

RESEARCH AT
JOHANNES GUTENBERG UNIVERSITY
MAINZ



Johannes Gutenberg University Mainz (JGU) is an international research university and with its approximately 36,000 students among the ten largest universities in Germany. As the only comprehensive university and the scientific hub of the state of Rhineland-Palatinate, JGU brings together nearly all academic disciplines on its Gutenberg Campus located near the city center of Mainz. Some 4,150 academics, including 540 professors, undertake research and teach at the university's more than 150 institutes and clinics. The integration of the Mainz University Medical Center and two colleges of art in one single institution of higher education is unique within the German academic landscape.

Originally founded in 1477 during the era of Johannes Gutenberg, Mainz University has remained true to the concepts represented by its namesake. With his ideas and achievements in mind, JGU strives to promote and implement innovative ideas, to use knowledge as a tool to improve the quality of life of all people, to facilitate their access to education and science, and to encourage them to transcend those boundaries that they encounter on a daily basis – between specialist fields and academic and scientific cultures, between generations, nations, cultures, and institutions.

This is the spirit of Johannes Gutenberg that informs the vision of the future of Mainz University:
The Gutenberg Spirit: Moving Minds – Crossing Boundaries.

Title image: Julia Doré, EU Officer at the Research and Technology Transfer Office

Prof. Walter Bisang, a fellow of the Gutenberg Research College, is conducting research into the global structural diversity of human language



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The research landscape in Rhineland-Palatinate is characterized by dynamism. Johannes Gutenberg University Mainz, one of Germany's leading research universities, is a good example of that. To further promote and develop its potential, JGU and the other institutions of higher education in Rhineland-Palatinate have been receiving additional financial support since 2008 through the Research Initiative program. This is used to subsidize the profile building research fields that have been identified within the various institutions. Rhineland-Palatinate has thus ensured that JGU is well placed in the national and international competition for top staff members, the next generation of researchers, and sponsorships. The success of this strategy is impressive and plain for all to see in this brochure. It only remains for me to encourage the university to maintain the course that it has adopted.



Doris Ahnen,
Minister of Science
Rhineland-Palatinate



THE GUTENBERG SPIRIT

Our profile building activities in the field of research have three central aims: to further bolster our core research areas, to provide targeted support to research projects in the humanities and social sciences, and, in particular, to stimulate cross-disciplinary exchange between the fields of medicine and the natural sciences to achieve the related fundamental strategic refocusing of research in the sector of the life sciences. However, to build a profile in research needs staying power. At the same time, this is an ongoing process in which all the areas of the university active in research must continually be assessed in competition with new ideas and innovative joint projects. Hence, the research profile presented here is the basis for a modern research university committed to constant progress.

*Prof.
Wolfgang Hofmeister,
Vice President
for Research*



Vice President Prof. Wolfgang Hofmeister, University President Prof. Georg Krausch, and Junior Prof. Christian Plonka-Spehr of the Institute of Nuclear Chemistry at the TRIGA research reactor (left to right)



Johannes Gutenberg University Mainz will further consolidate its position as one of Germany's leading research universities and increase its international competitiveness over the coming decade. For this purpose, JGU commits itself to focusing on specific research areas based on the diversity of disciplines of a comprehensive university. Thanks to its excellent researchers and the establishment of outstanding research networks in the fields of particle and hadron physics, the materials sciences, and translational medicine, Mainz University is already garnering international acclaim. In addition, JGU is focusing on various interdisciplinary research associations, such as in the field of media and historical cultural studies. These have the potential to become predominant within their disciplines in the medium term and thus achieve pre-eminence at the national and international levels.

*Prof.
Georg Krausch,
President*



It takes time and continuous effort to develop nationally and internationally outstanding core research areas. Ongoing critical reflection ensures that this process and the associated increase of competition within university lead to excellent results. In this context, it is the task of the Gutenberg Research College to provide for compliance with the most stringent academic standards and to ensure intra-university participation and acceptance.

Prof. Matthias Neubert,
Director of the
Gutenberg Research
College (GRC)



PROFILE BUILDING

The profile building strategy of Johannes Gutenberg University Mainz is rooted in the conviction that research achievements that stand international comparison can be achieved by means of targeted promotion of individual excellence and the strategic integration of outstanding academics in promising interdisciplinary research networks.

The institutional integration of excellent academics in the process of the strategic development of the university is a hallmark of university governance at JGU. In 2007, the Gutenberg Research College (GRC) was founded as the central strategic instrument designed to promote top-level research at Mainz University. Its executive committee is made up of outstanding researchers from JGU and its non-university partner institutions. Committee members are appointed by the University President in consultation with the University Senate on the basis of their individual research achievements. Designed to function as an expert body, the GRC advises the University Administration and the Senate on strategic issues relating to research. Furthermore, it promotes individual excellence by granting fellowships to leading

researchers. Back in 2007, the GRC participated in the drafting of the profile building strategy of JGU for the purpose of participation in the first Rhineland-Palatinate Research Initiative, in the course of which five research centers (strongholds) and seven research units (high-potential research areas) were identified. Furthermore, the GRC played an important role in 2010 in the selection of the areas that participated in the Excellence Initiative of the German federal and state governments by submitting draft proposals. Four of these were subsequently invited to submit full proposals. Finally, the PRISMA Cluster of Excellence and the MAINZ Graduate School of Excellence were selected for joint federal and state sponsorship.

Within the Rhineland-Palatinate Research Initiative, which is to be continued until 2016, Johannes Gutenberg University Mainz intends to systematically forge ahead with its strategy of concentrating its resources in selected areas of research. There are three particularly outstanding research-intensive areas being pursued among the many at JGU that specifically define the profile of the university.

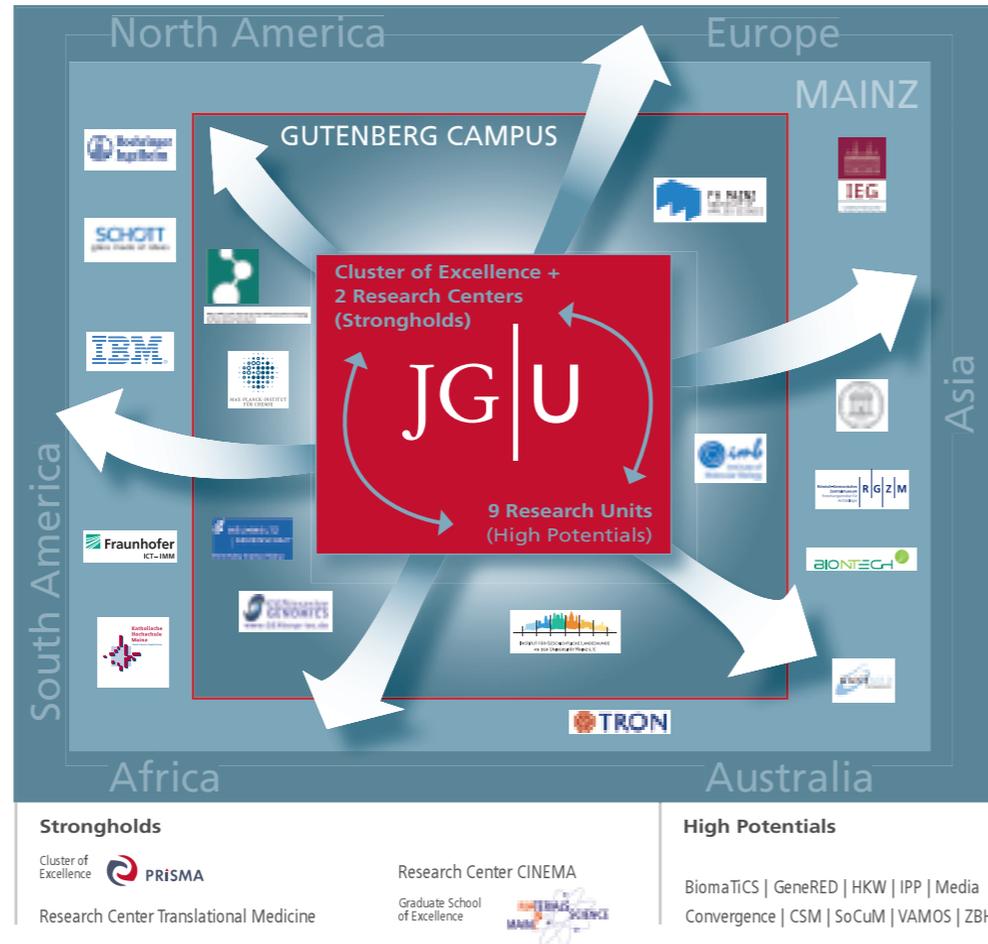
These are the PRISMA Cluster of Excellence and two research centers – one in the materials sciences (in close collaboration with the MAINZ Graduate School of Excellence) and one in translational medicine. In addition, the university is also providing targeted support to nine high-potential research units, including three new research projects. These core research areas receive total funding of EUR 8.5 million annually through the Rhineland-Palatinate Research Initiative.

In addition, Mainz University also provides a range of internal support instruments available to all JGU researchers through which backing for new projects and help with acquiring third-party funding can be obtained.



SCIENCE HUB MAINZ

- 2013 ■ **Mainz Institute of Microtechnology (IMM) integrated into Fraunhofer Society.** Mainz University collaborates closely with the IMM, which in future will be part of Europe's largest application-oriented research organization.
- 2012 ■ **Institute of European History (IEG) becomes Leibniz Institute.** Johannes Gutenberg University Mainz provides active support to the proposal to assimilate the Institute of European History in the Leibniz Association.
- 2011 ■ **ScienceCampus Mainz.** A project initiated by the Leibniz Association has resulted in the establishment of a unique platform for interdisciplinary Byzantine studies within an institutional framework that involves collaboration between the Roman-Germanic Central Museum (RGZM) and JGU.
- 2010 ■ **Institute of Translational Oncology (TRON) formed.** The purpose of TRON is to conduct research in the field of immunology with the aim of developing techniques that can be used in the diagnosis and treatment of tumor diseases.
- 2009 ■ **Helmholtz Institute Mainz (HIM).** The long-term collaboration between JGU researchers in the fields of particle and hadron physics and the Helmholtz Center for Heavy Ion Research (GSI) in Darmstadt leads to the foundation of HIM.
- 2009 ■ **Institute of Molecular Biology (IMB) founded.** With the support of a more than EUR 100 million donation from the Boehringer Ingelheim Foundation, the nucleus for a reorientation of the life sciences at JGU has been established.
- 2008 ■ **Max Planck Graduate Center with Johannes Gutenberg University Mainz (MPGC).** This newly established interdisciplinary graduate school is an outstanding example of innovative collaboration with non-university partners.



EN ROUTE TO INTERNATIONAL TOP-LEVEL RESEARCH

JGU's profile building efforts in science and research in the context of the Rhineland-Palatinate Research Initiative, started in 2007, are bearing fruit.

- The number of research institutes affiliated with Mainz University that are being co-financed by the German federal government has doubled. With the foundation of the Max Planck Graduate Center, the Helmholtz Institute Mainz, and the Institute of Molecular Biology, JGU has entered a new arena of institutional collaboration.
- Mainz University has achieved great success in the second round of the Excellence Initiative of the German federal and state governments. Three of its research centers were requested to submit full proposals for the establishment of clusters of excellence. In the end, the proposal for the Cluster of Excellence "Precision Physics, Fundamental Interactions and Structure of Matter" (PRISMA) was approved and it was agreed to prolong the funding provided to the Graduate School of Excellence "Materials Science in Mainz" (MAINZ). This means that Mainz University will receive additional financing of EUR 43 million (including overheads) supplied by the Excellence Initiative to 2017.

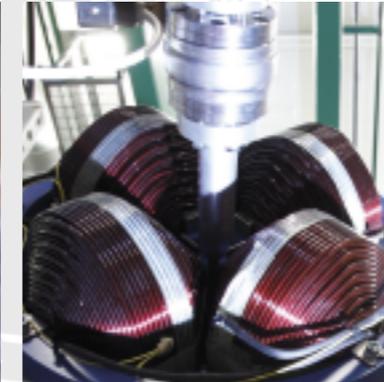
- In keeping with JGU's profile building strategy, more than 30 professorships have been established or reassigned over the past five years.
- In the period 2010–2013, JGU appointed 26 academics from outside Germany as professors; around half of them came from the USA. Of these appointments, around one in two related to the core research areas with the other half spread across the various disciplines at the university.
- The continuous improvement in JGU's research achievements since 2008 is evidenced by the number of coordinated research programs – 12 Collaborative Research Centers and 19 Research Units sponsored by the German Research Foundation (DFG) as well as 60 research networks financed by the EU and 93 research projects funded by the German federal government – and JGU's increasing success in the acquisition of third-party funding (expenditure of third-party funding in 2007: EUR 67 million; 2012: EUR 92.5 million).

JGU ON TOP!

In the current Funding Ranking of the German Research Foundation (DFG), JGU is in ninth place with regard to the acquirement of DFG third-party funding per professor in the natural sciences. JGU is even in first place in polymer research and in sixth place in physics.

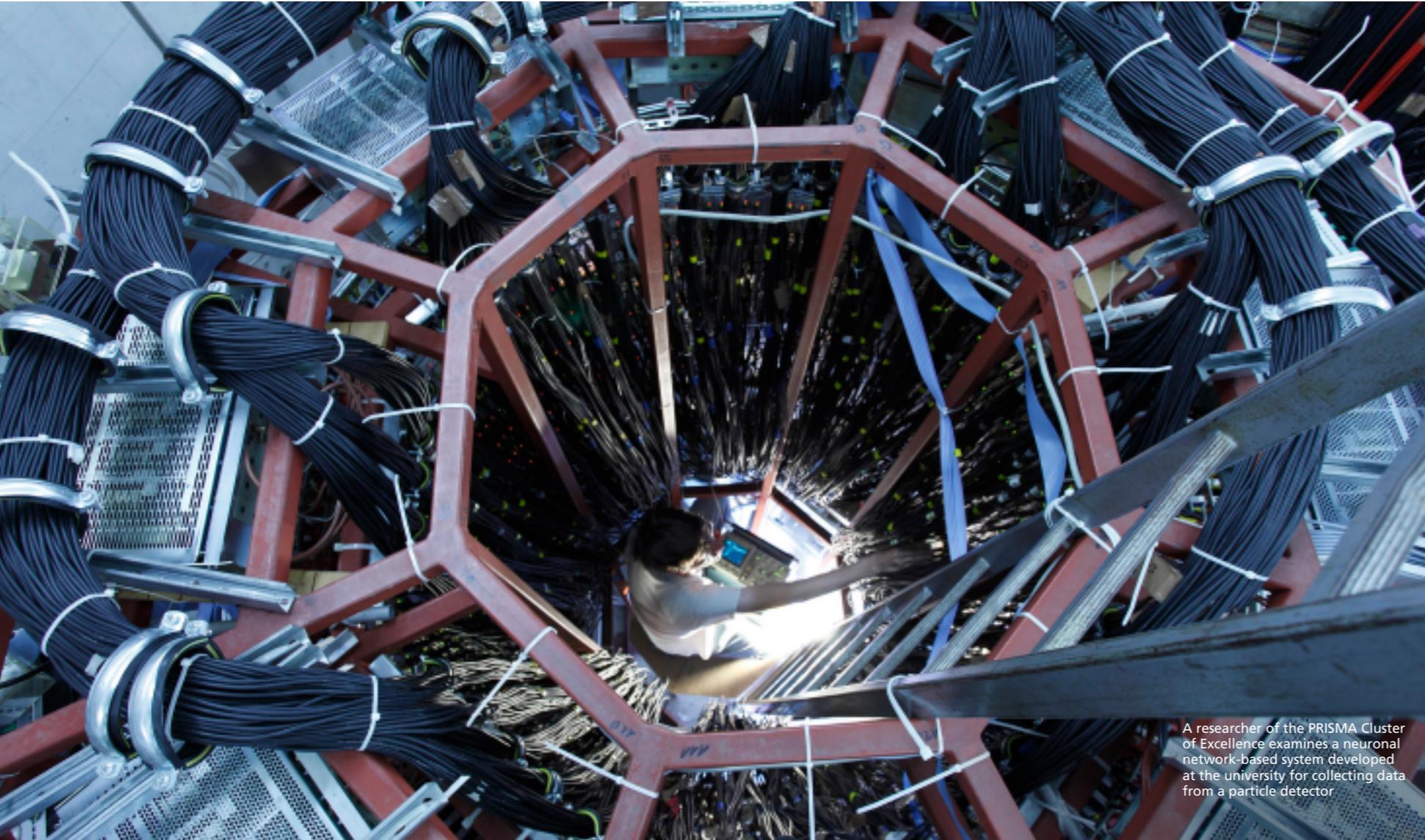
CLUSTER OF EXCELLENCE AND RESEARCH CENTERS

Focusing areas of top-level research: JGU's profile building within the context of the Rhineland-Palatinate Research Initiative 2014–2016 will concentrate on one cluster of excellence and two research centers as particular research strongholds, together with nine research units that exhibit particularly high potentials.



CLUSTER OF EXCELLENCE AND RESEARCH CENTERS AT JOHANNES GUTENBERG UNIVERSITY MAINZ

- Cluster of Excellence "Precision Physics, Fundamental Interactions and Structure of Matter" (PRISMA)
- "Center for Innovative and Emerging Materials" (CINEMA) in close collaboration with the Graduate School of Excellence "Materials Science in Mainz" (MAINZ)
- Research Center "Translational Medicine"



A researcher of the PRISMA Cluster of Excellence examines a neuronal network-based system developed at the university for collecting data from a particle detector

THE ORIGIN OF MASS

Decades of extensive experimental and theoretical research in the field of fundamental physics have produced a wealth of information on the origin of the universe and the structure of matter. The research being conducted worldwide in this area is concentrating on two core questions: What is the origin of mass? What phenomena might we encounter beyond the standard model of particle physics?

Researchers at JGU have for years been at the cutting edge of work being conducted in the fields of particle, hadron, nuclear, and atomic physics and are thus playing a major role in finding answers to these questions. As a result of their achievements, the proposal for the formation of the Cluster of Excellence "Precision Physics, Fundamental Interactions and Structure of Matter" (PRISMA) was approved in 2012. Participating in this cluster are also the Helmholtz Institute Mainz located on JGU's campus and the GSI Helmholtz Center for Heavy Ion Research in Darmstadt. The German Research Foundation will be providing a total of EUR 29 million to finance the activities of PRISMA until 2017. This funding will be used to promote research in the following four sectors:

- Precision measurements to establish the existence of previously unknown forces are at the core of the activities of the research area **Fundamental Interactions**. Searches for a hypothetical dark photon have been performed so far using the Mainz Microtron (MAMI). This search will be intensified with the aid of a new particle accelerator called MESA (Mainz Energy-recovering Superconducting Accelerator), which will complement similar work being undertaken with the Large Hadron Collider (LHC) in Geneva. The construction of MESA is a core structural initiative of PRISMA. In addition, there are plans to upgrade the source of ultracold neutrons at the TRIGA research facility (p. 14) and to establish an international user laboratory. Using this neutron source it should be possible, for example, to measure the lifetime of neutrons with extreme precision, which is crucial for determining the physics of fundamental interactions.

- The research area **Origin of Mass and Physics Beyond the Standard Model** is part of a larger international experimental activity investigating the physics of the Higgs boson and searching for new elementary particles. PRISMA researchers are not only playing a leading role in the analysis of LHC data, but are also significantly involved in the search for dark matter by participating, for example, in the XENON experiment based in the Gran Sasso underground laboratory in Italy and the IceCube neutrino experiment in the Antarctic.

THE MAINZ MICROTRON (MAMI) PARTICLE ACCELERATOR

The Mainz Microtron (MAMI) is an accelerator for electron beams with which it is possible to conduct precision experiments for investigating the structure of matter, in particular of protons and neutrons. The first stage of MAMI was constructed in the 1970s and has since undergone continuous development. It now occupies an area of 450 square meters and is the world's largest particle accelerator of the type known as racetrack microtrons. It generates a beam at an energy of up to 1.5 gigaelectron volt, which is controlled with the aid of four gigantic magnets that are each 5 meters across and 450 tons in weight. MAMI is operated by the researchers, engineers, and students of the Institute of Nuclear Physics at JGU.

CLUSTER OF EXCELLENCE PRECISION PHYSICS, FUNDAMENTAL INTERACTIONS AND STRUCTURE OF MATTER (PRISMA)

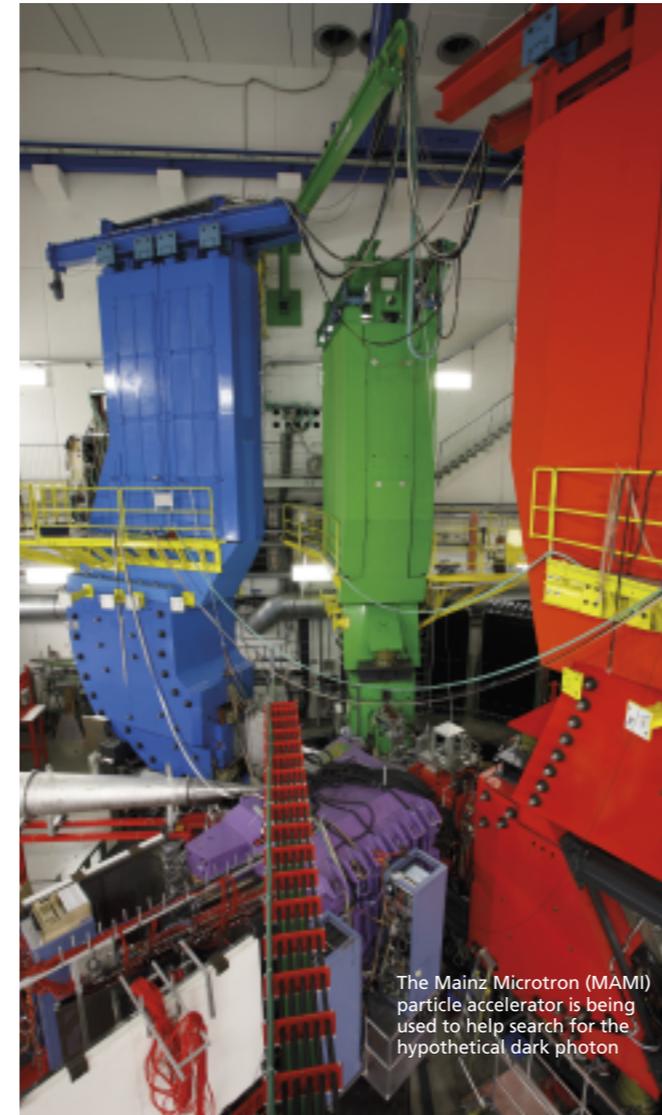
THE TRIGA REACTOR AT JGU

Construction of the TRIGA research facility at the JGU Institute of Nuclear Chemistry commenced in the 1960s, and its operation was initiated in 1967 by Nobel Prize laureate Otto Hahn. It is used purely as a research reactor and as a source of neutrons for experiments in various fields – from nuclear chemistry and fundamental physics through cancer research to the further development of solar cells. More than 30 TRIGA reactors are currently in operation worldwide. Although the maximum power output of JGU's reactor is relatively modest with an equivalent to about one 30,000th of that of a nuclear power plant, its range of scientific applications is wide. Due to the high demand, the reactor operates for some 200 days every year. The special feature of TRIGA reactors is their inherent safety: at an approximate temperature of 200 degrees Celsius, uranium fission ceases and the reactors automatically shut down.

- The objective of the research area **Structure of Matter** is to explore the internal structure of hadrons and atomic nuclei. Precision measurements undertaken using MAMI and the PANDA experiment at the future FAIR accelerator complex being built at the GSI Helmholtz Center for Heavy Ion Research are expected to provide important information in this regard. PRISMA researchers are extensively involved in the construction of the PANDA detector.
- The research area **Theoretical Concepts and Mathematical Foundations** is concerned with the development of new methods relating to quantum field theory, quantum gravity, string theory, and mathematical physics. As a central structure designed to provide additional support for theoretical research activities in all areas, the Mainz Institute of Theoretical Physics (MITP) was

founded under the aegis of PRISMA. Among its main responsibilities is the organization of scientific programs, workshops, and summer schools. Another task is to attract internationally renowned scientists to Mainz University for long-term research visits. It also provides an extensive training and support program aimed at doctoral students and postdoctoral researchers.

- PRISMA has established a central detector laboratory for the development and construction of innovative particle detectors at JGU to support the research being conducted at the university using the MAMI, TRIGA, and MESA research facilities and within the large-scale international projects. Similarly, the substantial expertise in the area of high-performance computing is to be extended via the collaboration with the Center for Computational Sciences (pp. 42–43) at JGU.



The Mainz Microtron (MAMI) particle accelerator is being used to help search for the hypothetical dark photon

NOTABLE ACHIEVEMENTS

Successful proposal for the establishment of the PRISMA Cluster of Excellence (worth EUR 29 million in funding), other major third-party funded projects, such as the Collaborative Research Center “The Low-Energy Frontier of the Standard Model: From Quarks and Gluons to Hadrons and Nuclei” (EUR 9.7 million), second funding period for the Research Training Group “Symmetry Breaking in Fundamental Interactions” (EUR 2.6 million), ERC Advanced Grant to Prof. Matthias Neubert (EUR 2.1 million)



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Researchers of CINEMA observing the self-assembly and reactions of organic molecules on an insulating surface with the aid of an atomic force microscope

NEW MATERIALS

There is a long-standing and very successful tradition of materials science research at Mainz. The achievements in this field by JGU and the nearby Max Planck Institute for Polymer Research (MPI-P) resulted, among other things, in funding of the Graduate School "Materials Science in Mainz" (MAINZ) in the first round of the Excellence Initiative in 2007. This success was again confirmed by further funding for MAINZ from 2012. In addition, many other materials science research networks were or still are coordinated by JGU, such as the DFG-funded Collaborative Research Centers "From Single Molecules to Nanoscopically Structured Materials" and "Nanodimensional Polymer Therapeutics for Tumor Therapy". Up to 2013, these activities were mainly initiated and coordinated by JGU's Research Center "Complex Materials" (COMATT). From 2014, the newly established Center for Innovative and Emerging Materials (CINEMA) will be the focal point for materials research-related activities with innovative funding schemes for high risk projects, interdisciplinary projects, etc. as detailed below. CINEMA was developed in response to the increasingly interdisciplinary nature of materials sciences. Therefore, CINEMA brings together research approaches for the development, production, and processing of new materials with a dedicated view on future applications. CINEMA has identified two particularly promising research areas, aiming at the establishment of two new Collaborative Research Centers funded by the German Research Foundation.

- The first of these areas deals with **soft matter**, which comprises materials like polymers and liquid crystals that cannot be directly assigned to a particular physical state such as solid or liquid. In this context, strategies are explored that allow for controlling non-equilibrium processes at the molecular level, thus creating new materials with tailor-made properties. Significant technical support in this area is provided by the Mainz Institute of Microtechnology GmbH (p. 8).
- The other area is that of **new 'hard' materials** made of crystalline solids that can have, for example, particular electronic or magnetic properties. Here CINEMA researchers aim at designing new materials based on the theoretical prediction of properties and providing synthesis guidelines for the development of material ranging from improved magnets to completely new states of matter.

CINEMA also contributes to the highly successful activities of JGU in the area of materials for biomedical applications. These activities have already led to the initiation of numerous joint projects involving JGU's various institutes of chemistry, the Mainz University Medical Center, and the Max Planck Institute for Polymer Research. As a result of these activities, the new Collaborative Research Center "Nanodimensional Polymer Therapeutics for Tumor Therapy" was granted in 2013.

NOTABLE ACHIEVEMENTS

Extended funding of the MAINZ Graduate School of Excellence (EUR 8.9 million), other third-party funded projects, such as the Collaborative Research Centers "From Single Molecules to Nanoscopically Structured Materials" (EUR 16.5 million) and "Nanodimensional Polymer Therapeutics for Tumor Therapy" (EUR 11 million)



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A doctoral candidate of the MAINZ Graduate School of Excellence using a femtosecond laser to measure a key property of a magnetic metal layer, the so-called circular dichroism

SUPPORT FOR YOUNG RESEARCHERS IN A CLASS OF ITS OWN

The Graduate School of Excellence “Materials Science in Mainz” (MAINZ) is a joint project of JGU, the University of Kaiserslautern, and the Max Planck Institute for Polymer Research located on the JGU campus. It provides for the training of internationally outstanding doctoral candidates in the field of materials research. Following the success of MAINZ in the first round of the German Excellence Initiative in 2007, more than 100 young men and women from around the world and from various disciplines, such as physics, chemistry, and biology, have acquired their doctorates in this program. MAINZ creates a unique potential for innovation by combining research from fields that are usually separated, namely **Model Systems and Correlated Matter, Functional Polymers, Hybrid Structures, and Biologically-inspired Materials**. With the approval of the extension proposal submitted in the second round of the Excellence Initiative in 2012, the research focus has shifted from mainly fundamental research to the synthesis and use of materials to obtain a useful functionality: Organic solar cells printed on clothing that supply the power for energy-saving multimedia devices or mobile phones, tiny medication capsules that release their contents precisely at that site in the body where the active substance will benefit the most, artificial photosynthesis

for technical applications in photovoltaic, as biosensors, or for optical set-ups – all these technologies developed by doctoral candidates at MAINZ can at some point in the future become part of our everyday lives. In order to provide its doctoral candidates with the necessary abilities to fill leading positions in science and industry, MAINZ provides them with tailored training in entrepreneurial skills. Here they benefit from the network that the Graduate School maintains with major industrial partners such as BASF, IBM, and Schott, which have recruited top researchers from MAINZ.

From its very inception, MAINZ has been involved in the internationalization process of JGU in order to increase the number of candidates from geographical origins which are a source for high potentials as well as to provide its doctoral candidates with the opportunity to conduct research at leading universities abroad. The current focus of MAINZ is on universities but also industrial research laboratories in the US and in Asia. MAINZ has already agreed on major collaboration projects with Seoul National University in South Korea, Tohoku University Sendai in Japan as well as Stanford University and the IBM Almaden Research Center in the USA.

NOTABLE ACHIEVEMENTS

More than 100 doctoral graduates; major third-party funded projects, such as the Humboldt Professorship for Jairo Sinova (EUR 3.5 million) and the BMBF-sponsored “SpinNet” network together with Tohoku University in Japan, Stanford University, and IBM Research Almaden (EUR 1 million)



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RESEARCH CENTER TRANSLATIONAL MEDICINE

RESEARCH CENTER IMMUNOLOGY (FZI)

RESEARCH CENTER TRANSLATIONAL NEUROSCIENCES (FTN)

CENTER FOR TRANSLATIONAL VASCULAR BIOLOGY (CTVB)

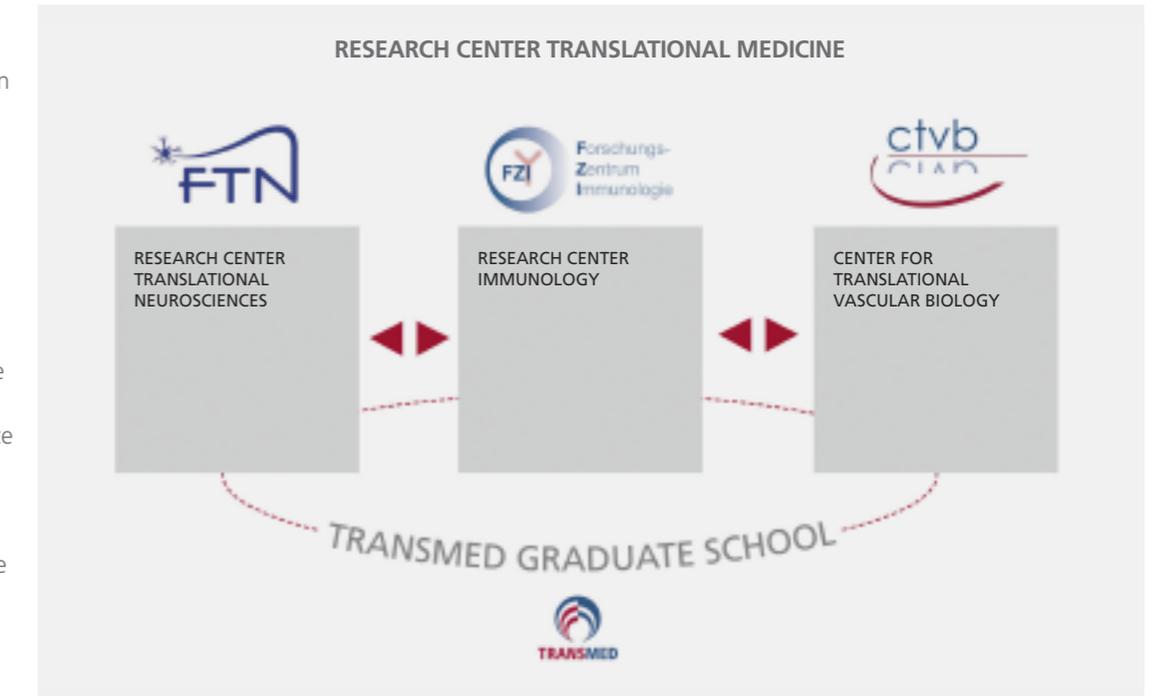


The Research Center Translational Medicine bridges the gap between theoretical and clinical research

FROM RESEARCH TO TREATMENT

From 2014, the present **Immunology Research Center (FZI)** and the two research units **Translational Neurosciences (FTN)** and Vascular Prevention at JGU will be united under one roof in the form of the Research Center "Translational Medicine". The previous Vascular Prevention Research Unit will in future be known as the **Center for Translational Vascular Biology (CTVB)**. The overall purpose – as suggested by the word 'translation' – is to bring theoretical and clinical research closer together for a more rapid conversion of theory into practice. The connecting link will be provided by the Graduate School "**TransMed**", in which research-oriented medical graduates work together with natural science graduates to undertake clinical research.

Each of the three institutions has its own technology platforms, which are to some extent already available for collaborative research. The intention is to further consolidate these platforms within the new research center.



THE IMMUNE SYSTEM AS THE CAUSE OF ILLNESS

Malfunctioning of the immune system can be the cause of a whole range of different disorders. It can be associated with an increased risk of infection or cancer, while overreactions to harmful substances or pathogens can lead to the development of allergies and autoimmune diseases. However, the complex processes involved in carcinogenesis and occurring during interactions between noxae or pathogens with the human body are still posing a wealth of problems to the researchers conducting theoretical and clinical research in the area of immunology.

The objective of the Immunology Research Center (FZI) at JGU is to better understand the underlying immunological processes and their role in the genesis of disorders and to use this insight to develop appropriate new treatment strategies. In the focus of this work will be the question of how patient individual factors contribute to disease progression and therapeutic success and how therapies can be appropriately individualized in view of this. The researchers involved decided to adopt this approach because the success of the latest generation of therapeutic strategies developed to rectify malfunctioning of the immune system in the presence of cancer can vary significantly, and the outcomes still differs greatly from patient to patient.

The FZI combines the expertise of a number of medical and non-medical institutions and facilities at JGU. The close interaction of preclinical scientists and

clinicians and their common interest in research with clinical relevance provides a unique atmosphere where the results that are generated in the laboratories can be directly used to develop new therapies. Research is supported by state-of-the-art technologies established within the FZI, including Next Generation Sequencing (NGS) and quantitative Mass Spectrometry (qMS). These techniques allow the identification of the hidden potential of yet unknown immunoregulatory mechanisms and also detect patient individual factors influencing the success of our therapeutic interventions. In all this, the FZI can rely on the input provided by the Cluster for Individualized ImmunIntervention (Ci3) sponsored by the German Federal Ministry of Education and Research (BMBF), the Translational Oncology (TRON) and the Cancer Immunotherapy (CIMT) spin-offs of the Mainz University Medical Center as well as by various research collectives funded by the German Research Foundation.

In addition, the Research Center Immunology also collaborates closely with non-university institutions, such as the two Max Planck Institutes (for Chemistry and Polymer Research) on the Gutenberg Campus, the Institute of Molecular Biology (IMB), which is also located on the JGU campus, Goethe University Frankfurt, and the Paul Ehrlich Institute in Langen. It facilitates the national and international exchange of information on immunological research and promotes young researchers through its "TransMed" Graduate School.



The objective of the Research Center Immunology is to better understand the role played by the immune system in the development of disorders and to use this insight to develop new therapeutic strategies

NOTABLE ACHIEVEMENTS

Major third-party funded projects, such as the BMBF-sponsored Cluster for Individualized ImmunIntervention (Ci3, EUR 40 million), the Collaborative Research Center "Nanodimensional Polymer Therapeutics for Tumor Therapy" (EUR 11 million), and the Transregional Collaborative Research Center "Initiating/Effector versus Regulatory Mechanisms in Multiple Sclerosis" (EUR 13.3 million divided amongst several universities), ERC Advanced Grant to Prof. Detlef Schuppan (EUR 2.5 million)



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CEREBRAL EQUILIBRIUM

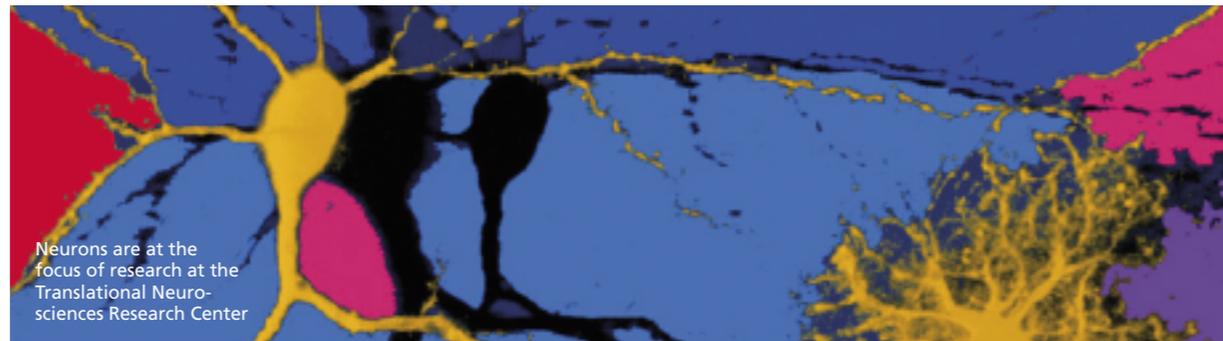
Many functional disorders of the brain can be attributed to impairment of so-called network homeostasis, in other words, of the brain's ability to counterbalance the inhibition and stimulation of neurons. This process plays a significant role in stress states and psychological illnesses. Many inflammatory cerebral disorders, on the other hand, are caused by an impairment of the structural and functional equilibrium of neurons and the glial cells that surround them. In recent years, considerable insight has been gained into these fundamental functional aspects. However, there is still much that is unclear with regard to the molecular and cellular processes that enable the nervous system to establish and maintain homeostasis and restore it following an adverse event such as inflammation.

Founded in 2010, the aim of the Translational Neurosciences Research Center (FTN) at JGU is to explore these processes and develop new therapies, and thus to contribute towards narrowing the gap between theoretical research and clinical applications in neuroscience. The FTN both consolidates and enhances the resources for neuroscience research at JGU, which focuses on the mechanisms involved in the neosynthesis of cerebral cells, the formation and stabilization of synapses between them, their processing of proteins, and the exchange of signals between them. To this end, its researchers are

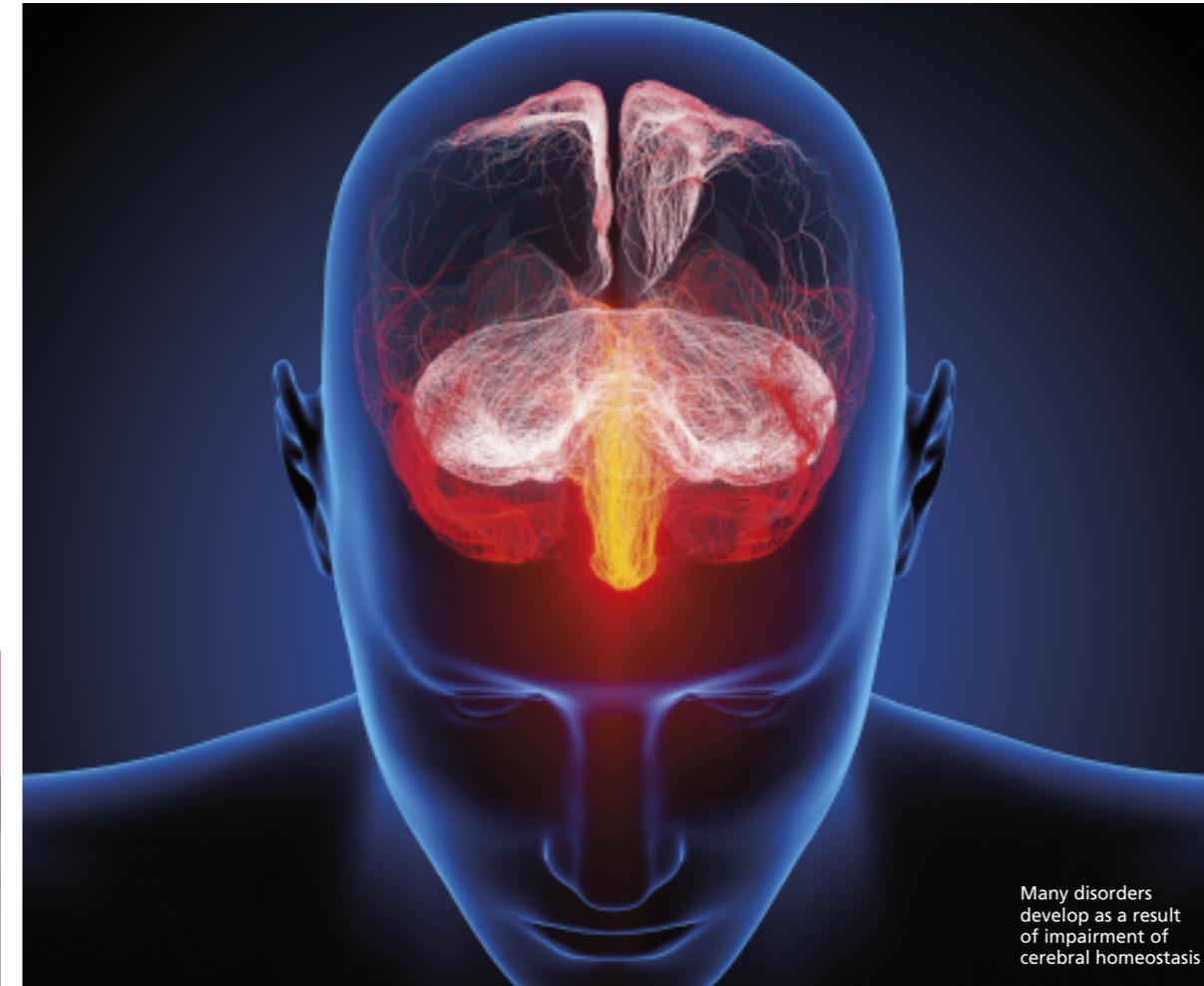
examining the molecules relevant to the control of interactions and signaling processes between cells. The work is currently focused within two research areas: **Establishment and Maintenance of Network Homeostasis in the Central Nervous System** and **Neuronal Homeostasis of the Central Nervous System – Challenges presented by the Immune System**. Core objectives are the determination of the resilience of the brain upon exposure to stress and research into multiple sclerosis, a disorder associated with inflammatory changes to the brain.

The FTN collaborates closely with various partners based in the Rhine-Main metropolitan region and, through its membership of the Rhine-Main Neuroscience Network (rmn2), maintains close ties with

the Institute of Molecular Biology (IMB, pp. 34–35) in Mainz, Goethe University Frankfurt, the Frankfurt Institute of Advanced Studies, the Ernst Strüngman Institute as well as the Max Planck Institute for Brain Research, which are also located in Frankfurt. Also part of the FTN are the Collaborative Research Center “Molecular and Cellular Mechanisms of Neural Homeostasis” and the Transregional Collaborative Research Center “Initiating/Effector versus Regulatory Mechanisms in Multiple Sclerosis – progress towards tackling the disease”. Thanks to its scholarships, its Graduate School “TransMed”, and its Research Training Group “Developmental and Disease-induced Modifications of the Nervous System”, the FTN is able to offer doctoral candidates an outstanding, high-quality support program.



Neurons are at the focus of research at the Translational Neurosciences Research Center



Many disorders develop as a result of impairment of cerebral homeostasis

NOTABLE ACHIEVEMENTS

Major third-party funding projects, including the Collaborative Research Center “Molecular and Cellular Mechanisms of Neural Homeostasis” (EUR 9.3 million) and the Transregional Collaborative Research Center “Initiating/Effector versus Regulatory Mechanisms in Multiple Sclerosis – progress towards tackling the disease” (EUR 13.3 million divided amongst several universities), ERC Advanced Grant to Prof. Robert Nitsch (EUR 2.5 million)



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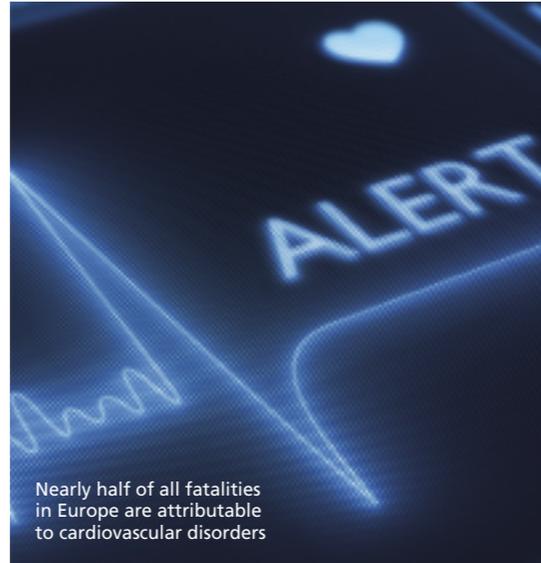
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CARDIOVASCULAR DISORDERS

Nearly half of all fatalities in Europe occur as the result of a cardiac or vascular disorder, such as myocardial infarction, stroke, arteriosclerosis, and thrombosis. Although there is currently a slight downward trend with regard to the mortality rate, it is expected that the incidence of disorders of this kind will actually increase in future because more and more people now live with the typical risk factors, including obesity and diabetes. There still is a need to significantly improve preventative measures and treatments in this area. One of the main problems, as in the case of other clinical indications, is the insufficient translational correlation of theoretical and clinical research, which results in a failure to develop new therapeutic approaches and effective prophylactic strategies. It is the aim of the Center for Translational Vascular Biology (CTVB) at JGU to offset this deficiency. Since 2007, it has provided researchers from various medical institutes with a basis for collaboration in interdisciplinary projects. The Graduate School "TransMed" provides the research center with the ideal platform for training the next generation of researchers.

One of the main projects being undertaken at the CTVB is the Gutenberg Health Study (GHS), a prospective cohort study that was launched in 2007. By 2012, some 15,000 subjects from a representative sample of the population in Mainz, Ingelheim, and



Nearly half of all fatalities in Europe are attributable to cardiovascular disorders

Bingen had been included in the study. The health status of the study participants will continue to be monitored to 2017. Particular attention will be paid to instances of myocardial infarction and deaths caused by it, but the incidence of cardiac arrhythmia, cancer, and depression will also be documented. The objective is to discover ways of better predicting the risk of illness in individuals and of developing individual measures that can be used for prevention and diagnosis. The strategic and structural orientation of

the CTVB is apparent not only through its GHS project, but is also demonstrated by the formation of its Center for Thrombosis and Hemostasis (CTH) in 2010 and collaboration with the German Center for Cardiovascular Research (DZHK) since 2011. It has already acquired more than EUR 35 million in third-party funding, which includes a Humboldt Professorship for Prof. Wolfram Ruf that is endowed with funding of EUR 5 million and sponsorship of EUR 3 million provided by Boehringer Ingelheim for the continuation of the Gutenberg Health Study. Other major and high-profile projects are currently in the process of development. A concept for a DFG-funded Collaborative Research Center is to be implemented in the near future. It is also planned to enhance expertise in the field of preventative cardiology, a core instrument that will facilitate investigations within the GHS.

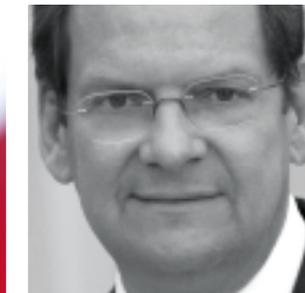
In coming years, the intention is to continue with the development of a new and holistic approach to cardiovascular disorders, which will systematically encompass theoretical research, prevention, and clinical treatment. For this purpose, a transregional network is to be established that includes other large-scale epidemiological projects in Germany, such as SHIP ("Study of Health in Pomerania") in Greifswald and KORA-Monica ("Cooperative Health Research in the Augsburg Region") in Munich.



One of the largest projects being undertaken by the CTVB is the Gutenberg Health Study with roughly 15,000 participants

NOTABLE ACHIEVEMENTS

Gutenberg Health Study with its more than 15,000 subjects; major third-party funded projects, such as the Center for Thrombosis and Hemostasis (EUR 20 million) and the German Center for Cardiovascular Research (EUR 5 million), Humboldt Professorship for Prof. Wolfram Ruf (EUR 5 million)

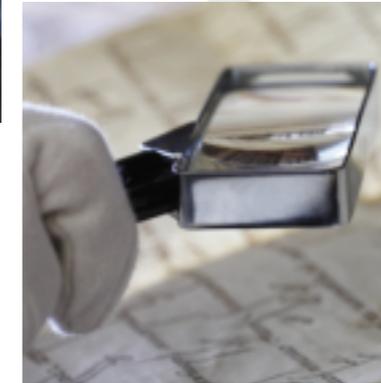
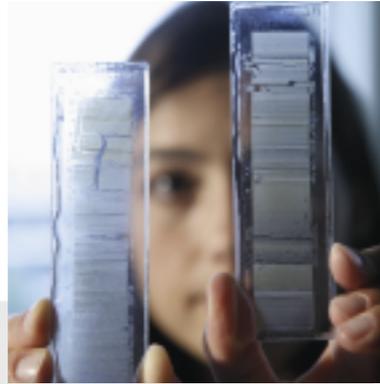


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RESEARCH UNITS



RESEARCH UNITS AT JOHANNES GUTENBERG UNIVERSITY MAINZ

- BiomaTiCS – Biomaterials, Tissues and Cells in Science
- Gene Regulation in Evolution and Development (GeneRED)
- Historical Cultural Sciences (HKW)
- Interdisciplinary Public Policy (IPP)
- Media Convergence
- Computational Sciences in Mainz (CSM)
- Social and Cultural Studies Mainz (SoCuM)
- Volcanoes and Atmosphere in Magmatic Open Systems (VAMOS)
- Center for Educational and Higher Education Research (ZBH)

REGENERATIVE MEDICINE

Artificial implants are today used in nearly all surgical contexts. Familiar examples are cardiac pacemakers, joint prostheses, and dental implants that act as artificial tooth roots. However, there are still problems when it comes to the way these interact with the human body as their efficacy can be impaired by inadequate or ineffective attachment or by rejection reactions caused by the body's immune system. This can also be the case for transplants that are not used to replace bone structures but act as substitutes for soft tissues, such as mucous membranes or blood vessels.

Over the course of recent years, a series of groups consisting of surgeons working in clinical fields and research at the University Medical Center Mainz have been formed to investigate the interactions between tissues and cells with exogenous materials in interdisciplinary projects. These collaborate closely with the materials scientists at JGU and the Max Planck Institute for Polymer Research based on the JGU campus. They also work with other national and international partners, including partners from industry. It can be assumed that as the average age of the population continues to increase, the importance of implants and the associated complications will grow in proportion. The plan is thus to develop the Research Unit "BiomaTiCS – Biomaterials, Tissues and

Cells in Science" to become an internationally prominent facility. The initial aim is to establish a corresponding research training group sponsored by the German Research Foundation.

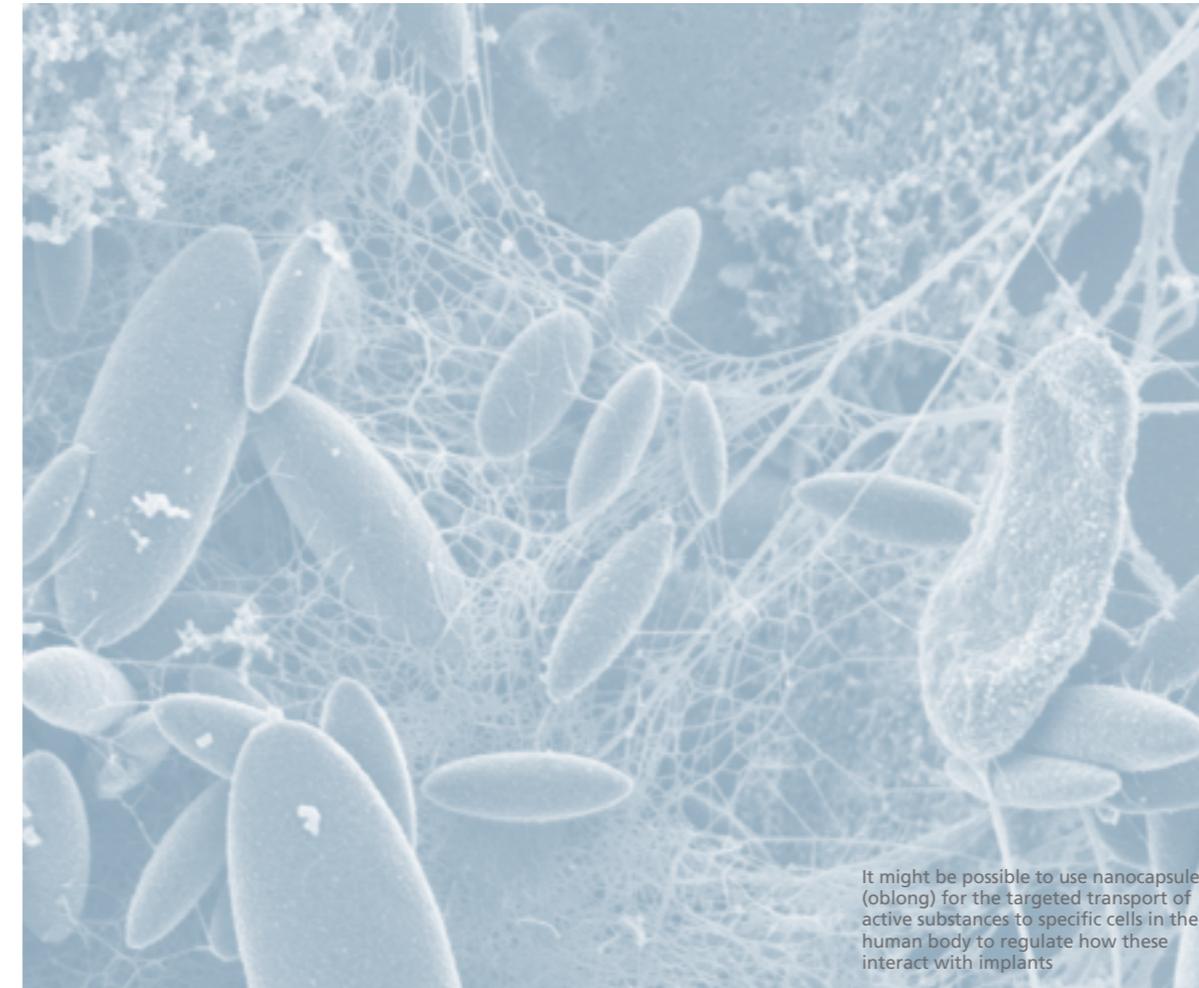
BiomaTiCS comprises three research areas: **Functional Replacements, Tissue Regeneration, and Responsive Systems**. In all three, an application-oriented approach to research is taken. This begins with analysis of the complications reported from medical practice. The expertise of the participating non-clinical work groups is then employed in order to find ways of avoiding these.

■ In the research field **Functional Replacements** the focus is on the investigation of the adhesion of proteins, cells, and tissues to implants designed to compensate for permanent functional defects. These implants include joint prostheses and dental implants. Materials that both enhance and reduce adhesion are investigated and modified accordingly. Unique in Germany is the use of insights obtained from research into marine organisms such as sea sponges, which are capable of highly organized processes of biomineralization.

■ The field of **Tissue Regeneration** looks at implants and materials that promote the healing of damaged

tissues and the growth of biological substitutes and that can be used, for example, for the reconstruction of ureters and blood vessels. These materials are not designed to be retained in the body but need to be either biodegradable in situ or be such that they can be removed on completion of the healing process without causing further injury.

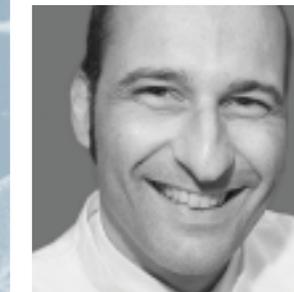
■ The objective of the research area **Responsive Systems** is to develop so-called intelligent materials that can adapt to changing physiological conditions in the body. This could involve, for example, the triggering of an antibacterial effect in response to elevation of the pH value. One approach being considered is the use of specific nanoparticles to provide implants with this kind of capability.



It might be possible to use nanocapsules (oblong) for the targeted transport of active substances to specific cells in the human body to regulate how these interact with implants

NOTABLE ACHIEVEMENTS

Major third-party funded projects, such as the EU programs "REPAIR-lab" (EUR 8.9 million) and "BlueGenics" (EUR 1 million), ERC Advanced Grant to Prof. Werner E. G. Müller (EUR 2.2 million); various patents



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THE LEADING DISCIPLINE OF THE 21ST CENTURY

Biology is regarded as the leading scientific discipline in the 21st century. Research into how the activity of genes is regulated is currently in the spotlight and will likely become more significant with time. Gene expression plays a central role in many biological processes, including the development of embryos, in many diseases, in the ageing process, the adaptation of organisms to their environments, and in evolution. Insights into gene regulation are also essential for stem cell research and regenerative medicine. The aim of GeneRED is to increase the number of research groups at JGU that investigate aspects of gene regulation with a view to establishing large network projects, such as Collaborative Research Centers funded by the German Research Foundation (DFG). Following the establishment of the Institute of Molecular Biology (IMB, pp. 34–35) on the JGU campus in 2011, it became possible to form the Research Unit “Gene Regulation in Evolution and Development” (GeneRED).

IMB has a number of very successful groups working in the field of gene regulation. Moreover, it has established an international PhD program (IPP) and an international summer school (ISS) with a focus on gene regulation. Groups from the Mainz University Medical Center and JGU’s Faculty of Biology are also involved in these initiatives. They thus represent an excellent basis for the collaborative activities that are required to make Mainz an internationally recognized center for research into gene regulation. The objectives of GeneRED are to increase the number of groups working in this field, to provide a sustained improvement of the research infrastructure in Mainz, and to foster further cooperation between JGU and IMB.



The genetic factors determining the division of labor among ants ...



... and so-called ancient DNA from prehistoric remains are only two aspects being investigated at the GeneRED Research Unit

NOTABLE ACHIEVEMENTS

Major third-party funded projects, including ERC Advanced Grants to Prof. Helle Ulrich (EUR 2.5 million) and to Prof. Christof Niehrs (EUR 2.4 million) and an ERC Starting Grant to Prof. René Ketting (EUR 265,000)



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RESEARCH UNIT GENE REGULATION IN EVOLUTION AND DEVELOPMENT (GENERED)
THE INSTITUTE OF MOLECULAR BIOLOGY (IMB)

EUR 150 MILLION FOR TOP-LEVEL RESEARCH

The Institute of Molecular Biology (IMB) on the JGU campus is a prime example of what can be achieved when the public sector and a private foundation collaborate. In 2010, to mark its 125th anniversary, the pharmaceutical company Boehringer Ingelheim decided to donate EUR 100 million through its non-profit Boehringer Ingelheim Foundation to sponsor IMB. This generous funding provides core funding over the institute's initial ten years of operation. The state of Rhineland-Palatinate financed the construction of the institute's building with another EUR 50 million. With its cutting-edge facilities and modern laboratories, IMB provides ideal conditions for top-level research. Currently, some 150 personnel, including biologists, biochemists, physicists, and computer scientists, work here hand in hand on interdisciplinary projects to find answers to fundamental questions relating to the life sciences.

Research at IMB focuses on three main fields: **Developmental Biology, Epigenetics, and DNA-Repair.**

■ The objective of investigations in **Developmental Biology** is to discover how genes control the complex processes involved in the development of a zygote into an adult organism. Since a disruption of this intricate process can result in disease, a bet-

ter understanding of the molecular mechanisms underlying embryonic development will also help develop new therapeutic approaches.

■ **Epigenetics** looks at how the activity of genes is controlled, in other words, how they are switched on or off in certain cells, and how genetic activity changes in diseases and ageing. New insights here could also result in the development of innovative drugs. A technique that allows activating anti-cancer genes that are switched off in tumor cells, for instance, would be a highly promising starting point for a new drug.

■ Research into **DNA Repair** has the aim of better understanding the physiological mechanisms involved in repairing DNA damage. Such damage can occur frequently, for example, when our skin is exposed to UV radiation. DNA damage can result in mutations, which in turn may lead to the uncontrolled growth of cells and thus to cancer.

In addition to these topics, researchers at IMB also develop new techniques and equipment, such as super-resolution light microscopes. These make it possible to see biological structures at a scale no human has ever been able to observe before.

Scientists at IMB also use mathematical models and

computer simulations to mimic and thus better understand how hundreds of proteins cooperate within a single cell.

Emphasis is also placed on training and mentoring junior researchers, for example through IMB's international PhD program and summer school, which focus on the topic of "Dynamics of Gene Regulation, Epigenetics and DNA Damage Response". As these programs also involve the participation of groups from JGU's faculties of Medicine and Biology, they also provide input for the new Research Unit "Gene Regulation in Evolution and Development" (pp. 32–33) at Mainz University.



The IMB building located on the JGU campus

NOTABLE ACHIEVEMENTS

Initiation of an international PhD program and an international summer school focusing on "Dynamics of Gene Regulation, Epigenetics and DNA Damage Response"; major third-party funded projects, including ERC Advanced Grants to Prof. Helle Ulrich (EUR 2.5 million) and to Prof. Christof Niehrs (EUR 2.4 million) and an ERC Starting Grant to Prof. René Ketting (EUR 265,000)



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WHAT IS REALITY?

How do people perceive reality? Or, more pertinently in this context: How did people perceive reality in the past? This is the question that is at the core of the work being undertaken by the Research Unit "Historical Cultural Sciences" (HKW) at JGU. It came into being in 2008 and brings together nearly all the disciplines at the university that deal with historical aspects – from classical and ancient studies, musicology, art history, literature, and linguistics through history, philosophy, and theology to the history, theory, and ethics of medicine. The specifically historical approach is derived from the insight that current phenomena and problems have historical roots and can be better understood from their analysis.

The materials researched and fields explored by the "Historical Cultural Sciences" Research Unit are as varied as the disciplines collaborating within it; they range from antique coins through medieval documents to 20th century Eastern European literature. The fundamental concept is based on an interdisciplinary approach: it is through a comparative analysis of various historical epochs in different parts of the world that the researchers gain greater insight into contemporary societies. Another central concept involves the continuing reassessment of methodologies employed. One of the purposes of this is to determine whether techniques developed within specific disciplines, such as narratology, can also be



The research material employed by the Historical Cultural Sciences Research Unit at JGU is particularly diversified. Among other things, antique coins ...

employed in other areas. The activities of this research unit are diverse. It initiates joint projects, provides advice, support, and financial help to researchers, contributes to and organizes conferences as well as workshops. In the national and international arenas, it collaborates with various partners, including the Roman-Germanic Central Museum and the Institute of European History (both based in Mainz), the Research Center for Historical and Cultural Studies in Trier, the International Research Center for Cultural Studies in Vienna, Austria, the Institute for Cultural History at the University of Turku in Finland, and the Center for Early Modern Studies in Aberdeen, Scotland.

The Research Unit "Historical Cultural Sciences" also collaborates with JGU's Gutenberg Research College (GRC, pp. 6–7) to invite excellent external researchers to Mainz. Through its Young Cultural Sciences Forum, it also provides young researchers with the ideal opportunity to form contacts within the established academic network. More than 70 young scholars are already members of this forum. Through its work, the research unit contributes significantly to the international prominence and the profile building of the cultural sciences at JGU. It also issues its own series of publications under the title *Mainzer Historische Kulturwissenschaften* that plays a major role in achieving the above mentioned objectives.



... and medieval documents are studied

NOTABLE ACHIEVEMENTS

DFG-financed Research Training Group "Early Concepts of Man and Nature" (EUR 2.8 million), DFG-financed Schlegel Edition Center (EUR 400,000), research project "Dynamics of Cultural Transfer in Europe 1500-2000" (in collaboration with the University of Turku/Finland), financed by the German Academic Exchange Service (DAAD); publication series *Mainzer Historische Kulturwissenschaften*



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UNDERSTANDING AND IMPROVING INSTITUTIONAL AND INDIVIDUAL DECISION-MAKING

Public institutions can only use their various policy instruments productively if they are able to adequately assess the effect they have on human behavior. Thus, the design of effective institutions and policies requires not only an understanding of the relevant and often interdependent social, economic, political, and legal contexts and mechanisms, but it also requires a deep knowledge about how human beings make decisions. In order to obtain the necessary insights, the Research Unit "Interdisciplinary Public Policy" (IPP) constituted at JGU in 2014 incorporates a number of different disciplines: economics, business administration, political science, psychology, the neurosciences, computer science, and law.

The IPP focuses on the following main questions: Under what circumstances should public institutions actively intervene in socio-economic systems? What form should this intervention take, e.g., environmental legislation, interest rate adjustments, measures to promote innovation or education? What would be the effects of intervention in the various forms? Would it really be possible to implement the intended changes in view of the given political/institutional situation in a state or a region? In order to find answers to these questions, it is necessary to conduct theoretical research into the economic, socio-psychological, and neurobiological mechanisms that determine human

decision-making and to undertake practice-oriented projects to investigate the effects of the specific policy measures under study.

The IPP Research Unit consists of the following four clusters:

- **Economic Policy:** Some markets function well on national and global levels with only little bureaucratic regulation, while others require stricter controls. One of the core concerns in this cluster is to find the correct balance between self-regulation and government control.
- The **Behavioral Science** cluster studies the factors that determine human behavior, i.e., psychological and neurobiological parameters, such as personality, neuronal predisposition, and also the influence of social networks. If these aspects are considered, it is possible to better predict not only individual determinants, such as educational and professional status and investment behavior, but also the functioning of markets.
- The **Political Science** cluster examines the room for maneuver available to governments of national states in the economic and socio-political spheres in the light of globalization.

- The capacity to process and evaluate large sets of data and expertise with regard to the use of innovative methods from the fields of Statistics, Econometrics, and Computer Science are an essential requirement for the work of the IPP Research Unit. This requirement is provided for through the **Data Science** cluster.

Innovative methods of data generation and analysis are the core cross-disciplinary skills available to the research unit. Quantitative and empirical methods as well as an approach inspired by experimental methodology used in the natural sciences not only link the research unit to other disciplines, but also represent a unique feature. The IPP Research Unit is also characterized by a number of features that have been systematically created in recent years. This includes collaboration with the Graduate School of Economics, Finance, and Management established in cooperation with the universities of Frankfurt and Darmstadt, innovative Master's degree programs offered by the JGU faculties participating in the IPP Research Unit, and a very active visiting academic program inviting prominent guests to Mainz.



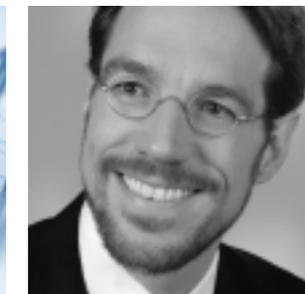
What room for maneuver do governments of nation states have in view of globalization ...



... and how exactly do human beings make decisions? Both these aspects are at the focus of the work undertaken by the IPP Research Unit

NOTABLE ACHIEVEMENTS

Third-party funding for the project "KIDS-WIN: Enhancing Cognitive and Motivational Skills in Children. A Large-scale Field Study with Primary School Children" (EUR 490,000), DFG-funded projects "Reward Expectation and Reinforcement Learning: Status-dependence and Diagnostic Specificity" (EUR 330,000) and "Financial Contagion Through Market Prices – Theory and Evidence" (EUR 184,000)



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SOCIAL CHANGES AND MEDIA TRANSFORMATION

The technical convergence of the media that began in the 1990s – the fusion of text, image, and sound – and the increasing use of interactive media have resulted in a rapid social and cultural transformation. The purpose of the Research Unit “Media Convergence”, originally formed in 2007 at JGU, is to study the social, legal, and economic effects of this development. JGU offers a uniquely comprehensive range of media disciplines (Book Studies, Film Studies, Theater Studies, Communication Studies, and Journalism). For the research unit, these have joined forces with the media-relevant cross-disciplinary subjects at Mainz University (Media Law, Media Education, Media Economics, Media Psychology, Neurolinguistics, and Psychosomatics). All of these disciplines also collaborate with the Mainz School of Music and, where appropriate, with the media disciplines at the Mainz University of Applied Sciences and with the members of an established network of organizations active in the field as well, i.e., regional broadcasters, publishers, and other media groups, such as the German public broadcasters ZDF, SWR, 3sat, and HR, the newspapers Frankfurter Allgemeine Zeitung and Frankfurter Rundschau as well as the German Publishers and Booksellers Association and the German National Library.

The Research Unit “Media Convergence” organizes various regular events, such as the MainzMediaForum that brings together academics, politicians, and representatives of the media world from Germany and abroad to discuss media-related issues with the public. The research unit is also responsible for coordinating expert hearings, workshops, and international conferences, the results of which are communicated through its publication and e-book series *Medienkonvergenz/Media Convergence*. For the purposes of knowledge transfer, the research unit also works extensively with the Zukunftsinitiative Mainzer Medienwirtschaft, which is a body whose members consist of representatives of the Chamber of Industry and Commerce, SWR, the Verlagsgruppe Rhein-Main publishing group, ZDF, the state chancellery, and the City of Mainz.

Over the period 2014–2016, the plan is to focus on three research fields: **Media Innovations**, **Media Diversity**, and **Social Transformation Processes**. In the Media Innovations field, the ongoing development of new communication structures within social media and changes to forms of media and usage will be considered. The research field Media Diversity will look at the question of how diversity of media and

opinions can be safeguarded in the era of the Internet. An assessment of the role that public service broadcasters and their online services should play in future belongs to this field as well. In the Social Transformation Processes field, the researchers intend to review the consequences of media convergence for the social and cultural sectors, with a special emphasis on education. The focus will be on how to use digital media effectively in schools and the requirements that need to be met to ensure that media and Internet skills are widely disseminated throughout society.



Communication structures undergo continual change in the presence of social networks

NOTABLE ACHIEVEMENTS

Major third-party funded projects, such as the BMBF-sponsored research group “Neuroenhancement: Between Standardized Knowledge Transfer and Unintended Consequences” (EUR 720,000), the DFG project “From Newsworthy to Discussion-worthy” (EUR 220,000), the DFG application of “Future Publications in the Digital Humanities” (together with the Humboldt University Library in Berlin, EUR 280,000), and the DFG network “Young Scholars Network on Well-Being and Media Use” (EUR 42,000); publication series *Medienkonvergenz/Media Convergence* (also available as e-books) produced by the publisher de Gruyter



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COMPUTER SIMULATIONS

It is increasingly the case that experimental setups are found to be inadequate for the task of depicting the kind of complex systems that are currently being studied in the natural sciences so that researchers now more frequently resort to the use of computer simulations. This is taking place in fields like nuclear and particle physics, chemistry, the materials sciences, genome research, population biology, climate research, and earth system science. Corresponding research not only includes aspects of numerical simulations and the development of necessary hardware and software, but more fundamentally the question whether at all and how the quantities of interest can be computed and what means of interpretation and visualization of the generated data are appropriate. These are the topics that are the concern of the Research Unit “Computational Sciences in Mainz” (CSM) that was established at JGU in 2008. It promotes interdisciplinary research projects between the fields of Computer Science and Mathematics on the one hand and the fields of Physics, Chemistry, Biology, and Geosciences on the other. It also works closely with the two Max Planck Institutes (for Chemistry and Polymer Research) and the Institute of Molecular Biology (IMB, pp. 34–35), all based on the JGU campus. The resultant interactions provide researchers with the opportunity to combine established approaches used in their own disciplines with differing methods used in related

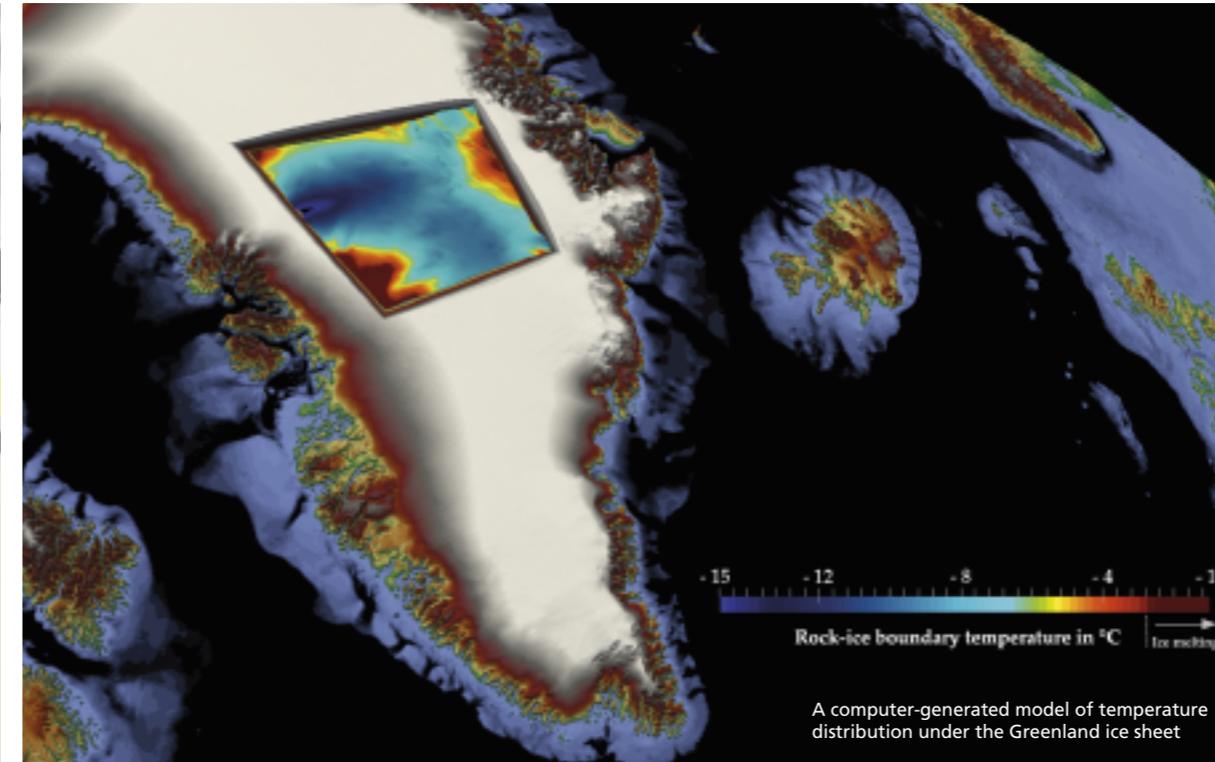
fields, the objective being to overcome obstacles and acquire new insights.

Many of the projects undertaken by the CSM Research Unit have attracted major third-party sponsorship. The Carl Zeiss Foundation has agreed to fund the research structure program “Material Design” and a junior research group on “Computer Simulations in the Materials Sciences”. In addition, CSM played a significant role in the application process relating to the acquirement of the MOGON high-performance computer.

The Research Unit “Computational Sciences in Mainz” also made valuable contributions to all the proposals submitted by JGU as part of the Excellence Initiative. Various CSM members including one of the junior research groups in each case are also integrated in the PRISMA Cluster of Excellence (Particle and Hadron Physics, pp. 12–15) and the MAINZ Graduate School of Excellence (Materials Science, pp. 18–19). One of the strengths of this research unit is its program for the sponsorship of young researchers. A total of three junior research groups have been established to date and another is to be formed in the next three years that will specialize in the field of bioinformatics. CSM has also been offering an interdisciplinary postgraduate program since 2013.



The MOGON supercomputer at JGU is among the 100 fastest computers in the world



A computer-generated model of temperature distribution under the Greenland ice sheet

NOTABLE ACHIEVEMENTS

Major third-party funded projects, including an ERC Starting Grant to Prof. Boris Kaus (EUR 1.2 million), the Carl Zeiss structural program “Material Design: Inverse Design with Defined Properties” (IDEE) (EUR 1 million), and the Carl Zeiss junior research group “Computer Simulations in the Materials Sciences” (EUR 400,000)



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FROM INDIGENEITY RESEARCH TO THE EUROZONE CRISIS

The social and cultural sciences at Johannes Gutenberg University Mainz comprise a variety of fields and subjects, each using its own specialist terminology and having its own theories and methodologies. These range from Sociology, Political Science, Communication Studies, and Education through Anthropology and Cultural Studies to Theater Studies, Literature, and Linguistics. The purpose of the Research Unit "Social and Cultural Studies Mainz" (SoCuM), which originated at JGU in 2008, is to tap the immense potential for innovative interdisciplinary research that results from cross-fertilization between these disciplines. For this purpose, promising research concepts are promoted by SoCuM in the form of work groups which are provided with the funding they need for submitting a successful proposal for a third-party funded cooperative project. SoCuM thus acts as an umbrella organization for promising research projects that transcend the boundaries between social and cultural sciences. A long-term dialog between the social and cultural sciences at Mainz University has been established with the help of regular interdisciplinary events, such as the annual Georg Forster Lectures and the biannual Mainz Social and Cultural Studies Symposium.

SoCuM is currently fostering five work groups. They deal with subjects ranging from theoretical research into the evolution of social and cultural differences

to indigeneity research at the international level and the socio-cultural effects of the Eurozone crisis. The success of the projects being undertaken under the aegis of SoCuM is demonstrated by the numerous publications of its members that have appeared in eminent journals and the acquirement of third-party funding of some EUR 4.7 million in 2012.

Among SoCuM's most ambitious future projects is the establishment of a new research institute, the Institute for Transnational American Studies (ITAS) designed to promote American Studies in Mainz. The institute is built on American Studies research at Mainz University, which was awarded a top grade evaluation in the research sector by the German Council of Science and Humanities in 2012, the only institute of this kind in Germany to receive this accolade apart from the Kennedy Institute in Berlin. The planned institute will usher in a new era of interdisciplinary North American Studies at Mainz University and will achieve prominence beyond national boundaries. It will consolidate the research being conducted in the field at the university, for instance in the area of life writing, where in cooperation with medicine and the life sciences funding has already been obtained for a Research Training Group supported by the German Research Foundation. ITAS will collaborate closely with a variety of disciplines at Mainz University, among them Cultural Geography,



Law, Canadian Studies, Caribbean Studies based in Gernersheim, as well as with the Atlantic Academy in Kaiserslautern. It will also incorporate the fields of transatlantic studies, studies of American-European relationships, Asia-Pacific studies, and studies of American-Asian-Australian relationships.



NOTABLE ACHIEVEMENTS

Major third-party funded projects, including the DFG-funded Research Unit "Un/Doing Differences. The Processes of Human Differentiation" (EUR 1.8 million); visits of internationally renowned academics to offer the Georg Forster Lectures, among them Fredric Jameson and Bruno Latour



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VOLCANISM AND ITS CONSEQUENCES

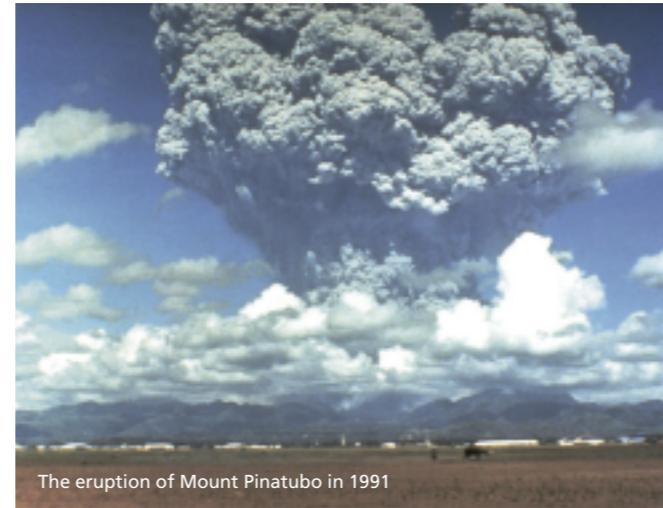
More than 500 million people live in areas dominated by active volcanoes and are thus at risk of exposure to the effects of the solid rock or lava, ashes, gases, and acids that these discharge when they erupt. On the other hand, many of those living in such regions also benefit from the fertile soil that is the residue of such eruptions. Volcanism is something that actually has an impact on the whole of humanity since the eruptions of active volcanoes not only have an effect on the landscapes surrounding them but also influence the climate. To give an example, sulfur emissions produced during the eruption of Mount Pinatubo in the Philippines in 1991 resulted in a fall in temperatures worldwide. The origin of volcanic eruptions is to be found deep within the Earth. Volcanoes are ruptures in the crust of the Earth that allow lava and gases to escape from subterranean magma chambers and thus are a critical influence on the atmosphere. As yet, the fundamental mechanisms that are involved in the formation of magma and gases, their transport, and the composition of the resultant volcanic plumes are still largely unknown.

The purpose of the Research Unit "Volcanoes and Atmosphere in Magmatic Open Systems" (VAMOS) at JGU is to explore, quantify, and, where possible, predict the chemical and physical processes that cause volcanoes and their magma chambers to

erupt into the atmosphere. In addition, VAMOS explores the environmental effects that volcanoes are likely to have on the areas where they are located. For this, the researchers will model the formation and movement of magma under the Earth's crust and construct theories relating to the origin of eruptions. The generation of magma in the presence of high pressures and temperatures and its crystallization will be simulated in the laboratory to clarify why most magma remains below the Earth's crust and does not come to the surface in eruptions. Another aspect to be considered is the effect of the volatile substances produced during eruptions on the atmosphere. The larger the amount of volatile substances emitted, the greater and more far-reaching are the interactions with the atmosphere.

VAMOS is an outgrowth of the previous "Geocycles" Research Center at JGU. The new research unit will provide for synergies through interactions between the fields of Petrology, Geochemistry, and Geology and ensure their profile is enhanced through consolidation. In addition, the existing infrastructure and the aim of providing its students with future-oriented qualifications will be at the center of considerations.

One of the first objectives of VAMOS is to prepare for the submission of a proposal to the German



Research Foundation for the funding of a major collaborative research group. Much of the groundwork for this will be put in place by means of a special young researchers program for postgraduates. An international research training group is to be constituted in the near future.



NOTABLE ACHIEVEMENTS

Major third-party funded projects, including an ERC Starting Grant to Prof. Boris Kaus (EUR 1.4 million); Pius XI Gold Medal of the Pontifical Academy of Sciences to Prof. Ulrich Pöschl, Paul Niggli Medal of the Swiss Society of Mineralogy and Petrology to Prof. Boris Kaus



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THE TRANSFER OF KNOWLEDGE

How is knowledge disseminated and shared with relevant groups? What is education? What role do institutions such as schools and universities play in education? And what effect do social change and mobility have on these institutions? These and other questions are at the core of the activities of the Center for Educational and Higher Education Research (ZBH) at JGU. Formed in 2006 on the initiative of Prof. Franz Hamburger and funded since then by the state of Rhineland-Palatinate, the research unit promotes interdisciplinary projects in theoretical and applied research in the field of Higher Education, including lifelong learning and learning beyond and across institutions. The ZBH also undertakes contract research. Among other things, it has been commissioned by the Ministry of Education of Rhineland-Palatinate to investigate to what extent the education provided to school students is determined by the social and economic status of their parents.

The ZBH brings together various institutions and disciplines, including Education, Psychology, Sociology, and JGU's Center for Quality Assurance and Development, each with their specific methodological approach. In order to combine didactics in various fields with empirical research, the research unit has established a Teaching Methodology interest group. The ZBH also collaborates closely with the Economics and Business Education division and the Institute of Occupational, Social, and Environmental Medicine at JGU. The aim of this network is to define and actively develop joint projects in overlapping fields. One outstanding example is the research project on "Evidence-based Intervention in the Multi-level School System" (EviS), for which the German Federal Ministry of Education and Research provides funding of EUR 575,000.

The ZBH also plans to establish a research training group to promote young researchers in the discipline. In view of the fact that higher education research has received little attention to date in Germany, the ZBH put in place a junior professorship pertaining to the field. Dr. Johannes Angermüller was appointed to the post. He successfully submitted a proposal for an ERC Starting Grant worth EUR 1.5 million.

The work of the ZBH focuses on the following four areas:

- **Transfer and acquisition of knowledge**
- **Points of transition and selection in educational pathways**
- **Governance in educational institutions**
- **Professional development** of teachers and faculty in schools and in higher education.



How can digital media be used in education? This is one of the aspects investigated by the Center for Educational and Higher Education Research

NOTABLE ACHIEVEMENTS

Major third-party funded projects, such as EviS (EUR 575,000) and WiwiKom (EUR 389,000), ERC Starting Grant to Junior Prof. Johannes Angermüller (EUR 1.5 million)



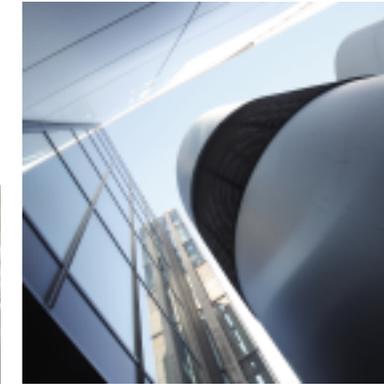
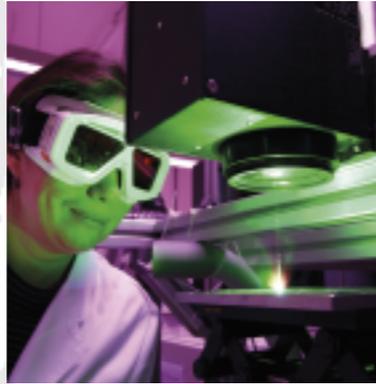
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CROSS-SECTIONAL TASKS AND INFRASTRUCTURE

- Promotion of young academics
- Technology Transfer
- The Gutenberg Campus



PATHS INTO SCIENCE

Johannes Gutenberg University Mainz considers the promotion and mentoring of young research talents as one its core tasks. Some 600 young academics acquire doctorates at JGU annually; 51 percent of them are female. In addition to this, about 35 academics obtain postdoctoral lecturing qualifications every year and about 50 are appointed to junior professorships. There are also eleven independent, third-party sponsored junior research groups. In addition to individual doctoral studies, Mainz University offers a range of interdisciplinary structured programs for young researchers that provide support during the doctoral as well as the early and late postdoc phases.

These include:

- The Gutenberg Academy for Young Researchers, which provides an exclusive mentoring program for the top 25 students and young artists at Mainz University.
- A great variety of courses in which key skills can be acquired and consolidated as well as measures to support networking, career planning, and a successful entry into professional life.

- Special qualification opportunities for doctoral candidates that take account of new developments in their fields and related disciplines.
- Carefully designed gender equality measures tailored to the various career phases of young female academics.

In addition to these interdisciplinary structured programs at JGU, there are also numerous third-party sponsored programs for postgraduates, such as the Graduate School of Excellence "Materials Science in Mainz" (MAINZ, pp. 18–19), the Max Planck Graduate Center with JGU, numerous research training groups financed by the German Research Foundation, internally sponsored graduate schools in the fields of social sciences and the humanities, and the International Max Planck Research Schools.

The successful JGU measures and mentoring programs for doctoral as well as for postdoctoral students and those striving for a postdoctoral lecturing qualification are catered for by the Gutenberg College for Young Researchers (GNK). Established as an expert body under the Excellence Initiative of the German federal and state governments, the Gutenberg College for Young Researchers provides for the structuring and communication of existing funding

formats as well as for the development of new ones. Specific tasks of the GNK are the sustainable improvement of the working conditions and mentoring situation of young researchers and the provision of individually tailored support services.

The GNK aims to develop further options for young academics that will provide support in the specific phases of their careers.

GNK



JGU offers young researchers a wealth of different courses to obtain key qualifications

JGU ON TOP!

In its core research areas, Mainz University is an internationally recognized and globally competitive workplace for young researchers from Germany and abroad. At JGU, they find the freedom and infrastructure they need to undertake their research and develop long-term professional prospects. This is confirmed by the rankings given to JGU postgraduate training programs in chemistry and physics by the Center for Higher Education (CHE), which classify these disciplines in the Excellence Group of the best European universities.

PATHS INTO BUSINESS

From research to application, from concept to company: scientists at Johannes Gutenberg University Mainz cooperate successfully with businesses and organizations of all sizes and sectors – regionally, nationally, and globally. Bilateral projects between firms and individual institutes at the university play an important role here as does participation in joint projects with various partners from research and industry.

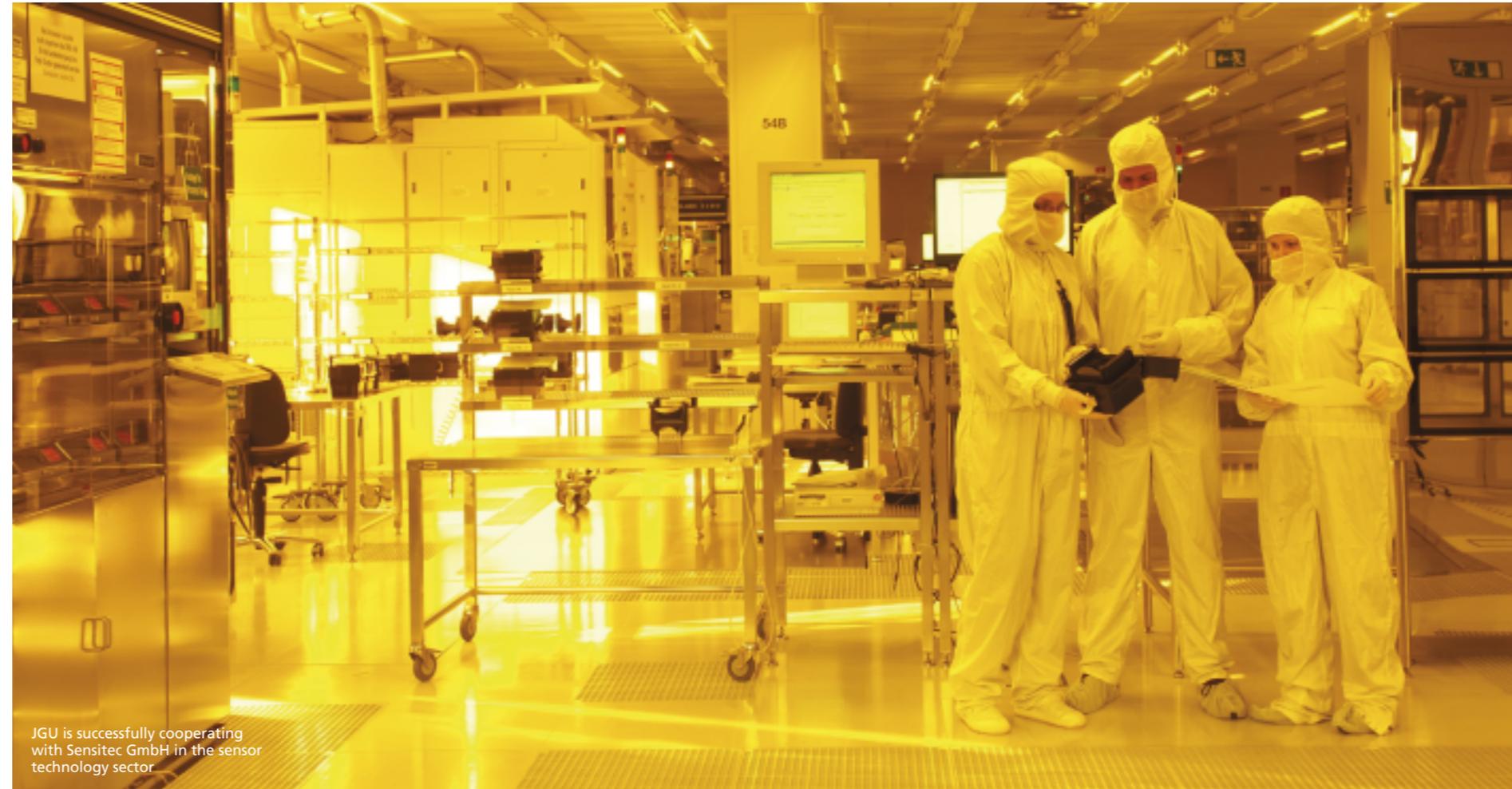
The collaboration with industry provides Mainz University with the opportunity to acquire additional third-party research funds. In 2012, for example, JGU obtained third-party funding to the tune of nearly EUR 25 million solely through collaborations with industrial companies.

JGU is head of the Rhineland-Palatinate Research Patent Association, which provides support in the exploitation of patentable inventions made at the university, and collaborates closely with IMG Innovations Management GmbH, which provides the university with help in the patenting and commercialization of innovations. Since the reform of the German Employee Invention Act in 2002, JGU has registered more than 250 inventions; the rights to 125 of these have been acquired and relevant applications for patent protection have been submitted. Over the

same period, the transfer and licensing of existing patent rights to commercial businesses earned the university a total of EUR 1.6 million.

Those looking to launch their own companies can obtain help and advice from the Mainz Office of Entrepreneurship, a joint initiative of JGU, the Mainz University Medical Center, and the Mainz University of Applied Sciences. As a matter of fact, spin-offs from the university play a significant role in converting research results into products with a market value.

The product or business ideas for new startups are developed by our academics as part of their research work. The spin-off companies profit from their proximity to the university, as they are granted direct access to the facilities and equipment; they secure the intellectual property rights necessary for their business operations by obtaining patents and licenses. Prominent examples of spin-offs of Johannes Gutenberg University Mainz are GENTERprise GENOMICS and Ganymed Pharmaceuticals AG.



JGU is successfully cooperating with Sensitec GmbH in the sensor technology sector

TECHNOLOGY AND KNOWLEDGE SCOUTING

The purpose of technology and knowledge scouting is to identify the existing scientific and technological potentials at JGU, the Mainz University Medical Center, and the Mainz University of Applied Sciences as well as to systematically prepare these for exploitation. The long-term aim is to initiate new projects between the universities and the business sector or other stakeholders in the innovation process. At the same time, regional businesses and stakeholders are contacted to find out about their research and information needs and to set up a network of innovation drivers within reach of the university. The aim is to provide structured information that gives regional stakeholders an idea of the potentials of knowledge transfer and enables them to manage the innovation process in a targeted way.

THE GUTENBERG CAMPUS

Johannes Gutenberg University Mainz is the only German university of its size that has nearly all its institutes and faculties located on one single campus near the center of the city. This campus is also home to the Mainz University of Applied Sciences and JGU's four top-level research partners: the Max Planck Institute for Chemistry, the Max Planck Institute for Polymer Research, the Helmholtz Institute Mainz, and the Institute of Molecular Biology.

The state of Rhineland-Palatinate is currently investing in the modernization of the Gutenberg Campus by implementing a new urban planning concept. Since 2005, construction projects in the amount of EUR 600 million have been initiated, while others are already in the pipeline. In the case of three new research buildings, the federal government has agreed to co-finance the projects, meaning that some EUR 50 million will be provided by Berlin to Mainz.

Mainz School of Music
Campus music center
EUR 12.5 million



Nuclear Chemistry
Top-level equipment
EUR 10.7 million



Lecture Hall Building for Chemistry and Physics
Modern study facilities
EUR 7.3 million



Laboratory for Molecular Exercise Physiology
Personalized diagnostics and therapy
EUR 1.2 million



Nuclear Physics
Infrastructure for the future
EUR 3.3 million



Institute of Molecular Biology
Benchmark project in the sciences
EUR 51 million



Physical Chemistry
World-class research
EUR 33 million



Institute of Anthropology
New facility for outstanding research
EUR 10 million



Max Planck Institute for Chemistry
Open-plan design, inspired by research topics
EUR 44 million



Georg Forster Building
Innovative design and energy-efficient construction
EUR 53.4 million



Center of Data Processing annex building
Built using renewable resources
EUR 5.6 million



Helmholtz Institute Mainz
In line with international standards of top-level research

Biology
Facility for cutting-edge research in the life sciences

Inter I renovation
Former student residence to become University Media Center

Biomedical Research Center
Renovation sponsored by federal and state governments

2008

2009

2010

2011

2012

2013

under construction

planned

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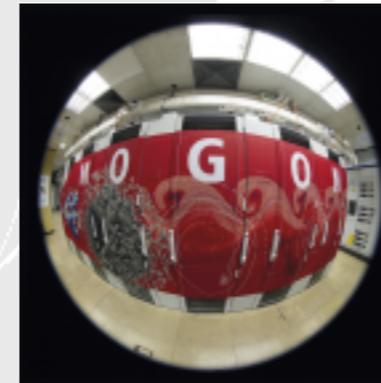
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THE
GUTENBERG SPIRIT
MOVING MINDS –
CROSSING BOUNDARIES

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