recording their eye movements. Using a driving simulator test drivers encounter prototypes of assistance systems during virtual drives. What happens, for example, if a car comes off the road? Psychologists establish how effective the individual systems really are in assisting the driver. Dangerous situations do of course not present a serious problem at the simulator: if you come across a tree in the road and drive into it, the drive still remains accident free.

In terms of rail traffic, the DLR undertakes research as to how technology and operation be can organised in an efficient and safe way. Currently a standardized train control system is being established across Europe, replacing a multitude of different rail systems still in use at present. The interaction of technologies will thereby be examined very carefully in the laboratory. ■

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Where research achieves a great deal

The research airport sets its sight on safe mobility

UAV – Unmanned Aerial Vehicle, CFD – Computational Fluid Dynamics, ATM – Air Traffic Management, Flight Calibration Services, Full Flight Simulator, In-flight Simulator, ATTAS – Advanced Technologies Testing Aircraft System, ATRA – Advanced Technology Research Aircraft, Special Mission Aircraft, Carolo and Caroline, assistance systems for drivers, pilots and air traffic controllers, ITS – Intelligent Transportation Systems, GAUSS and Galileo:

- to the outsider these terms represent nothing but a confusing agglomeration of terms, work fields, and projects
- but to researchers, engineers, technicians and students everywhere they are the epitome of a concentration of expertise unique in Europe with one ambitious aim:

to improve safety, reliability, eco-friendliness and interaction of our worldwide traffic systems. Braunschweig has its finger on the pulse: The research airport is working functionally as well as locally concentrated on cross-system transport technologies.

The Technical University Braunschweig, the German Aerospace Centre, the German Federal Office for Civil Aviation (LBA), a large number of medium-sized high-tech enterprises as well as R&D institutions of the big companies form a network in which more than 30 members are closely linked together, mutually supporting each other through efficient collaborations in the pursuit of their respective ambitious aims.

The model of the Triple-Helix-Cluster is the idea the research airport Braunschweig is based upon: it is mainly about universities, industry and authorities working closely together. Projects are realised in close cooperation, wherein the smaller companies in particular make vital contributions and are considered important partners in the network. It is an ideal win-win situation, in particular with regard to the research airport's European appearance.

"Many people here have known each other since university, and are benefitting from this large network, which, although its roots are here, is well connected internationally and can draw upon a large number of con-

tacts". This remark of a young entrepreneur is spot on. Everyone here knows everyone else, trusts one another, finds the courage to do something new, receives valuable advice without unnecessary detours, and has the chance to expand a fledgling business into a medium-sized enterprise at a manageable risk – a motivating signal from the lively young entrepreneur scene. Successful specialists such as Aerodata, delair, etamax, IntegNav, mavionics, messwerk, Oecon and Simtec started out in this environment.

With established large-scale corporations like Volkswagen, Bosch and Siemens on site and close by, researchers can readily find a local partner in the industry sector. Airbus and EADS, Deutsche Flugsicherung (DFS) (German Air Traffic Control) and EUROCONTROL have numerous business connections of all kinds with the research airport, which is successfully involved in major European research and development programmes.

The positive effects of this constellation are measurable via unmistakable indicators: the number of aviation and aerospace students studying for a master's degree

has meanwhile risen to 1.000, and students are very enthusiastic about the Europe-wide unique, praxis-oriented training they receive within the functional and social network of the research airport. Which other technical university has not only one, but two own research aircraft functioning as flying laboratories, in which each student is allowed to fly a "compulsory practical course"!

Related fields will soon strengthen their ties even further. Two major units, the Campus Forschungsflughafen (Campus Research Airport) and the Automotive Research Centre Niedersachsen, NFF, are beacons of hope for fundamental and applied research. They consolidate related disciplines and institutes in close proximity under the same roof. The cluster at the Hermann-Blenk-Straße next to the research airport is distinguishing itself lastingly as first address for anyone interested in keeping our world moving.

Specialists at the GAUSS Centre (Galileo Centre for safety critical applications, certifications and services) see the globe from a higher perspective. Their concepts and technical trials are focused to ensure that in the future with the new European satellite system Galileo all types of vehicular locomotion anywhere in the world will pass off with the same accuracy and reliability.

GPS is only of limited use in safety-critical applications, for instance, in aviation during a precision approach, because the simultaneous self-regulation of the system is insufficient. In poor weather conditions, the pilot has to make a split second decision whether to perform an automatic landing or go-around. In such circumstances, however, it would already be much too late, if the GPS does not signal until hours later that a failure has oc-

curred. For this reason, the tried and tested on-board aircraft instruments, together with the precision approach system on the ground, are still the worldwide standard for safe landing manoeuvres. However, aviation technology experts are certain that on the basis of Galileo significantly better centimetre-level positioning accuracy can be developed to a stage where this development will be fully operational for all safety-critical applications in traffic. In Braunschweig, GAUSS will carry out the certification of all instruments, software and operating procedures required for this purpose, so that these can be used anywhere in the world, and at the same time allow to save considerable costs in the long run where aviation infrastructure installations, still indispensable today, are concerned. AviationGATE is an experimental facility of the TU Braunschweig at the Research Airport Braunschweig-Wolfsburg and simulates realistic operating conditions for high-precision aviation applications long before the operational approval of the Galileo-system has been given. In in-flight tests, research aircraft of the TU and the DLR with its Europe-wide unique new flagship, the Airbus A320 ATRA, will provide evidence for the operational readiness of new, satellite-based systems.

Traffic, Transport & Telematics Braunschweig (GZVB) is in charge of the technical platform "car-2-car-communication", which is considered a beacon of hope in terms of road safety. The DLR, TU Braunschweig, and alongside Volkswagen all other German car manufacturers are involved in the development of intelligent computer-aided inter-vehicle data communication. These driver assistance systems are aimed at accident prevention, traffic monitoring to diffuse traffic jams, and ensuring optimised user friendliness in the cars of tomorrow. Progress in the mobility sector requires, literally, space to move for experimentation. In the case of aviation research this means the runway extension at the Braunschweig-Wolfsburg airport. With it, the research airport can strengthen its Europe-wide unrivalled position as powerhouse for all developments seeking to improve transport safety. Today, milestones of progress are

once again set at a place with such a long aviation tradition, which goes back to 1784 when the first unmanned hot air balloons took off from here, and later on in 1945 when the first experimental tests of the back-swept wings triggered an unprecedented surge in the development of global air traffic with jet aircraft. Aviation history was once again made in this place, when in 1989 the first ever fully-automatic landing of an aircraft of the TU Braunschweig took place, with the aid of a GPS-system which at the time was still in its infancy. With the ATTAS simulator of the DLR, which is still in use today, the revolutionary idea of placing aircraft developments at the drawing board stage, long before the first test flight, into the hands of the future test pilots has proven itself over more than 20 years – an important link in the long chain of contributions from Braunschweig towards the high safety standards in world aviation.

The research airport entertains feasible ideas of similar importance in its heads, laboratories, simulators, experimental aircraft and experimental vehicles. That is the reason why this site is a fascinating magnet to all those who have committed themselves to its aims. So on closer inspection, the small airport Braunschweig-Waggum presents itself suddenly as research-technical "hotbed" and hub for ideas in Europe.

On August 10, 2008, the Federal President has awarded the research airport with the title "Selected Landmark 2008" within the frame of the "Germany-Land of Ideas" Initiative. ■



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Transport Competency Cluster Research Airport

All around the runway of the research airport Braunschweig, a large number of future-oriented institutions have teamed up in a high-technology cluster of international standing. A close-knit network has developed in which science, federal authorities and businesses cooperate successfully. Almost 2.000 employees are working in the growing sector of air and road safety. The qualification of the European satellite system Galileo for safety critical applications is a key concern within the European competition.

Modelled on Nature

Biotechnology and Systems Biology

Modelling instead of experimenting

At the "Centre for Systems Biology", Braunschweig's research institutions have joined forces to try and model biological processes.

Trying out a just designed aircraft to see if it can actually fly? No engineer would dream of doing that. "Modelling instead of experimenting" – this trend not only applies for engineers, but also to biology. It is over 100 years ago since mathematical methods have been first used to describe the principles of physics and chemistry and make processes predictable.

» Braunschweig is the one location in Germany, where all necessary areas of expertise converge «

Dieter Jahn, Technical University (TU)

This knowledge forms the foundation of modern engineering. Now it is biology's turn. With the aid of computer simulations, systems biology is trying to predict crucial details of the infinitely complex biological processes happening in a cell: thousands of proteins metabolise nutrients, regulate growth and protect the cell against heat or stress. "With our experiments and models, we want to try and understand the essential principles of life", Dieter Jahn, head of microbiology at the Technical University of Braunschweig, defines the objective. Braunschweig's research institutions have joined forces in order to be able to compete in this innovative area. Their project: to predict what is going to happen when a bacterium infects a cell.

"Braunschweig is the one location in Germany, where all necessary areas of expertise converge", Dieter Jahn is convinced of this. The Technical University (TU) brings in its tradition of engineering education, the expertise of computer scientists, mathematicians,

biologists, chemists and physicists. The Helmholtz Centre for Infection Research (HZI) contributes with its knowledge on pathogenic bacteria and the human immune system. With the German Collection of Microorganisms and Cell Cultures (DSMZ), Braunschweig has the worldwide largest selection of microbial life on hand. Securely sealed, over 17.000 bacteria cultures are archived here as lyophilized cultures or stored in liquid nitrogen. Using systems biology methods, one work group is investigating how viruses in turn infect and kill bacteria. "Maybe we can learn something from these viruses to help us combat pathogenic bacteria", hopes Sabine Gronow, microbiologist at the DSMZ.

Explaining regulatory principles inside human cells is the business of Biobase. Founded in 1997 by scientists of the Gesellschaft für Biotechnologische Forschung (GBF), the name of the HZI at the time, the Wolfenbüttel-based provider of scientific services was soon amongst the fastest growing technology companies worldwide. Meanwhile, 130 experts in Germany, the USA, India and Japan are working for Biobase. "But we will never abandon the 'Made in Germany' label", promises co-founder Holger Karas.

Biobase also distributes the data base "Brenda", in which Dietmar Schomburg, head of bioinformatics at the TU collects all noteworthy information on enzymes. These proteins regulate and catalyse metabolism, and with that consequently also everything from utilisation, to nutrients, to the formation of growth factors. "Brenda is an intelligent data system", explains the bioinformatics engineer. The user displays a chemical structure on the computer screen and Brenda knows which enzyme can metabolise this substance. The Biobase founder Edgar Wingender is convinced that "the future lies in providing data

bases together with user interfaces to solve the problem". From here it is only a few steps to the simulation of processes. Thus, it is, for instance, predictable how cancer cells grow and, with the aid of a model, possible to seek the best moment to intervene. "We biologists", says Dieter Jahn, "are leaving behind the times of accumulating and describing scientific evidence. We are now beginning to comprehend". ■

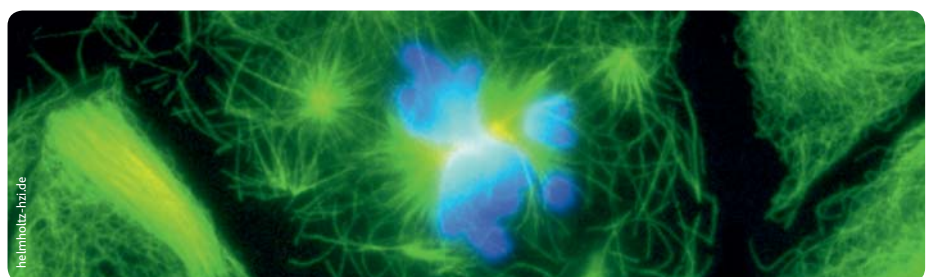
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Thriller Scene: Cropping Soil

Braunschweig's researchers keep guard on the safety in agriculture

The truth lies in the soil. You literally have to rifle through soil, if you want to understand how tens of thousands of different bacteria, fungi and protozoa are working together interdependently to degrade fertiliser and pesticides, produce compost, and fight against pathogens in the rhizosphere of plants. Only through the analysis of DNA has it become possible to track them down. "It's like in a TV-thriller, we are detecting individual genes which lead us to the identity of the microorganisms", says Dr. Christoph Tebbe, team leader of the molecular environmental microbiology work group at the Johann Heinrich von Thünen Institute (vTI). Braunschweig's researchers at the vTI, HZI, and JKI were amongst the first worldwide, who were capable of purifying soil DNA of impurities, such as humic acids in particular, and using fingerprinting techniques to study soil microorganisms", states Dr. Kornelia Smalla of the Julius Kühn Institute (JKI).

With the aid of these methods Dr. Kornelia Smalla can track down antibiotic resistance genes in soil microorganisms. Over a period of seventy years in which antibiotic use was unrestricted, bacteria which were naturally resistant to antibiotics had a clear survival advantage. Since bacteria are able to pass DNA from one bacterium to another, they can pass on their defence mechanism through horizontal gene transfer. Now Dr. Smalla has proven that this kind of gene exchange booms in soils fertilised with liquid manure containing antibiotics.

The team of Dr. Christoph Tebbe analyses soils on which genetically manipulated maize was cultivated. Transgenic maize produces Bt toxins, an agent against crop pests. After the harvest, part of the agent remains in the field, first contained in crop roots later on in the soil. "By using highly sensitive detection methods we can detect traces even in the nanogram range (0.000



Braunschweig Stadtmärkte GmbH/overland-archiv

000 001 g), amounts far below any biologically effective dose. "These data are important in the safety assessment of genetically engineered plants, before farmers cultivate such plants. Dr. Tebbe gives reassurance: "Bt-maize has a lower negative environmental impact than conventional pesticides." Sometimes one has to rifle through dirt for a clean agriculture of the future.

In 2008 BBA and FAL have been re-structured, and split up into two federal institutes whose research focuses are "research on cultivated plants" and "rural areas", the latter one has its headquarters on the site of the FAL in Braunschweig. This move has made the research even more efficient. ■

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Braunschweig

Integrated Centre for Systems Biology (BRICS)

The huge technological and methodical progress made over the past years has opened up entirely new opportunities and chances to investigate and understand biological systems in their entirety. Research is mainly focused on studying the dynamics of biological systems, their components and architecture. By linking experimental biological functional analysis (genomic research) and computer-aided bioinformatics analyses (bioinformatics), the development of drugs and therapies can be approached from an entirely new angle. By developing suitable mathematical models it becomes possible to model biological processes and simulate changes in these processes, to discover new purposes for therapeutics and vaccines and develop these further for medical use and application within the biotechnological industry.

For this reason, the Helmholtz Centre for Infection Research and the Technical University of Braunschweig are planning to establish a joint centre for systems biology, the BRICS (Braunschweig Integrated Centre for Systems Biology) within the framework of TRAIN (Translation Alliance Lower Saxony). The aim of this centre is to explore the dynamics and regulatory processes within complex biological systems. The centre is to be closely linked with the research activities of experimental biology and chemistry, as well as engineering sciences (cybernetics, institute for scientific computing, informatics). The new BRICS-complex does therefore primarily serve the purpose of bringing together research teams from different scientific disciplines like life scientists, computer scientists, mathematicians and engineers. The centre will make use of cutting edge technologies for genome analysis and bioinformatics in order to ensure internationally visible research.

For the first time, university and non-university research institutions are pooling their expertise and infrastructure within TRAIN in order to push forward the development of active substances and vaccines. To ensure efficient management of the translation process from basic research to clinical trial, close collaboration between partners is indispensable in such a highly interdisciplinary approach. Three infrastructure projects are therefore realised first, namely the Centre for Systems Biology (BRICS), an R&D Centre for ac-



The TRAIN partners

The Translation Alliance Lower Saxony (Translationsallianz Niedersachsen, TRAIN) is an association of following partners:

- Helmholtz Centre for Infection Research (HZI)
- Leibniz University of Hannover (LUH)
- UNIVERSITY OF VETERINARY MEDICINE HANNOVER (TiHo)
- Technical University of Braunschweig
- Fraunhofer Institute for Toxicology and Experimental Medicine in Hannover
- Hannover Medical School (MHH)

tive substances and a clinical research centre (HCTM), which will enable interdisciplinary research at the interfaces of research areas and translation phases. They represent integral elements of the TRAIN concept and complete strategically and operationally the existing research landscape with the help of the complementarity of their expertise and research approaches. ■

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Virus Hunters

At the Helmholtz Centre for Infection Research scientists study mechanisms of infectious diseases and defence mechanisms against infections. Understanding these mechanisms will contribute essentially to combating infectious diseases with the aid of new drugs and vaccines.

helmholtz-hzi.de

In Profile

Mobility

Systems Biology

Optical Technologies & Metrology

Information Technology

Renewable Resources

Culture and Communication

Precision on the Smallest Scale

Optical Technologies, Microsystems Technology, and Surface Technology

The research region Braunschweig "illuminates" the future

While aircraft engineering and aerospace technology are in charge of "the big stuff", other institutions in the region bring research back "to the surface". Microstructures must be measured to be, for instance, ready for use in the latest computer technology. And whoever hears the term „measuring" in Braunschweig will immediately think of the National Metrology Institute (Physikalisch-Technische Bundesanstalt, PTB).

Makes the scale bar ever smaller: The National Metrology Institute

Described as the "guardian of units", the institute is not only in charge of the exact determination and transmission of legal time, but also different kinds of measurements, including measurement of surfaces with the aid of light. Measuring experts apply the technique of optical form measurement for flat, non-structured surfaces. Even on irregular lenses such as the ones used in mobile phone cameras or spectacle lenses, surface roughness in the sub-nanometre range can be quantified by using specific measuring methods – this is the equivalent to measuring the curvature of the earth on the surface of a muesli bowl!

Things are getting more complicated whenever the structures on surfaces – for example on modern computer chips – are getting so

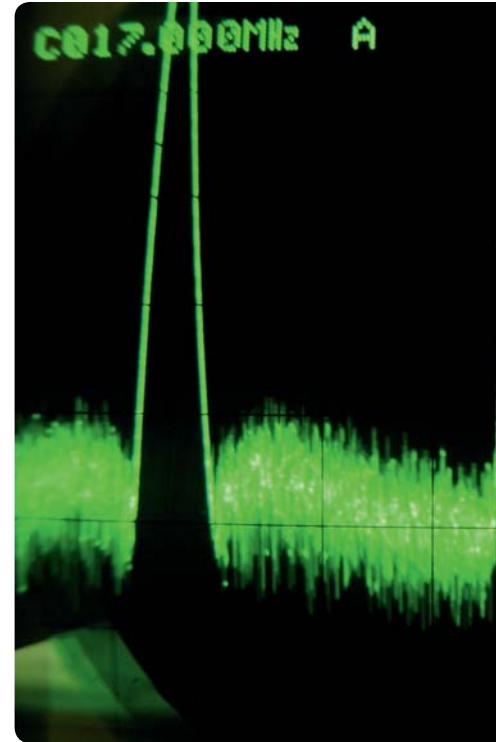
are needed for this purpose which scan the surface with tiny sensors (ideally of atomic size). These "sensed" data can then be used to calculate the exact image of the surface. Not only the semiconductor industry but also, for instance, the chemical industry use such microscopes to make the development of innovative lacquers possible, which can produce different colours depending on the type of light used. They can be used for troubleshooting in microproduction and even the cosmetics industry applies such microscopes. At the end of the day, what manufacturers actually want to know is just how well their new anti-wrinkle cream can really reduce the appearance of wrinkles...

"A novel atomic force microscope measures even millimeter-sized areas at nanometer resolution making PTB a worldwide leader in this field", explains Dr. Hans-Ulrich Danzebrink, head of the working group Quantitative Scanning Probe Microscopy, who also likes to exercise his artistic talent and in 2007 received the award Best "Nano-film" for his short film "Dimensionen".

Film classics with a twist: Braunschweig and the computer of tomorrow

Also in the field of data storage, one of the most important innovations, the so-called MRAM (Magnetic Random Access Memory) comes from the PTB. The measuring experts developed this new technology which, in contrast to the currently used types of memory, records digital data through magnetic storage by aligning specific magnetic cells. This technology would allow data to be preserved even if the power supply was interrupted and the time-consuming boot process to restart the computer could thus be omitted. At the moment, intense efforts are made to optimise the concept of the MRAM in order to realise this concept as soon as possible.

In the field of quantum optics the PTB works on the development of single-photon light sources. Taking advantage of the quantal nature of light, information can be transmitted which is tap-proof due to the fact that any "eaves dropping" will leave visible marks at the receiving end.



"In the future if the viewer doesn't want Ben Hur to die at the end of the feature film, he can simply choose one of several endings which are transmitted simultaneously, providing there is enough bandwidth available. Optical technology provides the opportunities necessary for this as well as for future optical computers with their expected increase in speed. Just like the 20th century has been the century of the electron, without which, for instance, computers would not exist, the 21st century will be the century of the photon. And at the PTB, we have the necessary measuring technology available which is required for high-energy lasers as well as for testing the newest generation of light sources", says Dr. Fritz Riehle, head of the department of optics, pointing out the significant role of the federal institute.

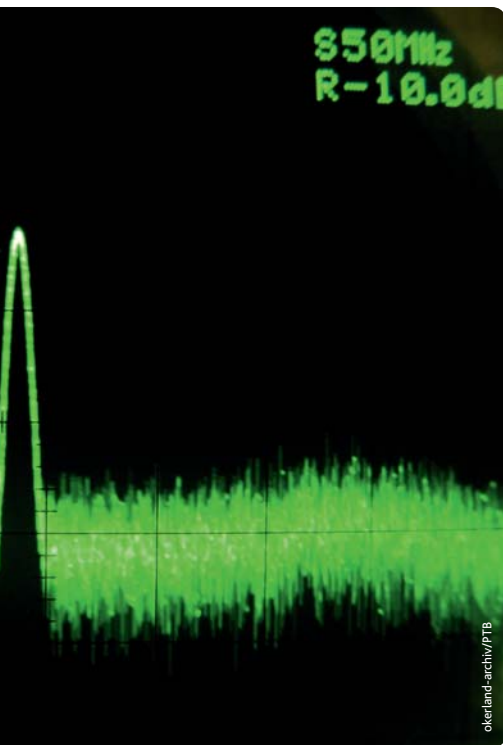
Future made in Lower Saxony: Innovations of the Technical University Carolo-Wilhelmina at Braunschweig

Among future light sources are the so-called organic light emitting diodes (OLEDs), studied and developed at the Technical University

» A novel atomic force microscope measures even millimeter-sized areas at nanometer resolution making PTB a worldwide leader in this field «

Dr. Hans-Ulrich Danzebrink, PTB

small that light waves are too large for the small interspaces. With wavelengths between 400 and 700 nm, visible light is too coarse for the much smaller conductive paths of the latest generations and therefore practically useless. So-called scanning probe microscopes



(TU) of Braunschweig. OLEDs consist of organic, semiconductive materials which can be attached to practically any surface. In contrast to conventional LED screens OLEDs do not require a backlight to function and can be produced cost-effectively. Mobile phone batteries could operate a lot longer on the same charge since without backlight OLEDs use far less energy. After finishing a presentation, the speaker would simply have to roll up his screen and tuck it under his arm. During the journey home, as if by magic, a traffic jam alert would appear on the inside of the windscreen...

Application possibilities of OLEDs for current and future display technologies are already very versatile. Moreover, how would you like it, if a film consisting of countless luminous dots would regulate the lightning according to your mood? Cold light for work, and warm red light to relax in your leisure-time – the light release of the OLEDs could be varied as required. This new form of illumination may well be replacing the conventional light bulb within the next few years, wherein the research region Braunschweig will play a decisive role. ■



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A Game of Nano-Billiard for the Industry: A worldwide unique tool at the Fraunhofer Institute for Surface Engineering and Thin Films

The Fraunhofer Institute for Surface Engineering and Thin Films (IST) is involved in the development of techniques for the production and encapsulation of new illumination and display technologies. This "stronghold of plasma technology" plays a leading role in the field of surface coating. How can flexible, extremely thin coatings be applied onto all kinds of surfaces? Experts of the IST pool their expertise in the field of plasma technology in a worldwide unique way to provide customised solutions for specific problems concerning coatings at subatomic level. A process referred to by engineers as "sputtering" allows the detachment of individual atoms with the aid of plasma. Like in the opening move of a game of billiard, the atoms of solid state bodies are physically knocked loose in order to be reassembled under vacuum conditions. For example, for a silver coating of 12nm thickness researchers stack approximately 30 atoms on top of each other. If these atoms are then recombined in different ways while new components are added, new characteristics will ensue. This way it is possible to apply scratch-resistant coatings to the paint of a car, put very slender displays in position or attach thin insulating films to window glass. The IST is also one of the first ports of call in the field of complex multilayers. The integration of tiny sensors into the thinnest possible surface allows, for instance, the production of an "intelligent work bench", which can measure temperature, pressure or rotation speed electrically and initiate measures accordingly so that tools and machines

can be utilized more efficiently than before. High competence in the field of microsystems technology thereby facilitates the manufacturing and processing of extremely small components which have to be inserted into the "skin of a machine".

The head of the IST, Prof. Dr. Günter Bräuer is also the head of the Institute of Surface Technology at the TU, and due to this dual role basic research and teaching can be better coordinated across the field of coating technology and plasma-based production.

When individual particles come together and become an entity: Combined strengths and a central port of call

An increased collaboration between the TU Braunschweig and the PTB has brought the Joint Optical Metrology Centre (JOMC), a joint research centre, into being. The purpose of the joint project is to improve and elaborate measuring techniques and equipment primarily in the visible and infrared range.

"At the TU alone there are countless institutes working in this field, and the PTB, in its role as national measuring institute, is naturally also strongly represented in this sector. Thus the JOMC was created to pool existing potential and promote knowledge transfer, joint projects and productive exchange. The combination of TU and PTB provides unique possibilities. Above all, amongst the large number of addresses, it provides a first port of call to the industry, making excellent use of the advantages all these facilities have to offer", says Prof. Dr. Wolfgang Kowalsky, spokesman of the JOMC and Head of the Institute for High-Frequency Technology at the TU. In 2005, the

Centre for Microproduction (ZeMPro e.V.) was founded in Braunschweig linking different research facilities in the field of microsystems technology in a similar way. At the centre, the TU Clausthal and the TU Braunschweig, the Fraunhofer Society and the PTB, as well as the companies "eck*cellent IT GmbH", based at Braunschweig, and "Stieler Kunststoff Service GmbH", based at Goslar, are working together in the field of basic research, and, in close collaboration with the industry, on the production and application of cutting edge microtechnology, such as surface treatment, microassembly, and connection of smallest elements.

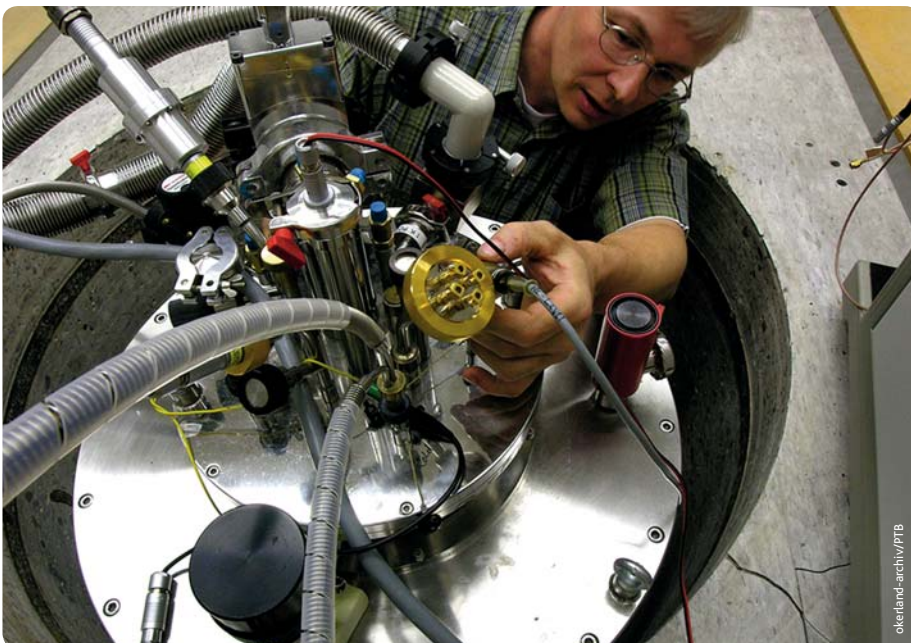
This way, individual research institutions increasingly come together to form an entity which, like an OLED, sheds new, future-oriented light on Braunschweig's individual research institutes illuminating even the "smallest details"...

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On the Same Wavelength

Information and Communication Technologies

The information and communication sector of the region is looking optimistically into the future. Business and science are working closely together when it comes to pushing technical developments in telecommunication – from big corporations like Intel to small and medium-sized businesses to universities. They are no bigger than a thumbnail. A silver artwork adorned with very fine lines. And yet: these tiny structures – the so-called chips – ensure that we can nowadays store and handle millions of data on our computers without giving it another thought. The chip production is part of the daily business of Intel: The worldwide largest manufacturer in the semiconductor development sector produces thousands of these modules. "The cost to develop such microchips nowadays can run to several 100 million dollars", explains Nikolaus Lange,

Product Development Manager of Intel, Germany.

The market pressure is enormous – even a global player like Intel is feeling the effect of this. Companies in this sector are meanwhile operating from quarter to quarter. Intel invests almost six million dollars in research and development every year, and has continued to expand its site at Braunschweig since the year 2000 in order to cope with the ever shorter development times of innovations. Today, this site is one of Intel's largest chip research centres in Europe. Its research is focused on multi-core processor architectures. Instead of one or two cores, these processors possess even more than one hundred cores. "Multi-core processors will enable us to achieve the so-called terascale computing", predicts Nikolaus Lange. Better processing power

in the future will be particularly interesting for the computer games industry and high performance computers. "Terascale computing allows completely new appli-

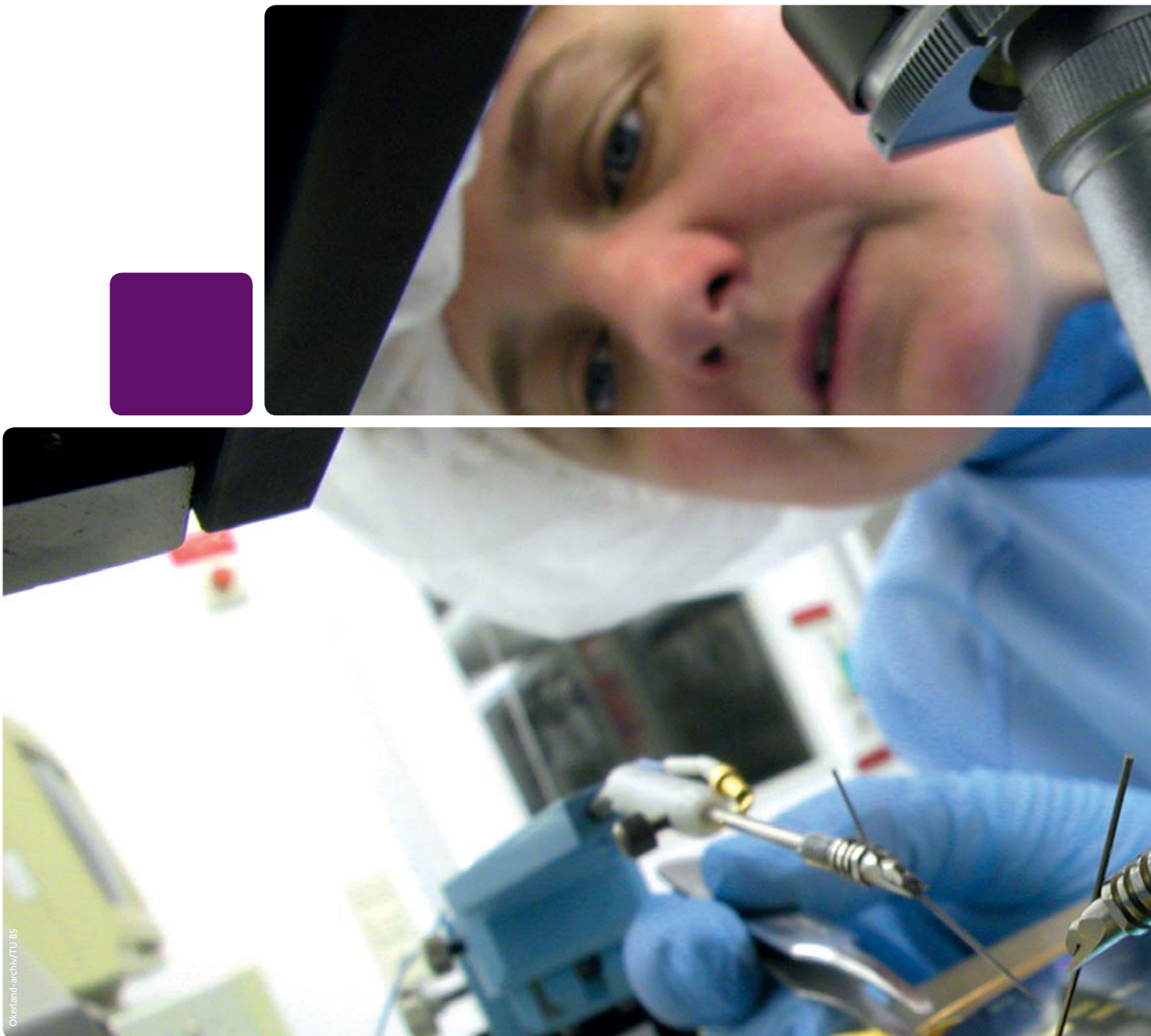
» We are heading in the right direction in the region «

Nikolaus Lange, Intel Germany

cations, for example, in the graphics sector", says Lange. "By increasing the performance tenfold or hundredfold significantly more detailed and realistic graphics can be achieved". In addition, Intel cultivates its future experts at the Technical University of Braunschweig. Since 2004 the degree



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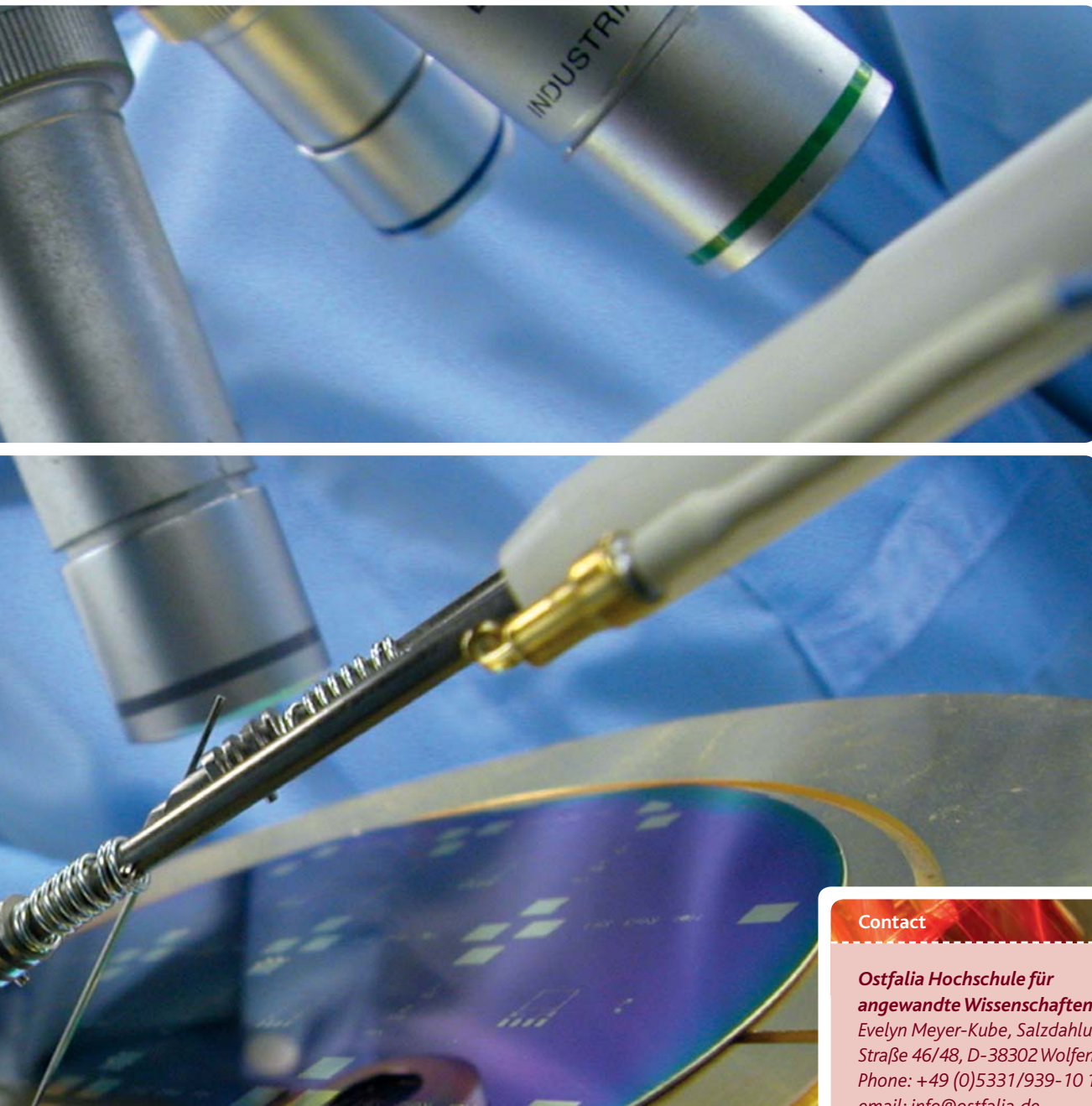
programme "Advanced VLSI Design", which is tailored to the particular needs of the semiconductor industry, is sponsored by Intel. "Both sides can benefit from this", explains Nikolaus Lange: it allows Intel to counteract the imminent shortage of specialists while the highly practical orientation of the course makes it easier for graduates to embark on a professional career later on. "We are heading in the right direction in this region", is Nikolaus Lange positive verdict on the potential. The Intel® Leibniz Challenge has been set up by Intel Braunschweig in collaboration with the Leibniz University Hannover and is aimed at pupils in year 9 to 13 at high schools, vocational high schools as well as comprehensive schools. The contest seeks to convey a better understanding of the job profile of an engineer and wants to raise pupils' interest in heading towards a career in the technical

sector. The American company is also currently working together with Volkswagen AG in the field of car communication.

Emerging from the shadow of the automobile industry

Not only a giant like Intel, but also Professor Dr. Diederich Wermser from the Ostfalia University of Applied Sciences has an optimistic view on regional developments in the information and communication technology sector. The 54-year-old is spokesman of TELIAISON. This association was founded in 2004 and includes two universities and eight companies – all of which are well-positioned in the field of telecommunication. "The name TELIAISON is short for "Telekommunikations Liaison Südost-

Niedersachsen and might sound a little bit bulky", admits Prof. Diederich Wermser, "yet the word "liaison" suggests what the association wants to be: an exciting business relationship." TELIAISON was born on board a plane. While travelling regularly between Munich and Braunschweig, Wermser frequently got into conversation with representatives of small and medium-sized businesses and came to the conclusion that "the sector needs to be led out of the shadow of the powerful regional car industry." Wermser: "Information and communication technologies play an enormous role worldwide, and also in the Braunschweig region". In order to strengthen market recognition, produce synergetic effects, and achieve better perception through a joint market presence, TELIAISON was founded four years ago by its members. According to its spokesman "Not from a position of weak-



ness, but from a position of strength: with an annual turnover of approximately 95 mill. EUR between them, the companies are doing very well financially".

The companies Auerswald, BCC, Brunel, Harman/Becker, GOD, the "Institut für angewandte Funktechnik" (the Institute for Applied Radio Systems Technology), eck* cellent IT GmbH, Netzlink, as well as the Technical University of Braunschweig and the Ostfalia University of Applied Sciences are participating in the consortium. The Wolfenbüttel based telephone system manufacturer Auerswald, the Braunschweig based network operator BCC, and the Ostfalia are currently cooperating in the field of IP telephony. The improvement of provisioning also plays an important role, this means establishing and providing an

IT service for the customer. "Taking today's production cycles of the sector into consideration, then the establishment of such a service takes far too long due to the services and costs involved", is something Wermser notices regularly. Particularly in this area, the companies want to find suitable solutions.

What about promoting young talents? "TELIAISON specifically wants to promote graduates", stresses Wermser. "Qualified people have excellent career opportunities in the IT sector, but women in particular are still hesitant to study for a degree in this field". The joint presence of the TELIAISON partners on the market also serves to emphasise the attractiveness of the sector. ■

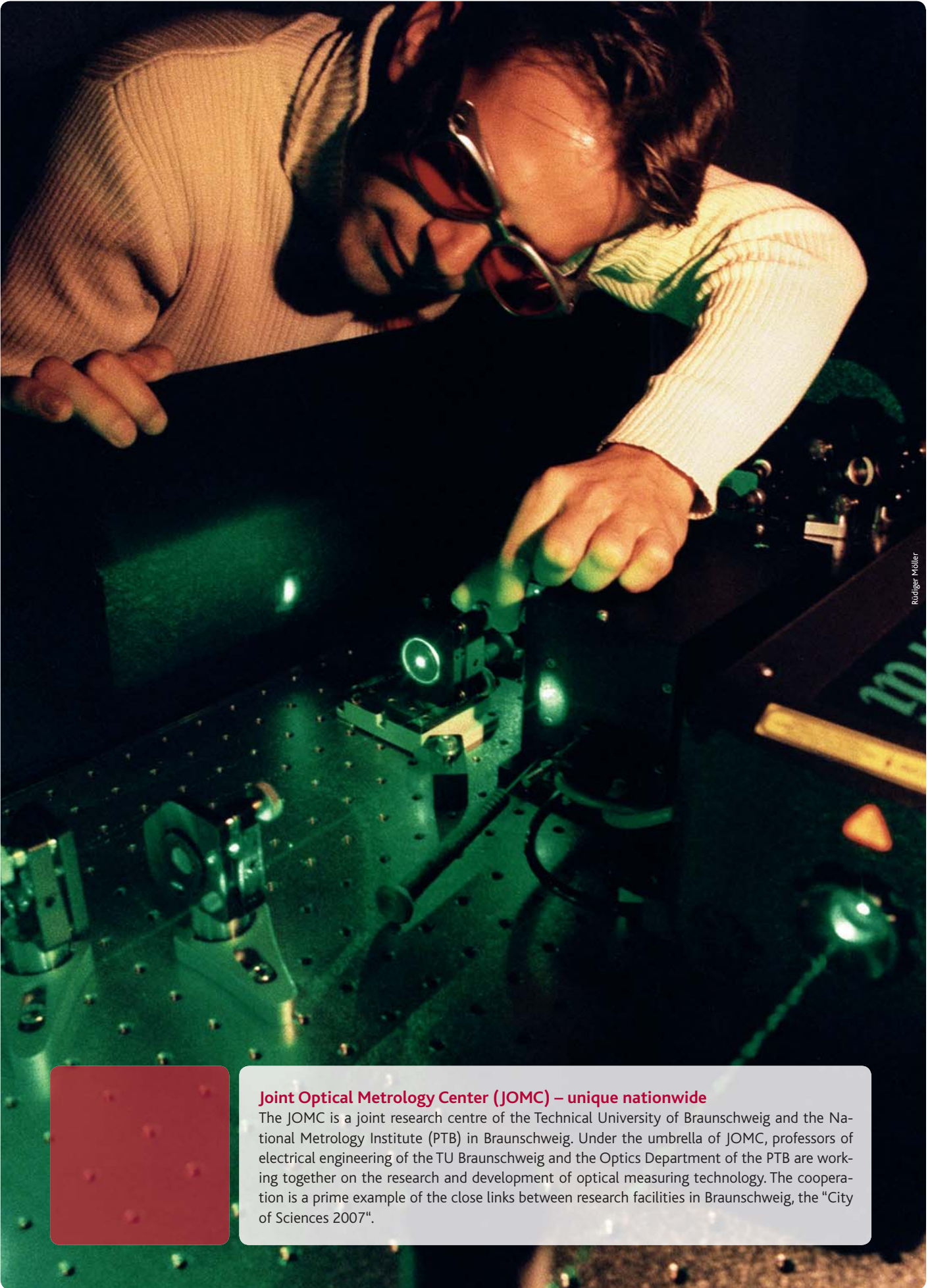
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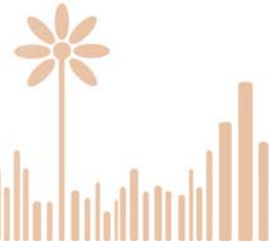
Rüdiger Meller

Joint Optical Metrology Center (JOMC) – unique nationwide

The JOMC is a joint research centre of the Technical University of Braunschweig and the National Metrology Institute (PTB) in Braunschweig. Under the umbrella of JOMC, professors of electrical engineering of the TU Braunschweig and the Optics Department of the PTB are working together on the research and development of optical measuring technology. The cooperation is a prime example of the close links between research facilities in Braunschweig, the "City of Sciences 2007".

Using Green Energies

Agriculture and Renewable Resources



A pipeline is leading the way

Braunschweig's scientists do not only study alternative energies they also use them. Energy from renewable resources is used to power and heat the National Metrology Institute (PTB) and the Johann Heinrich von Thünen Institute (vTI). The unique aspect about this is that biomethane is transported in Germany's first biogas pipeline across a distance of 20 kilometres to a combined heat and power plant.

The biogas pilot project of Braunschweig's energy supplier BS|Energy and the Braunschweig sewerage board serves as a role model since it bridges the gap between rural biogas production and urban biogas utilisation. Its big advantage: the heat energy is produced in the same place where it is needed. It is not being lost. BS|Energy plans to connect more farmers to the gas pipeline – with the aim to operate an entire biogas network within the next few years. ■

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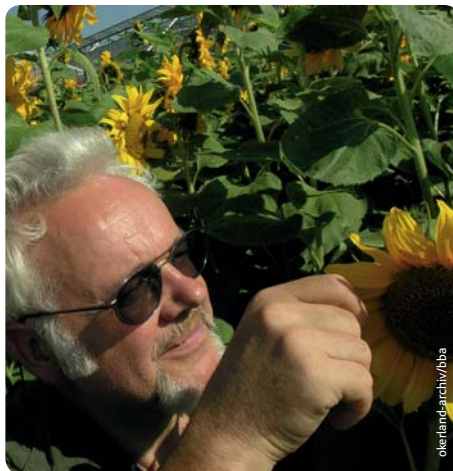


Designer Fuel from Green Gas

OptiBtLGas – stands for optimisation of the H₂:CO-ratio in synthesis gases for the production of 2nd generation fuels – a complex procedure for cleaning and treatment of product gases from biomass gasification. CUTEC coordinates a new EU project aimed at the production of designer fuels in form of synthetic diesel or methane from renewable resources such as, for instance, straw or digestates.

ERA-Net BIOENERGY is an EU-wide network of national research and development programmes on aspects of bioenergy research. In Germany, OptiBtLGas is backed by the FNR – “Fachagentur Nachwachsende Rohstoffe” (Agency for Renewable Resources), Gülzow, and in Austria by the FFG – “Österreichische Forschungsförderungsgesellschaft” (Austrian Research Promotion Agency), Wien. Of the participating partner companies, CUTEC and Fa. H. C. Starck of Goslar are from Germany, and Europe wide renowned institutions such as the TU Wien, Fa. REPOTEC and the biomass power plant Güssing are from Austria.

Two gasification facilities for the thermal decomposition of biomass for the production of synthesis gas have been running successfully at Güssing and Clausthal for several years and provided the starting point



for the project. A range of hydrocarbons is used as fuel source at the Clausthal site, while the Güssing facility is already being commercially operated as a combined heat and power demonstration plant.

Carbon monoxide and hydrogen are needed as components for the synthesis of artificial fuel. For artificial diesel, so-called BtL, a ratio of 2:1 is sufficient, however, cars powered by natural gas already require a ratio of 3:1. The specific aim of the OptiBtLGas project is therefore to use carbon monoxide and water to selectively produce the missing component hydrogen. The energy contained in the biomass should therefore ideally be transferred into fuel with the highest possible efficiency. The partners have divided the various tasks among themselves: In the Harz, the focus lies on the treatment of raw gas directly after gasification and dust removal, and in the Burgenland the purified gas is used prior to synthesis.

It is a notable aspect of this project that, with the pilot plant in Clausthal and the demonstration plant in Güssing, once again two institutions have come together within an EU project, which pursue different approaches to fluidised bed gasification. While the facility in Clausthal investigates the autothermal principle, which is independent of external heat input, using steam and oxygen, the Güssing team favours the allothermal fluidised bed system (involving energy input) which has been perfected at the TU Wien under Professor Hofbauer, using two instruments and steam and air. ■

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Little Helpers on a big Mission

It has a certain charm that the smallest of all come to the rescue to tackle the big problems in the world. Researchers of the Johann Heinrich von Thünen Institute (vTI) in Braunschweig have realised the importance of those tiny helpers, and the vTI Institute of Agricultural Technology and Biosystems Engineering is guarding their valuable microorganisms day and night. "We put in a huge amount of effort to ensure that bacteria do their job", says Professor Klaus-Dieter Vorlop, director of the institute. The mission of these little helpers is as tricky as it is important; Their job is: to keep up the recycling of nutrients from renewable resources, to vitalise white biotechnology, and to spur on change

»» Away from oil, and
towards renewable resources – that
is our objective ««

Dr. Stefan Friebe, Fraunhofer-Institute
for Wood Research, Braunschweig

within the chemical industry. Welcome to the world of high-performance fermenters, chromatography, and mass spectroscopy: sophisticated, multi-million euro technology and a team of 25 scientists at the vTI laboratories ensure that bacteria and fungi get everything they need and can evolve into high-performance microorganisms. Bacteria are some of the most important allies of the international biotechnology programme IG-Biotech. Together, the vTI, the Fraunhofer-WKI and a multitude of other research and industry partners want to develop surface coating resins and cast resins as well as fibre-reinforced composites from renewable resources, while, at the same time, paving the way for environmentally-friendly production technologies.

Researchers are particularly interested in glycerin. Large amounts of this liquid are generated as a by-product of the biodiesel production – and the microorganisms of the vTI are able to convert glycerin under anaerobic conditions into 1,3-propanediol. 1,3-propanediol is one of the more promising renewable resources; the dihydric alcohol can, for example, be used as component for polymers which can also form surface coat resins. The search for more and more effective microorganisms is a cumbersome task. „We had to

take thousands of soil samples before we finally found them“, says Klaus-Dieter Vorlop. But this perseverance has paid off. "Our bacteria are clearly superior to the ones, which have been known up to now". Additional support comes from the industry: the pilot plant at the Mechanical Engineering Institute in Braunschweig is to isolate 1,3-propanediol from the murky fermentation broth.

"Away from oil and towards renewable resources – that is our objective", says Dr. Stefan Friebe, Project Manager of Lacquers and Adhesives at the Fraunhofer-Institute for Wood Research, Wilhelm-Klauditz-Institute Braunschweig (WKI). Like the vTI, the WKI is one

of the project partners sponsored by the Federal Ministry of Education and Research and industrial firms. The research work attracts much interest since time is running short. Stefan Friebe: "Germany urgently needs alternatives to petrochemical resources in order to reduce its level of dependence on oil-exporting countries". And also to contain climate change. "The production process for one kilogram of plastic from crude oil generates approximately one to three kilograms of carbon dioxide", points out Stefan Friebe.

Braunschweig's researchers share the workload: while polymer chemists of the vTI are focussing on the synthesis of cast resins and



fibre composites, the WKI is primarily engaged in developing modern surface coat resins for wood coating. Institutes of the TU Braunschweig and the Ostfalia University of Applied Sciences undertake basic research.

Lacquers from renewable resources protect not only the environment – the utilisation of glycerine is also of benefit for biodiesel producers by giving them a new source of income. There is an enormous market for wood lacquer finish. "In Germany, more lacquer is produced for use in wood than for use in automobiles", says Dr. Guido Hora, Head of the Department Surface Technol-

ogy at the WKI. The German industry has been appreciating the synthesis capacity of nature already for some time. About ten percent, approximately three million tons, of the overall raw material charge in the chemical industry are renewable resources. The vTI and WKI want to ensure that this share will increase. Research projects cover all levels of the value-added chain – from the bioconversion of glycerine into 1,3-propanediol, to further processing into surface coating resins and thermoplastic resins.

The properties of lacquers and plastics from renewable resources are equal to those of petroleum-based products. The biotechno-

logical process for upgrading raw materials to plastics presents a great scientific challenge. It is one of the most difficult tasks to establish the economic efficiency of the production chain – since glycerine utilisation should be profitable for the agriculture sector as well as the chemical industry. The development at the vTI is even further advanced where the conversion of sugars into detergents containing gold nanoparticle catalysts is concerned; here, the sugar industry is already operating a pilot plant.

The production of itaconic acid, which can be isolated from sugar, also opens up new future prospects for farmers: researchers at the vTI have succeeded in increasing the yield of itaconic acid, which can be converted to polyesters in a biotechnological process, in which mould fungi are useful helpers. The vTI will leave nothing undone to further improve the bioconversion processes carried out by these fungi strains. We have already come a long way: researchers have succeeded in synthesising materials from itaconic acid and 1,3-propanediol which consists entirely of renewable resources. The WKI has also accomplished a breakthrough. Guido Hora: "The two components are a crucial development towards the production of lacquers made entirely from renewable resources". ■



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Establishing Business Relations, Promoting Dialog

Culture and Communication

In the cultural network

Braunschweig is a place which creates knowledge. However, it is not enough to gather new knowledge, in order to gain the right to exist this knowledge also needs to be propagated and refined. And to prevent it from being lost, it needs to be conserved. This applies to natural sciences and engineering sciences as well as to the art and culture sector. Here, both fields are closely linked in a network and work together: university research meets cultural institutions.

The State Museum of Braunschweig was founded in 1891 and is one of the largest historical museums in Germany due to its large collection housed in four buildings. In the main building at the Burgplatz, visitors can encounter innumerable objects from the areas of history, culture, science, technology, art, folklore, and social history – from with the 8th century right up to the present day. Numerous events, conferences, and presentations make the museum a vital cultural centre where the regional history of Braunschweig is conserved and studied. It represents a hub for

culture and science in the heart of the city and has cooperations with many other research institutions. Braunschweig has also a lot to offer where art is concerned. The spectrum ranges from contemporary art, where the Braunschweig University of Art (HBK) is playing a pioneering role in Germany, to the internationally renowned Herzog Anton Ulrich Museum (HAUM). The HAUM is one of the oldest museums in Europe and has enriched the lives of generations of people since its opening in 1754. Overall, approximately 170.000 works of art covering a period of almost 3.000 years are facilitating a sensuous experience and comprehension of art. “We are a universal art museum. We show not only paintings but also graphic, sculptures, furniture, majolica, and East Asiatica – to name only a few. Our picture gallery of Old Masters includes works of Rubens, Rembrandt, and Vermeer, and is one of the most important galleries in Germany. The “Kupferstichkabinett” (collection of prints) with its 120.000 works of art is among the most important graphic collections in Europe”, explains Prof. Dr. Jochen Luckhardt, director of the museum. The museum will be

refurbished between 2009 and 2012, but nobody will have to miss out on the enjoyment of art – the HAUM will show a selection of highlights of its collections in the “Epochal” exhibition in Dankwarderode Castle at Burgplatz. Administration wise, the HAUM is tied

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Prof. Dr. Jochen Luckhardt,
Herzog Anton Ulrich-Museum

in with the State Museum of Braunschweig and the State Natural History Museum. The three museums form the Lower Saxony State Museums Braunschweig. With three of the six state museums of Lower Saxony based at Braunschweig, the city is an important location for culture – which is, above all, broadly diversified. Alongside art and history, natural history is also very well represented: The State Natural History Museum of Braun-



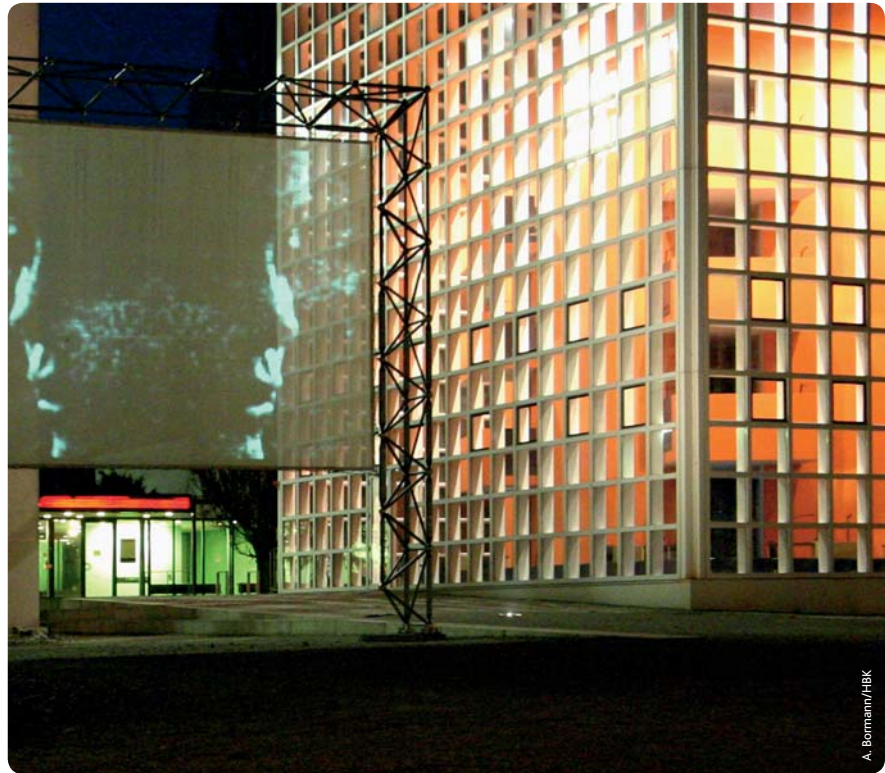


HAUM/Verena Helwig



schweig is Germany's oldest natural history museum and houses large and valuable collections. In the fields of systematic zoology and palaeontology, the diversity of animal species worldwide are studied and classified here. New findings are obtained with the aid of modern molecular biological methods – naturally, in close collaboration with the Technical University (TU) of Braunschweig. Topics like dinosaurs and snakes are covered by research, as well as by attractive special exhibitions.

300 years ago, the Herzog August Library was already celebrated as the eighth wonder of the world. In 1666, at the time of Herzog August's death, it was one of the most famous baronial book collections and, in view of the number of prints, arguably the largest library worldwide; the collection of medieval manuscripts was amongst the most important ones in Europe. Today, the Herzog August Library is one of the oldest, preserved libraries still intact and the cultural memory in the field of research of European cultural history of the mediaeval times and early modern history. "One thing that is so special about our library is that it is full of activity, it is being used", points out Dr. Helwig Schmidt-Glitzner, director of the Herzog August Library. The Wolfenbüttel library provides the setting for a number of scientific events, in addition to a divers culture programme, which includes a series of events such as "Politik im Gespräch" (politics in talk), or, in collaboration with the "Friedrich-Ebert-Stiftung" (Friedrich Ebert Foundation), the "Wolfenbütteler Gespräche" (talks of Wolfenbüttel) on issues of religions in civil society. This also includes conferences, workshop discussions and guest seminars on a wide range of topics. "The promotion of young researchers is important to us", says Prof. Dr. Helwig Schmidt-Glitzner.



A. Bornmann/HBK

With the aid of grants, which are internationally announced, numerous young researchers from all over the world come to Wolfenbüttel in order to study the sources of their research interests. Special exhibitions make the comprehensive stock of books, which has a lot of treasures on offer including the Gospels of Henry the Lion, accessible to a wide audience. Since 2007, the Herzog August Library, together with the Herzog Anton Ulrich-Museum, is in the process of establishing a virtual "Kupferstichkabinett" (collection of prints) which already contains the images of 25.000 graphics from the 15th to the 19th century and makes the valuable drawings and prints digitally accessible anywhere in the world. The Herzog August Library already represented the epitome of sciences and the mirror of the academic universe for Leibniz, who, like Lessing, worked as a librarian in Wolfenbüttel. Lessing's drama "Nathan the Wise", postulating religious tolerance and humanity, was written during his time in Wolfenbüttel.

The "Georg-Eckert-Institut für internationale Schulbuchforschung", GEI (Georg Eckert Institute for International Educational Media Research) is also working on the issue of tolerance and intercultural understanding. It analysis the role of school relevant educational media in the development of self-perception and the perception of oth-

ers, as well as the conflict potential which is associated with this. Educational books can become weapons, for instance, because they convey ideas which develop into a mindset and persist for a long time. Central fields of activities are "Muslim societies and Europe", "Educational Media in Times of Globalisation", " Images of Europe", and

» We are a **nationally and internationally unique centre of expertise** for comparative educational media research «

Verena Radkau, Georg Eckert Institute for International Educational Media Research

"Textbook and Conflicts". The GEI brings together researchers of different disciplines, as well as experts of teaching and textbook practice in order to encourage a reflective way in dealing with cultural diversities. Cooperations with the Council of Europe and the UNESCO as well as the recent recommendation of the German Science Council to make the institute a member of the Leibniz Society speak for the GEI's high reputation. "We are a nationally and internationally unique centre of expertise



for comparative educational media research. In the future we will also increasingly focus our attention on the analysis of other school-relevant media and become the (virtual) hub within the international network of education media research. This is a very interesting field of research, due to the fact that textbooks always convey the spirit of time and reflect the self-conception", concludes Verena Radkau, the spokeswoman of GEI. Connections to the TU Braunschweig exist within the scope of a cooperation contract agreed in 2005. The director of the GEI, Prof. Simone Lässig, was jointly appointed and, in addition to her activities at the institute she teaches at the history seminar of the university.

Interdisciplinary young scientists are educated in Braunschweig in order to continue cross-cultural work. The aim of the master's programme "Kultur der technisch-wissenschaftlichen Welt" (culture of the technical-scientific world) at the TU Braunschweig

is to give students a spiritual home in both, arts and natural sciences, since well-founded knowledge of the other culture can only be beneficial to the professional life. For this purpose institutes are working closely together: English studies, German studies, history, and philosophy meet sciences like engineering, pharmacy, physics, and psychology. The course is aimed at interested students who already have a first academic degree – in whatever scientific culture. And while culture is already being mentioned here, in Braunschweig you are bound to come across the "Hochschule für Bildende Künste", HBK (Braunschweig University of Visual Arts), sooner or later. It is the second-largest university of the arts in Germany and the epicentre so to speak of contemporary art in Braunschweig. Intensive research and teaching is undertaken here in the fields of art, design and media science. Degree courses – whether Fine Arts, Art Mediation, Performing Arts, Art and Media Science, Industrial Design, and Communica-

tion Design – all live on the interdisciplinary interpenetration and the close proximity to artistic work. This is not primarily about creating new works of art, instead this is about developing new insights, new research findings and new media and industrial products. Because whether it is art, design or science, all are working according to the same principles: research, observation, and perception.

The next generation of artists is working and being raised at the HBK, designers are shaping the world of tomorrow, and scientists are contributing their part to scientific groundwork. The close interdisciplinary work creates a fertile ground for numerous collaborations. For instance, within the frame of the Transportation Design degree course major companies of the mobility sector such as Volkswagen, BMW and others are participating in co-operations to find solutions to the questions of the 21st century.



Braunschweig Stadtmarketing GmbH / Sacha Gramann



TU Clausthal

Depending on the type of degree course, close working relationships existed or exist with the Museum of Art in Wolfsburg, specialised in modern and co temporary art, the HAUM, the TU Braunschweig, and many other institutions. Many of the ideas produced in Braunschweig are consequently originating from the studios, workshops, laboratories and lecture rooms of the HBK. As Lower Saxony's University of the Arts, the HBK is therefore of importance far beyond the national borders. In June 2009, the Kunstzeitung wrote: "The Braunschweig University of Art is one of the most vital universities, if not the most exciting one in Germany."

Another partner of the HBK: the State Theatre of Braunschweig. Opened as early as 1690 by Herzog Anton Ulrich, it can today look back on a large number of successful productions. Amongst others, the debut performance of Lessing's Emilia Galotti

and Goethe's Faust I took place at this theatre. Some 750 shows are performed at the 4 venues each season, including around 35 premieres and numerous concerts. The cooperation with the Research Airport Braunschweig-Wolfsburg facilitated the German premier of the helicopter-string quartet of Karlheinz Stockhausen within the event "Festliche Tage neuer Musik" (festive days of modern music). And for anyone who does not want to spend all his time browsing in history, enjoying the pleasures of art or getting spellbound by music, a visit to Germany's unique science centre, the phäno, in Wolfsburg, can be warmly recommended. Visitors of the centre become explorers and have the opportunity to discover the world of science with all senses at 250 interactive experimental stations, partly installed by artists. Technology and art form an exemplary symbiosis in this place. ■

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Show initiative, join in the discussion, and get involved –

A house as a showcase for science

The latest addition to the "City of Science" is the "Haus der Wissenschaft". In May 2009, the House of Science Braunschweig has opened its doors offering a forum for dialog between science and people from all walks of life.

All those who are interested get the chance to see and experience science in a different light. Ordinary people are to be included into the discussion of scientific issues, because today's research and science has a decisive impact on tomorrow's life! In events such as the "Nachtcafé für Aufgeweckte" ("Café of the Bright"), people can discuss their views on controversial issues in a relaxed atmosphere. "Tatsachen? Forschung unter der Lupe" ("Facts? Research under the spotlight") is a series of events hosted by the Haus der Wissenschaft and the Helmholtz Centre for Infection Research in which anyone can discuss issues such as genetic engineering, stem cell research or future mobility with leading experts. Different styles leave plenty of room for interaction with the speaker and give the audience a strong voice.

One of the most important aims of the Haus der Wissenschaft is to increase efforts to promote young talents. With events during school holidays like "KIWI – Forschertage für Neugierige" (Research days for curious kids) the Haus der Wissenschaft wants to inspire enthusiasm for science and research in children and young people. In an exciting programme seminars and lectures convey theoretical knowledge while laboratory experiments, guided tours and art projects offer a more practical approach to science.

An already successfully established event in the Haus der Wissenschaft is the so called "Science Slam". More than 300 interested visitors regularly follow the short presentations of the speakers. Every speaker has a 10 minute speech limit to present his current research topic in a popular scientific way in which he has to win over the audience. In the meantime, this concept has been successfully copied in many other cities. In addition to hosting its own events, the Haus der Wissenschaft can also be hired as a venue for presentations, lectures, seminars or conferences. Besides reliable, modern conference equipment, the Haus der Wissenschaft has attentive service personnel looking after con-

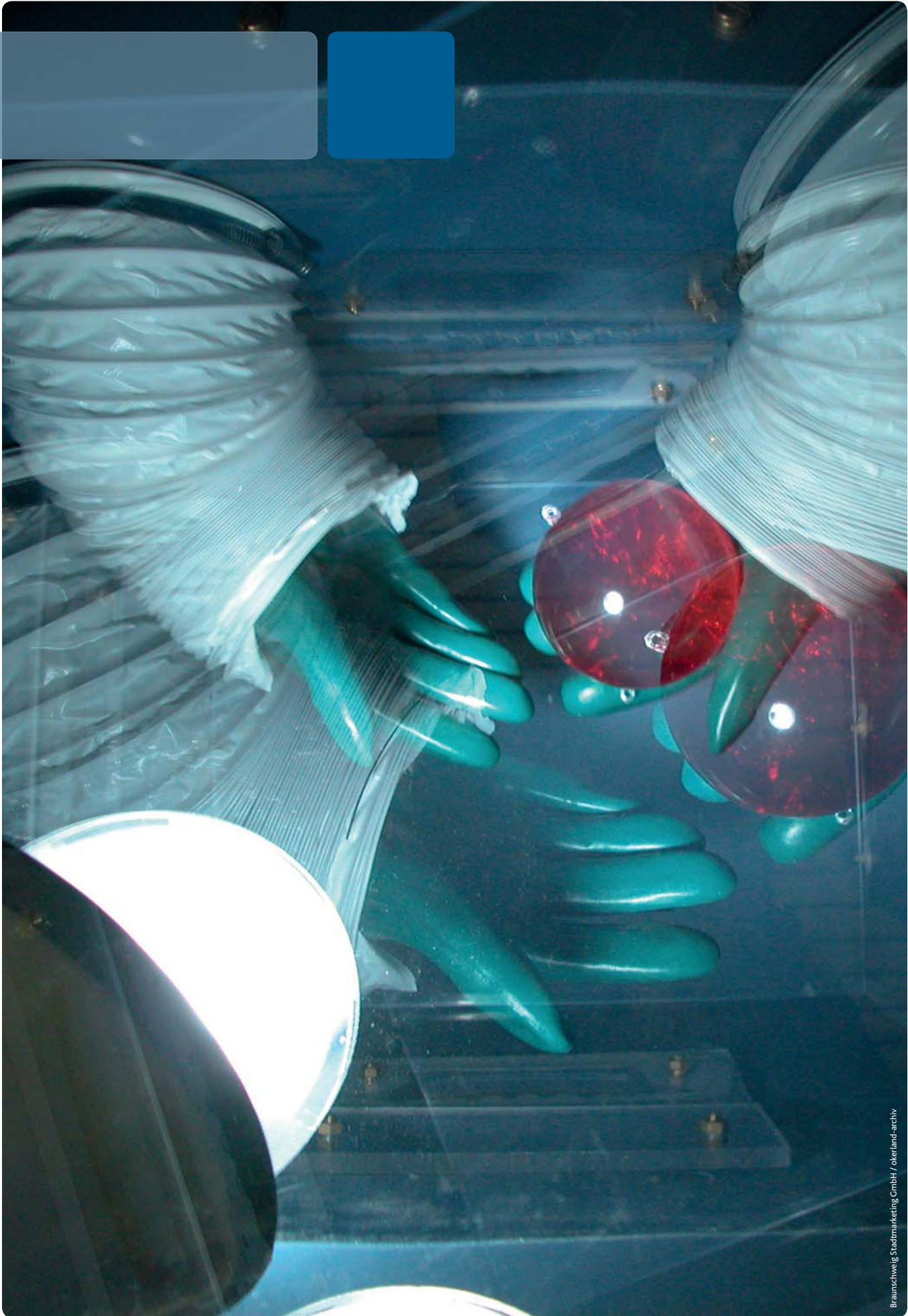


ference participants and offers professional catering. The restaurant "La Cupola" is situated on the sixth floor and is a meeting place ideally suited for informal talks over a freshly prepared Italian meal. ■

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