

# THE RESEARCH UNIVERSITY IN THE HELMHOLTZ ASSOCIATION

Annual Report 2020 of Karlsruhe Institute of Technology



## **KIT – The Research University in the Helmholtz Association**

### **Mission**

We create and impart knowledge for the society and the environment.

From fundamental research to applications, we excel in a broad range of disciplines, i.e. in natural sciences, engineering sciences, economics, and the humanities and social sciences.

We make significant contributions to the global challenges of humankind in the fields of energy, mobility, and information.

Being a big science institution, we take part in international competition and hold a leading position in Europe.

We offer research-based study programs to prepare our students for responsible positions in society, industry, and science.

Our innovation efforts build a bridge between important scientific findings and their application for the benefit of society, economic prosperity, and the preservation of our natural basis of life.

Our working together and our management culture are characterized by respect, cooperation, confidence, and subsidiarity. An inspiring work environment as well as cultural diversity characterize and enrich the life and work at KIT.

### **Employees 2020**

Total:	9,618
Teaching and research:	5,397
Professors:	378
Foreign scientists and researchers:	1,284
Infrastructure and services:	4,221
Trainees:	370

### **Students**

Winter semester 2020/2021:	23,321
----------------------------	--------

### **Budget 2020 in Million Euros**

Total:	967.7
Federal funds:	288.9
State funds:	283.7
Third-party funds:	395.1



Karlsruhe Institute of Technology – The Research University in the Helmholtz Association – stands for excellent research and outstanding academic education. It also is a driver of innovation by making the best possible use of the synergies resulting from the merger eleven years ago of a state university with a national large-scale research center.

In our annual report, we look back on the challenging and eventful year of 2020 and present to you some of its highlights. You will read about exciting results and course-setting developments in the areas of research, teaching, and innovation.

In a review of the unique conditions posed by the coronavirus pandemic, we report on the extraordinary challenges for routine business, studies, and teaching at KIT and also on how these mammoth tasks were mastered through great commitment, firm solidarity, and strong cohesion. Moreover, you will learn about research and relief activities initiated by KIT to explore, mitigate, and overcome the pandemic and its impacts.

We take a look at the developments of our unique IT infrastructure and present some current and completed construction projects. We report on current battery research and provide insights into the latest developments in the field of 3D printing in nano and micro dimensions. Read about technologies for negative greenhouse gas emissions, methods for a closed loop for plastics in automotive engineering, a new generation of versatile and customizable humanoid robots for elderly persons, and many other exciting projects conducted by the researchers at KIT.

Numerous awards, including four remunerative ERC grants, and the honorable tasks entrusted to it are evidence that KIT is optimally prepared for a successful future, thanks to the talents and commitment of its outstanding students, professors, and staff in research and administration.

On behalf of the Executive Board of KIT, I express my sincere thanks to our political partners, our partners in research and industry, the KIT Supervisory Board, and the members of KIT for last year's trusting, intense, and successful cooperation.

I cordially invite you to take your time to read and leaf through this annual report and I hope you will enjoy looking back on the year 2020 at KIT – The Research University in the Helmholtz Association. May 2021 become just as exciting in terms of science and research policy!

Enjoy reading.

Yours,

A handwritten signature in black ink, appearing to be 'H. Hanselka', written in a cursive style.

Professor Dr.-Ing. Holger Hanselka  
President of KIT

# CONTENT

<b>A RETROSPECTIVE VIEW OF KIT</b> .....	<b>6</b>
<b>RESEARCH</b> .....	<b>18</b>
POLIS, CELEST, BATTERY 2030+, and Clusters of Competence.....	22
Additive Manufacture on the Micrometer and Nanometer Scales .....	24
KIT's Research and Help .....	26
KIT Successfully Passes Evaluations for the Next Funding Period.....	28
Recycling of Automotive Plastics and Conversion of CO <sub>2</sub> .....	30
Future Mobility with Regenerative Fuels .....	31
New Generation of Humanoid Robots for the Elderly .....	32
Experiencing Artificial Intelligence through Humanoid Robots .....	33
Highest Data Rate in Terahertz Transmission .....	34
TrackAct CRC Covers Theory and Practice .....	35
First Recombination of Genes on a Chromosome with CRISPR/Cas.....	36
Projects on Radicalization and Urban Mobility and New Study Relating to Consumption Behavior.....	37
Scalable Algorithms for Many Applications.....	38
ERC Synergy Grant for HiSCORE Project .....	39
<b>TEACHING</b> .....	<b>40</b>
Digital Teaching and Flexibility for Required In-person Courses .....	44
Additional Housing for Students of KIT at Schroff Kolleg .....	45
Outstanding Quality of Study Programs and Teaching at KIT.....	46
Physics Online Course Facilitates Start of Studies .....	47
<b>INNOVATION</b> .....	<b>48</b>
KIT Career Fair@home Has More than 2,000 Participants .....	52
TRIANGEL Stands for Encounters, Competencies, and Inputs.....	53
Several Startups Moved into the ZEISS Innovation Hub @ KIT .....	54
SATIRE Project Promotes Transfer of Scientific Findings to Industry.....	55
<b>PROMOTING YOUNG TALENT</b> .....	<b>56</b>
Junior Research Groups at Karlsruhe Institute of Technology.....	60
Plannable Careers for Young Scientists.....	62
Composites Have High Potential for Applications in High-temperature Processes.....	63

<b>INTERNATIONAL AFFAIRS</b> .....	<b>64</b>
EPICUR Research – A New Dimension for the European University Association .....	68
Strong Partnerships Ensure Successful Digital Exchange.....	69
New Programs and Projects at CLUSTER and CESAER.....	70
Support for Vulnerable Students and Researchers.....	71
<b>KIT AS AN EMPLOYER</b> .....	<b>72</b>
Care for KIT Employees during the Pandemic .....	76
Evaluation and Follow-up Project Gender Equity 1.....	79
<b>LIFE AT KIT</b> .....	<b>80</b>
New Concepts for Daily Life at KIT .....	84
Klaus Tschira Foundation Builds InformatiKOM for KIT.....	85
The Newly Merged "KIT Freundeskreis und Fördergesellschaft e.V" .....	86
New Research Building Occupied on Campus North.....	87
<b>SUSTAINABILITY</b> .....	<b>88</b>
Structural Implementation, Including the Structure and Development Plan 2022-2026.....	92
Transfer of Top-level Research to Society and Environment .....	93
Collaboration of Science and Society.....	94
The Environment as Deposit and Future Resource Supply .....	95
<b>PRIZES, HONORS, AWARDS, AND APPOINTMENTS</b> .....	<b>96</b>
KIT Computer Scientist Was Elected Chair of Germany's Premier Advisory Body for Research Policy .....	100
Honors for Maximilian Haider, Harald Rose, Knut Urban, and Ondrej Krivanek.....	101
DFG Funds Peter Roesky's Work on Sandwich Compounds within a Reinhart Koselleck Project.....	102
Other Prizes, Honors, Awards, and Appointments .....	103
<b>FACTS AND FIGURES</b> .....	<b>112</b>



## A RETROSPECTIVE VIEW OF KIT

2020 was an unusual year in many respects for the Karlsruhe Institute of Technology (KIT). The coronavirus pandemic affected routine business and presented KIT with numerous challenges. A crisis team set up by the Executive Board coordinated the implementation of the infection protection guidelines issued by the politicians and translated them into concrete measures to protect the KIT employees and students. Thanks to the great commitment of all those involved, 2020 was not a lost year, neither in research, which in this challenging situation produced many contributions to overcoming the crisis, nor in teaching, where both lecturers and students adapted to the unfamiliar conditions and worked out solutions for successful studying.



At all levels, KIT implemented pandemic-driven digitization swiftly and in a targeted manner.

In other respects, too, the year 2020 was successful for KIT. In its first reading, the State Parliament of Baden-Württemberg discussed the 2<sup>nd</sup> KIT Further Development Act, which will enable KIT to take another step forward in its unique role in Germany – namely, to be a large-scale research institution and a university at the same time. To exploit KIT's full potential in research, teaching, and innovation, hurdles will be removed and more flexibility will be allowed in the use of funds and in the deployment of personnel. The basis for this was an amendment to the German Basic Law passed by the

Bundestag at the end of 2014. This amendment lifted the ban on cooperation between the federal and state governments and created new opportunities for collaboration. As a result, it was possible to significantly enhance the KIT Act of 2009.

The content-related research framework of the research financed through the Helmholtz Association leads to financial planning reliability until 2027 and ensures the quality of KIT's research activities. The research framework was established in accordance with recommendations by the Senate of the Helmholtz Association for the fourth round of program-oriented funding (PoF IV).

### KIT in Times of Pandemic

In 2020, the coronavirus pandemic triggered by the novel coronavirus SARS-CoV-2 affected many processes at KIT. KIT has always given top priority to the health of its employees and students and maintained its capabilities throughout the pandemic. A crisis team set up by the Executive Board ensured that measures taken at KIT in response to the spread of SARS-CoV-2 took place in a coordinated manner in compliance with the principle of subsidiarity. On its homepage, the student websites on the Internet, the employee portal (intranet), the KIT student portal, and on other channels, KIT provided information about containment measures and recommended actions, which were continuously adapted on the basis of the regularly amended ordinances issued by the State of Baden-Württemberg and the Corona Ordinance on Academic Education Operations (Corona-Verordnung Studienbetrieb) issued by the Ministry of Science, Research, and the Arts.

Even high-ranking visitors followed the Corona rules:  
Environment Minister Franz Untersteller on August 6, 2020.



The pandemic's impact on the KIT routines was manageable due to the strong commitment of the staff. As many employees as possible were allowed to work from home in order to reduce contacts. The technical prerequisites for this were created by the staff of KIT's Steinbuch Centre for Computing (SCC). New formats for digital and hybrid events replaced face-to-face encounters at lectures, conferences, meetings, and seminars. The event management team of the General Services Unit (AServ) provided support in planning, and the Center for Technology-Enhanced Learning (ZML) assisted with questions about

technical equipment. Moreover, a great deal of logistical effort was required to adapt the operation of the canteen and cafeteria to the changed conditions (see page 84).

### Effects of the Pandemic on Teaching

The nationwide contact restrictions imposed in spring 2020 included the suspension of on-campus teaching and learning at the universities. Digital formats that minimized disadvantages for the students were the only way out of this situation. An Online Teaching Expert Group was founded, backed by the Executive Board. The didactics and technical implementation had to go hand in hand to deliver solutions for 5,000 teachers and 24,000 students. The group defined four target scenarios: Guided self-studies, interactive courses in small groups, large courses with live interaction, and large courses without live interaction. Different business units contributed their expertise: SCC upgraded the IT infrastructure and integrated the new services, the Library installed the video portal OpenCast, and the Digital Office procured the video software Zoom. Finally, ZML precisely developed and elaborated the four scenarios for use by the lecturers and students in virtual lecture halls. The great willingness of the lecturers to accept the new conditions, and the rapid adaptation of central solutions in the eleven KIT departments led to success. Just in time for the start of lectures in the summer semester, the "temporary online university" presented itself as a technically upgraded, stable, and didactically up-to-date teaching and learning concept.

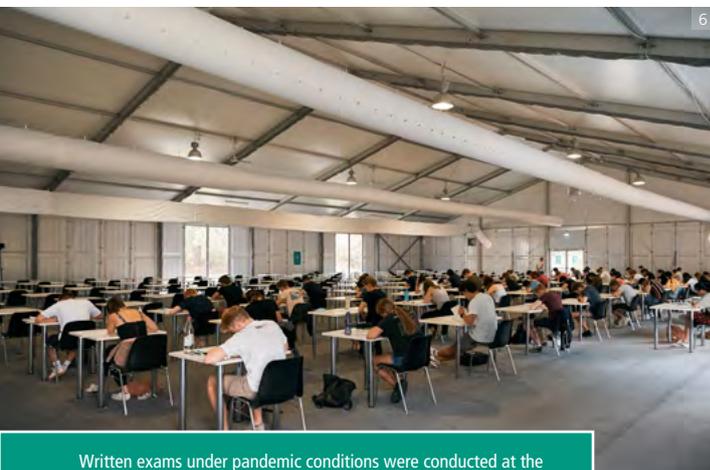
First assessments predominantly showed approval and satisfaction among lecturers and students alike. In the winter semester of 2020/2021, which was marked by the second corona wave, KIT was prepared for hybrid teaching.



Only a few students were able to attend on-campus courses at Campus South.

Due to the requirement to again reduce contacts during a weak lockdown, courses continued to be held digitally.

Also, exams scheduled for the winter semester of 2019/2020 were interrupted and postponed initially. As of April 20, oral exams were again possible with a maximum of five persons present or via video conferencing. Written exams were conducted at large event halls in Karlsruhe and in a tent set up in front of the Audimax lecture hall on Campus South. This solution had been enabled through cooperation of KIT's event management team with Messe Karlsruhe and implementation of a comprehensive room and hygiene concept developed by both partners (see page 44).



Written exams under pandemic conditions were conducted at the exam tent set up in front of the Audimax lecture hall.

## Research on Corona Topics

KIT supports society in dealing with the coronavirus crisis by conducting research, providing scientific and technical services, or evaluating data that can serve as a basis for political decisions. Infrastructures are provided for various projects studying SARS-CoV-2, and research is performed on the social and technical consequences of the crisis. The exceptional situation also creates extraordinary conditions for research to produce new findings. The spectrum of activities at KIT reflects the different dimensions of the pandemic (see page 26).

A study by the Institute for Technology Assessment and Systems Analysis examines the long-term consequences of the pandemic and related measures in terms of their political and temporal relevance and their probability of occurrence. The Center for Disaster Management and Risk Reduction Technology collects current data on developments in the coronavirus pandemic, which are included,

for example, in the reporting of the TV broadcaster ZDF and the daily newspaper Tagesspiegel as well as in the much-cited figures of the Johns Hopkins University.

An Internet platform developed by KIT together with the Heidelberg Institute for Theoretical Studies (HITS) bundles the short-term predictions of coronavirus infections, compares the predictions of international data modeling groups, and merges them into an ensemble forecast. In the BLUESKY project, the Institute of Meteorology and Climate Research investigates the effects that the shutdown of social and economic life has on pollutant concentrations in the atmosphere. The Institute for Mechanical Process Engineering and Mechanics studied the effect of HEPA filters in places such as a classroom of a primary school. The Aerobuster developed by KIT researchers can very effectively inactivate viruses and other pathogens from the ambient air.

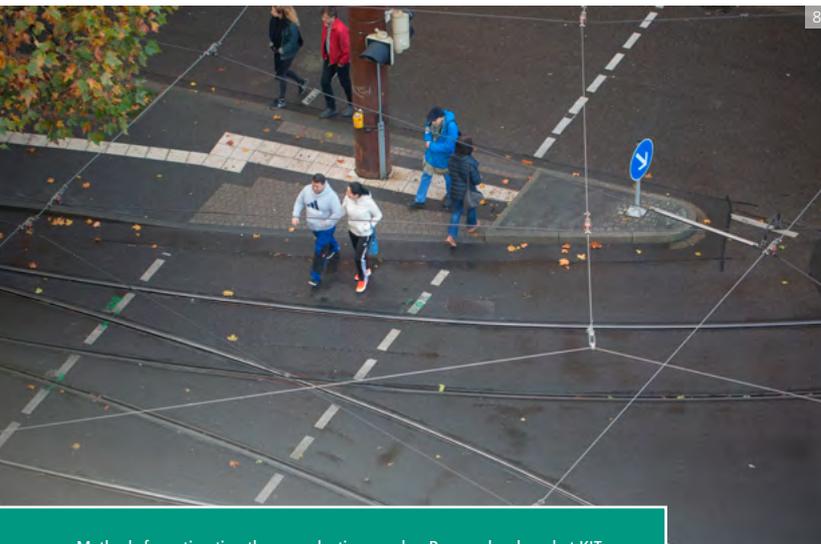


KIT investigates the effects of the pandemic on the atmosphere.

The Engler-Bunte Institute investigates the spread and transmission risks of SARS-CoV-2 viruses in wastewater. To ensure compliance with mandatory masking in public spaces, the Karlsruhe Service Research Institute developed a novel concept for a face mask recognition video system that preserves privacy and protects personal data. The Institute for Automation and Applied Informatics developed a method for estimating the time-dependent reproduction number  $R$  that avoids unwanted time delays and compensates for weekly periodicities.

With the First Aid Kit for Successful Distributed Working, the Institute of Information Systems and Marketing and Mittelstand 4.0 Kompetenzzentrum Usability (Usability

Competence Center 4.0 for Medium-sized Enterprises) are supporting small and medium-sized enterprises that must cope with the crisis-induced switch to radically decentralized working. The Institute of Applied Informatics and Formal Description Methods supports Internet users in recognizing phishing emails, whose number rose to a record level during the pandemic.



Methods for estimating the reproduction number R were developed at KIT.

With the Karlsruhe Research Accelerator KARA, KIT's Institute for Beam Physics and Technology provides an infrastructure for the development of new diagnostic methods and analyses of biomolecules. Computing resources of the Steinbuch Centre for Computing support distributed projects aimed at improving the understanding of proteins, such as the SARS-CoV-2 virus.

Together with Hochschule Karlsruhe – University of Applied Sciences, the wbk Institute of Production Science and the Institute of Product Engineering founded a “production network” that supported Karlsruhe hospitals in equipping themselves with visors from a 3D printer. At the

Large infrastructures, such as the KARA research accelerator, are available at KIT.



beginning of the crisis, there was a shortage of manpower to carry out and evaluate Covid tests. Students from the master's biology program at the KIT Department of Chemistry and Biosciences responded by assisting at one of the health care centers involved.

### **KIT's Role in the Development of Research Infrastructures**

KIT is involved in the establishment and operation of large research infrastructures that are used far beyond its domain. For example, the Joint Science Conference (Gemeinsame Wissenschaftskonferenz – GWK, which coordinates funding of science by the federal and state governments), decided in 2020 to locate the directorate of the National Research Data Infrastructure (Nationale Forschungsdateninfrastruktur (NFDI) in Karlsruhe. It jointly entrusted KIT and FIZ Karlsruhe – Leibniz Institute for Information Infrastructure with the tasks involved in the complex foundation phase. The decisive factor for this decision was Karlsruhe's status as a center for information infrastructure, boasting a broad spectrum of disciplines and subjects, a very good IT infrastructure, and diverse networks on a national, European, and international level. In the NFDI, the valuable data stocks of science and research are to be systematically made accessible, networked, and harnessed for the entire German science system. Up to now, they have mostly been available on a decentralized, project-related, or temporary basis. The federal and state governments will jointly promote the NFDI and make this digital knowledge repository an indispensable resource for dealing with new research questions, findings, and innovations.

GWK appointed a renowned information scientist, Dr. York Sure-Vetter, as founding director of the NFDI. A professor at KIT's Institute of Applied Informatics and Formal Description Methods, he has proven research experience in artificial intelligence and data science and knows both industry and academic research institutions very well.

Formally, the NFDI is a legal entity in its own right, managed and coordinated by the directorate. The central element of the NFDI will be consortia, where users and providers of research data will cooperate with institutions of the information infrastructure. In the meantime, the GWK has announced the first nine consortia that will be funded within the framework of the NFDI. KIT researchers are involved in three of these consortia; they focus on

chemistry (NFDI4Chem), engineering sciences (NFDI4Ing), and catalysis research (NFDI4Cat).



Sabine Brünger-Weilandt, FIZ Karlsruhe, Holger Hanselka, President of KIT, Eva Lübke, NFDI, York Sure-Vetter, KIT, NFDI, and Frank Mientrup, Mayor of Karlsruhe, (from left to right) cut a red ribbon at the opening of the NFDI Directorate on October 5, 2020.

GWK designated KIT as the Center for National High Performance Computing (NHR) in November 2020. With HoreKa, the Karlsruhe High Performance Computer, one of the most powerful supercomputers in Europe will be located here beginning in spring 2021. HoreKa has a computing power of about 17 petaFLOPS, i.e. about 17 quadrillion computing operations per second, which corresponds to the power of more than 150,000 laptops.

HoreKa will be available to scientists from all over Germany. Thanks to the new supercomputer, researchers will be able to gain a more detailed understanding of highly complex natural and technical processes, particularly in materials science, Earth system sciences, energy and mobility research, engineering, life sciences, and particle and astroparticle physics.

As a center for data-intensive computing and the analysis of large-scale data as well as an innovative and agile IT



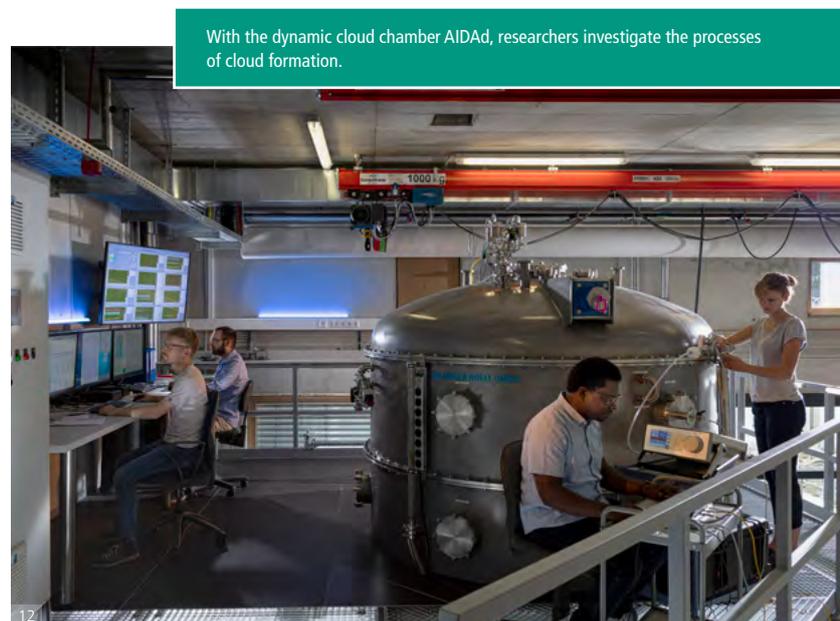
Starting in 2021, the Karlsruhe High Performance Computer (HoreKa) will serve as a tool for many researchers seeking to understand highly complex systems.

service provider, the Steinbuch Centre for Computing at KIT operates large-scale facilities for scientific high-performance computing and data-intensive sciences including the supercomputer ForHLR, the bwUniCluster 2.0, and the Grid Computing Centre Karlsruhe (GridKa), in addition to HoreKA.

In 2020, KIT also became the first location in Europe to put the novel NVIDIA DGX A100 AI system into operation. It was purchased with funds from the Helmholtz Resources Initiative (HAICORE), which is closely linked to Helmholtz AI, the Helmholtz Artificial Intelligence Cooperation Unit. Whether in the development of autonomous robotic systems or novel functional materials, in the optimization of energy systems or in the improvement of climate models, artificial intelligence and machine learning are now an important part of research at KIT.

In 2020, the Institute of Meteorology and Climate Research commissioned the new dynamic cloud chamber AIDAd, a novel experimental facility for the laboratory investigation of clouds. With a volume of 3.8 cubic meters, AIDAd is much smaller than AIDAc (AIDA classic), but has the advantage that its walls can be cooled dynamically over a wide temperature range from +30°C to -55°C. The cloud chamber itself is located in a vacuum chamber that can be evacuated in a controlled manner. This allows the system to create clouds that are particularly close to reality.

This globally unique cloud simulation chamber will enable new laboratory-based research on the effects of aerosols



With the dynamic cloud chamber AIDAd, researchers investigate the processes of cloud formation.

on cloud formation, droplet, and ice particle processes in clouds, and precipitation formation. The formation and radiative properties of clouds continue to be among the largest uncertainties in climate models. Just like the well-established AIDAc facility, the new dynamic cloud chamber will be open to national and international projects and collaborations. Research with AIDA is particularly supported by the Helmholtz research field Earth and Environment.

### Research for the Energy Transition

The German government's climate protection targets for the year 2050 make it inevitable to transform the current energy landscape. The Kopernikus Initiative launched by the German Federal Ministry of Education and Research (BMBF) is the largest research initiative to date of the energy transition in Germany. Kopernikus is a comprehensive and integrative research program on the energy transition so that the current energy system can be transformed in a future-oriented, safe, clean, and affordable way.

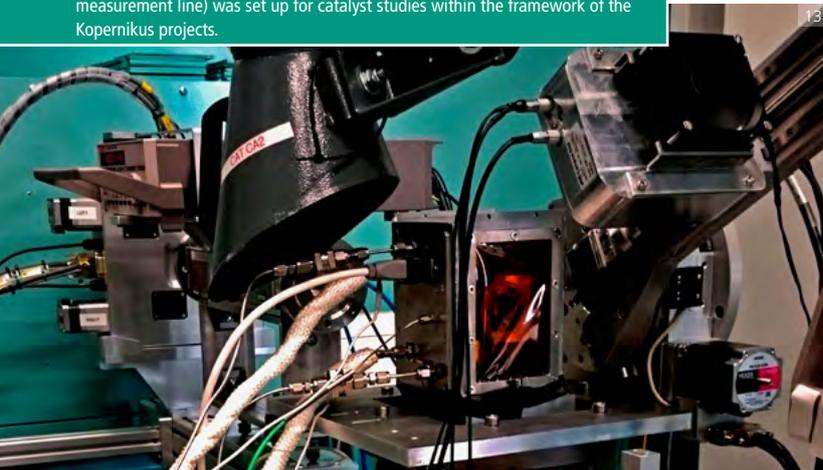
The four Kopernikus projects ENSURE, P2X, SynErgie, and ENavi investigate key areas of the energy system in close cooperation between science, industry, and society. KIT is involved in all four projects. In the ENSURE project, the second phase started in February 2020. Employing a holistic systemic approach, ENSURE pursues the goal of researching and providing new energy network structures for the energy transition. Under the leadership of the Institute for Automation and Applied Informatics, investigations into the creation of models for the electrical transmission grid and research into distribution grids are already very advanced. In addition, the researchers developed a real-time simulation of the dynamics of the

power grid at KIT's Campus North as an example of an industrial distribution grid. Moreover, they are developing approaches based on modern information and communication technology to realize semi-autonomous operational management and control of the overall grid using intelligent decentralized plant networks.

The Energy System 2050 research initiative of the Helmholtz Association, in which KIT is also involved, investigates how Germany can rapidly and comprehensively minimize the use of fossil fuels and thus transform the energy system. For this purpose, it develops strategies, technologies, and open-source tools. With the Energy Lab 2.0 on the premises of KIT, Europe's largest research infrastructure for renewable energies has been created. The intelligent networking of environmentally friendly energy generators and storage methods is among the topics being investigated here.

Researchers have also realized the HECI platform as part of the Helmholtz Energy System 2050 initiative: With the Helmholtz Energy Computing Initiative (HECI), in which KIT researchers participate, the Helmholtz Association presents a new platform on which access-free benchmarks, scalable methods, realistic data, and open-source software for project planning and optimization of future energy systems are available for the first time. HECI aims to facilitate collaborations in the implementation of climate protection measures in energy systems. The computer models it has developed will help to plan capacities for the conversion, transport, and storage of energy, taking into account dynamic parameters, such as weather and consumption.

At the KIT synchrotron, the CAT-ACT measurement line (CATalysis and ACTinide measurement line) was set up for catalyst studies within the framework of the Kopernikus projects.



HECI aims to facilitate collaborations in the implementation of climate protection measures in energy systems.

## ERC Grants

The European Research Council (ERC) is a science-led institution established by the European Commission to fund excellent researchers with groundbreaking research projects. The ERC awards grants of various durations and funding amounts in a number of funding programs. KIT researchers obtained four ERC grants in different funding programs in 2020.



15 Tonya Vitova was awarded an ERC Consolidator Grant for her research project "The Actinide Bond."

An ERC Consolidator Grant was awarded to Dr. Tonya Vitova, Head of the High-resolution X-ray Spectroscopy Group at KIT's Institute for Nuclear Waste Disposal; her project, "The Actinide Bond – Actinide Bond Properties in Gas, Liquid and Solid State," focuses on the relationship between the covalency and strength of the chemical bonds of actinides in gaseous, liquid, and solid

materials. In the periodic table, actinides are the successive chemical elements from thorium to curium. They pose great challenges to fundamental physical and chemical research.



16 An ERC Consolidator Grant was awarded to Laurent Schmalen for his project "RENEW."

With his team in the project "RENEW – Reinventing Energy Efficiency in Communication Networks," Professor Dr. Laurent Schmalen from KIT's Communications Engineering Lab works on ways to reduce both the complexity and the power consumption of communication technology. This would enable higher data rates and better environmental compatibility. Using artificial intelligence and

machine learning techniques, the research group reduces the cost-intensive algorithms used by receivers. This project also was awarded an ERC Consolidator Grant.

Basic computational tools for many different applications are developed by information scientist Professor Dr. Peter Sanders in his "ScAIBox" project at the Institute of Theoretical Informatics. The goal of the project is to provide algorithms and software libraries that can handle very large amounts of data and run on millions of processors working in parallel. The European Research Council ERC is funding the project with an Advanced Grant (see page 38).



17 Peter Sanders was awarded an ERC Advanced Grant for his project "ScAIBox."

Nuclear magnetic resonance (NMR) is an important tool for drug research because it can quantify and spatially resolve the binding of drugs to pathogens. However, NMR has so far lacked the sensitivity and capacity to efficiently scan large drug libraries. In the "HiSCORE" project, the research teams led by Professor Dr. Jan Gerrit Korvink, Director at the Institute of Microstructure Technology, and Dr. Benno Meier, Institute for Biological Interfaces, together with partners in Paris and Nijmegen, develop a method to enable high-capacity drug screening. The ERC is funding the project with a Synergy Grant (see also page 39).



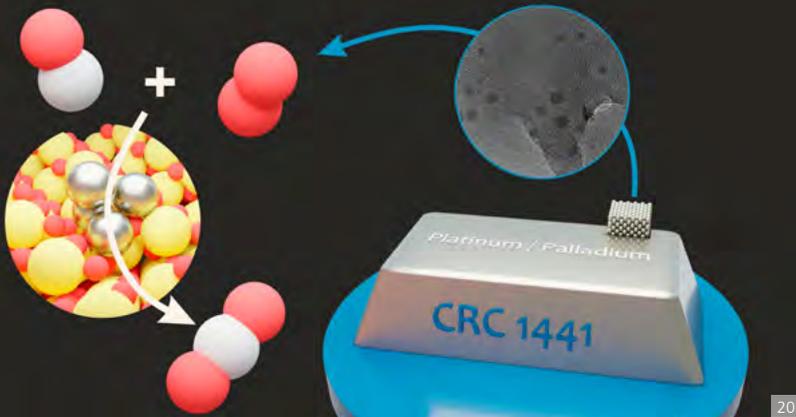
18 19 Jan Gerrit Korvink and Benno Meier were awarded an ERC Synergy Grant for their HiSCORE project.

### New Collaborative Research Centers

Heterogeneous catalysts consisting of noble metal clusters and particles play a major role in chemical processes and can effectively reduce harmful emissions. However, they are much more dynamic than previously thought and many of the effects that occur are not yet sufficiently understood. In November 2020, the German Research Foundation (Deutsche Forschungsgemeinschaft – DFG) decided to fund the new Collaborative Research Center (CRC) "TrackAct – Tracking the Active Site in Heterogeneous Catalysis for Emission Control" at KIT, which aims at a holistic understanding of catalytic processes.

The spokesman of the CRC "TrackAct" is Professor Dr. Jan-Dierk Grunwaldt, Head of the Institute for Chemical Technology and Polymer Chemistry. In the CRC, 19 KIT researchers are conducting research together with four colleagues from the Technical University of Munich and Deutsches Elektronen-Synchrotron DESY in Hamburg.

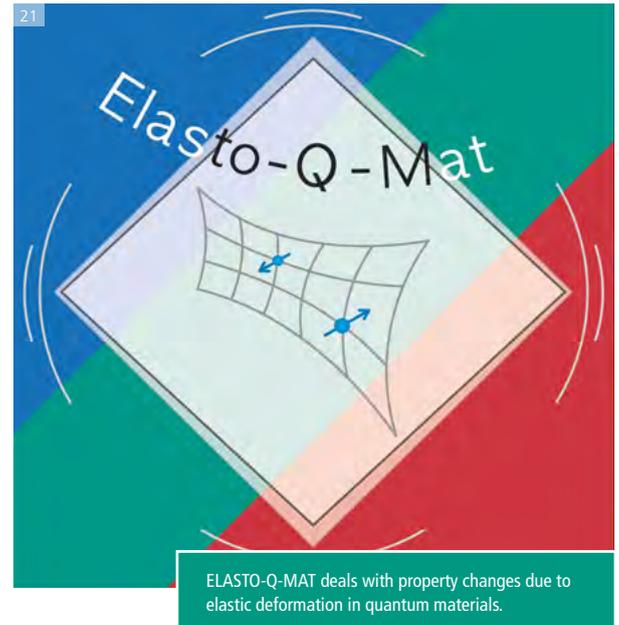
Heterogeneous catalysts consisting of noble metal clusters and particles play a major role in chemical processes.



Collaborative Research Centers enable interdisciplinary work on innovative, challenging, and long-term projects by coordinating and concentrating resources, and thus also serve to create focus and structure at the applicant universities. The new CRC will be funded from January 1, 2021 for an initial period of four years, with a maximum funding period of twelve years (see page 35).

KIT is also involved in the new cross-university CRC/Transregio 288 "Elastic Tuning and Response of Electronic Quantum Phases of Matter" (ELASTO-Q-MAT), which investigates quantum materials whose properties can be decisively changed by elastic deformation.

The Goethe University Frankfurt is in charge of the project. Spokesman at the KIT is Professor Dr. Jörg Schmalian, Institute for Theoretical Condensed Matter Physics. Also involved are Johannes Gutenberg University Mainz, Max Planck Institute for Polymer Research Mainz, and Max Planck Institute for Chemical Physics of Solids Dresden. The SFB/Transregio 288 started on July 1, 2020 and will also be funded for an initial period of four years.



### New Buildings

Since spring 2020, the "InformatiKOM" has been under construction on Campus South on the eastern Adenauer-ring. The new building project will be realized by the Klaus Tschira Foundation in 2023. It consists of two individual buildings with a usable area of around 10,000 square meters. With its open and versatile building structures, InformatiKOM will bring together institutes of informatics with facilities of science communication and applied cultural studies, thus providing a framework to promote knowledge transfer and dialog between KIT and society (see page 85).

On October 29, 2020, a new Campus North laboratory building was inaugurated. Research groups from biology and chemistry will work together intensively, using a floor space of around 2,800 square meters. The construction costs of around EUR 20 million were financed by the German Federal Ministry of Education and Research, the German Federal Ministry of the Interior, Building and Community, and the Baden-Württemberg Ministry of Science, Research, and the Arts (see page 87).

The visible-from-afar new building of the ZEISS Innovation Hub @ KIT at the southern entrance to Campus North serves as a platform for collaboration between the optics and photonics company ZEISS, KIT, and startups for the design of innovative future technologies. The building, which extends over seven levels, offers versatile laboratory, office, and open-space areas. KIT has moved into approximately 2,800 square meters of space. The official opening was postponed to 2021 due to the pandemic (see also page 54).

At Campus South, preparatory work for the new Mechatronics Learning and Application Center has been underway since 2020. Floor space of around 2,900 square meters will be created in the new building on Kaiserstraße by 2023. There, students will be introduced to the latest manufacturing technologies and processes and will be able to apply them within an innovative teaching concept that enables interplay of teaching, practice, and research. The construction project is being financed by the State of Baden-Württemberg and is supported by the machine tool manufacturer TRUMPF.

### (Virtual) Events

In 2020, the coronavirus pandemic made itself felt through many restrictions. One of the hardest hit sectors certainly was events. Numerous events and celebrations were canceled or postponed, while many new and innovative formats were developed.

The Center for Cultural and General Studies (ZAK | Zentrum für Angewandte Kulturwissenschaft und Studium Generale) moved its traditional Colloquium Fundamentale completely into virtual space. On the occasion of the "Science Year

2020 – Bioeconomy," experts from different disciplines in the summer semester of 2020 discussed controversies about a bio-based future. In the winter semester that followed, the Colloquium Fundamentale titled "Das vom Menschen Gemachte. Kulturwissenschaft gestern und morgen" (Human-made phenomena. Cultural studies yesterday and tomorrow) dealt with the different facets of cultural studies and their impact on politics, media, and society.

For the first time in the history of KIT, the freshers' welcome event on November 6 took place in digital form. Well over a thousand participants were present. The event, which was presented by Kristina zur Mühlen, was broadcast from the foyer of the Audimax lecture hall. Short welcoming speeches were delivered by President Professor Dr.-Ing. Holger Hanselka, Mayor of Karlsruhe Dr. Frank Mentrup, and Adrian Keller, Internal Affairs Officer of the AstA Student Union Executive Committee. During a live-streamed round of talks via YouTube, Vice-President for Higher Education and Academic Affairs Professor Dr. Alexander Wanner, student Robin Otto-Tuti, Dean of Studies of KIT's Department of Chemical and Process Engineering Professor Dr. Heike Karbstein, and Students' Union Managing Director Michael Postert answered questions posed by zur Mühlen and by students. After a discussion with students who were honored for their work in a student initiative or organization, the event came to a close with a performance by comedian Marcel Mann. Following the official part of the event, participating students had the opportunity to get to know different service offerings and university groups in a digital marketplace and to make initial contacts via chat.

Under the title of "Das vom Menschen Gemachte" (Human-made phenomena), the Colloquium Fundamentale dealt with the role of cultural studies.



22



For the first time, KIT's freshers' welcome event took place digitally.

Before pandemic restrictions came into effect, a very special event took place in the communications engineering lecture hall (“Nachrichtentechnik-Hörsaal”) at Campus South: In February 2020, Hasso Plattner was awarded an honorary doctorate by KIT’s Department of Electrical Engineering and Information Technology (ETIT). The certificate was presented by Dean of the Department and Head of the Institute of Industrial Information Technology Professor Dr. Fernando Puente León, who died unexpectedly a short time later on July 1, 2020.

KIT alumnus Hasso Plattner is committed to future-oriented research and to the educational and cultural sectors. He links business and science, advocates for the next generation of executives, and repeatedly develops innovations to advance digitization.



Hasso Plattner (right) received his honorary doctorate certificate from Fernando Puente León (†), Dean of the Department of Electrical Engineering and Information Technology (ETIT).

In 1968, Hasso Plattner completed his diploma studies in communications engineering at the Department of

Electrical Engineering of the then Universität (TH) – today’s KIT – with Professor Dr. Karl Steinbuch, who to this day is considered one of the pioneers of German informatics. He then joined IBM Germany in Mannheim as a program developer. Just four years later, he co-founded the software company SAP. Today, SAP SE, headquartered in Walldorf/Baden-Württemberg, is the world’s leading provider of software and software-related services for companies.

### Appointments and Reappointments

The five heads of division of KIT were newly appointed or reappointed in 2020 after expiration of their five-year terms.

In February 2020, Professor Dr. Andrea Robitzki took office as Head of Division I – Biology, Chemistry, and Process Engineering. Previously, she was Head of the Centre for Biotechnology and Biomedicine at Universität Leipzig, where she also held a professorship in molecular biological-biochemical process engineering.

No less than four heads of division were appointed for terms of five years as of October 1, 2020, after confirmation by the KIT Senate: The Head of Division II – Informatics, Economics, and Society, Professor Dr. Michael Decker, and the Head of Division III – Mechanical and Electrical Engineering, Professor Dr. Joachim Knebel, were reappointed. Head of Division IV – Natural and Built Environment Professor Dr. Johannes Orphal, previously Director at KIT’s Institute of Meteorology and Climate Research, was newly appointed. Also newly appointed was Professor Dr. Marc Weber as Head of Division V – Physics and Mathematics. He previously headed the Institute for Data Processing and Electronics and holds a professorship at KIT’s Department of Physics, which since 2011 has been co-opted to KIT’s Department of Electrical Engineering and Information Technology.



All of the five heads of division of KIT were newly appointed or reappointed in 2020: Andrea Robitzki, Michael Decker, Joachim Knebel, Johannes Orphal, and Marc Weber (from left to right).



President Holger Hanselka bid farewell to Doris Wedlich (l) and Karl-Friedrich Ziegahn (center) on their retirement.

On January 23, 2020, Professor Dr. Doris Wedlich as Head of Division I and Dr. Karl-Friedrich Ziegahn as Head of Division IV were bid farewell during a festive symposium. Doris Wedlich was closely involved in the formal founding of KIT in 2009, initially becoming Chief Science Officer from 2012 and “pioneering Head of Division” in the wake of the fundamental merger of the two institutions and their further development. Doris Wedlich passed away unexpectedly on September 20, 2020.

Karl-Friedrich Ziegahn was Research Director for the Energy and Environment Program at Forschungszentrum Karlsruhe GmbH. From 2011 to 2014, he was Chief Science Officer, and from 2014 to 2020 Head of Division

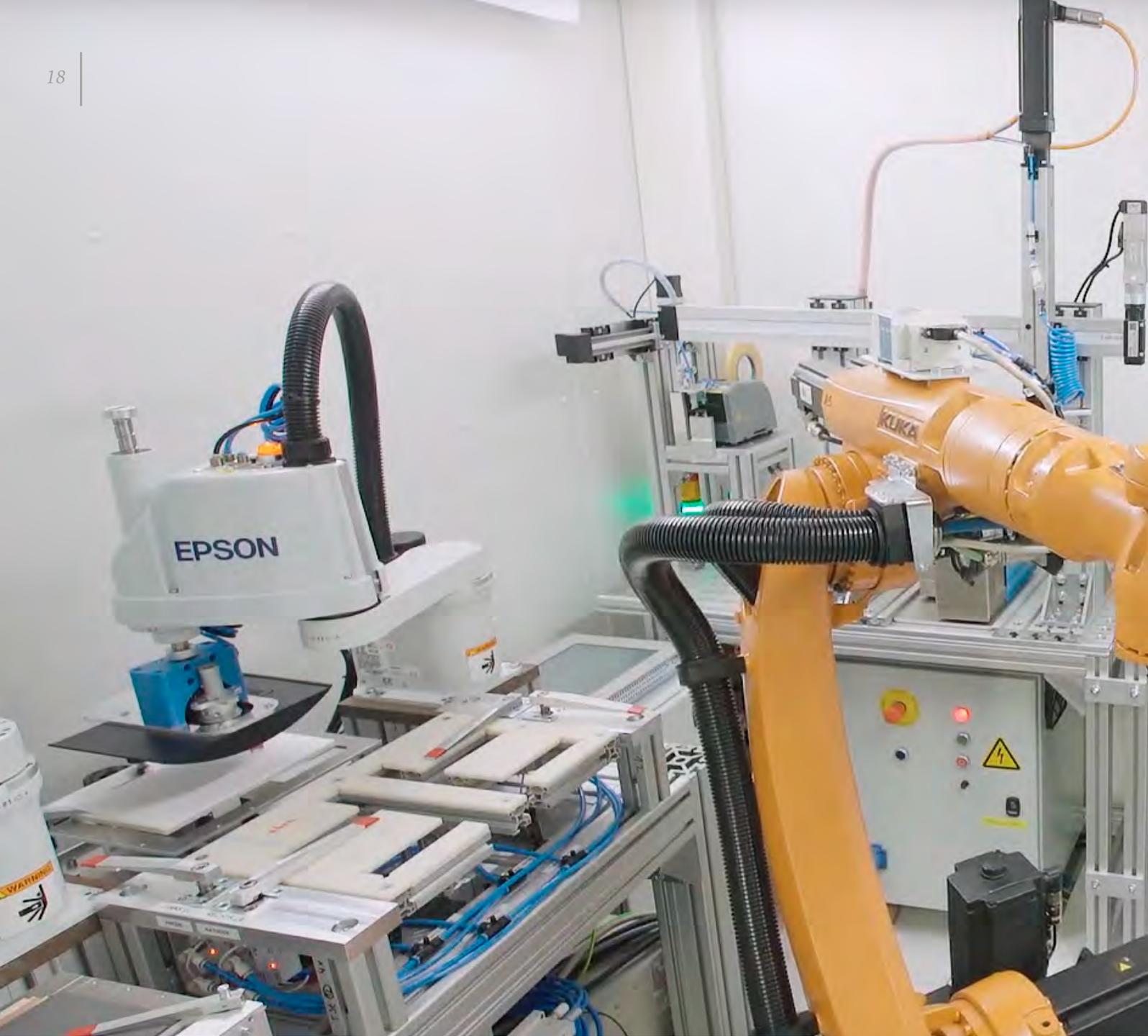
“Natural and Built Environment” at KIT. He contributed his expertise in countless functions and honorary positions, for example in the Council of the German Physical Society, the European Physical Society, the University Council of Augsburg University, and the Environment & Sustainability Commission of the Fédération Internationale de l'Automobile (FIA).

The previous Head of Division V Professor Dr. Johannes Blümer also retired in 2020. His retirement ceremony is due in 2021.

Shortly before the end of the year, the KIT Senate with a very large majority confirmed the vote of the Supervisory Board to reelect two KIT vice-presidents: Vice-President for Innovation and International Affairs Professor Dr. Thomas Hirth and Vice-President for Research Professor Dr. Oliver Kraft each were appointed for another six years. Their new terms of office will start on January 1, 2022.



The KIT Executive Board in 2020: Alexander Wanner, Michael Ganß, Thomas Hirth, Holger Hanselka, Christine von Vangerow, and Oliver Kraft (from left to right).



## RESEARCH

Scientists of different disciplines frequently work together on big research projects at KIT. They are closely interconnected and involved in both national and international collaborative projects. An example is AgiloBat: Researchers from seven institutes of KIT, the Center for Solar Energy and Hydrogen Research Baden-Württemberg, and the Fraunhofer Institute for Chemical Technology are involved in this project to develop an agile production system for batteries.

The production of high-performance, mobile battery cells is the backbone of several industry sectors. Germany, however, mainly imports battery cells from Asia and North America. Battery manufacture is thus an area



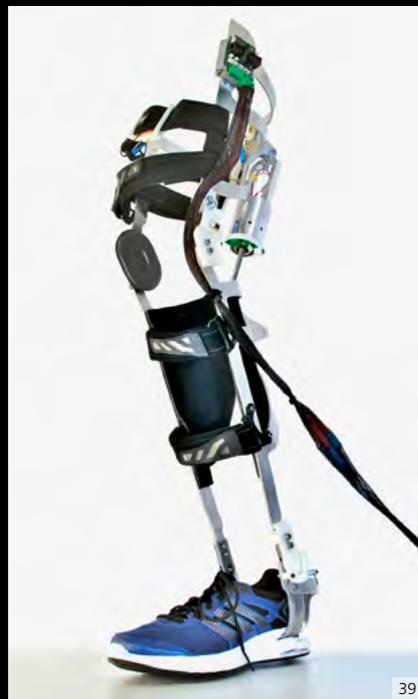
in which Germany must catch up with its international competitors.

Conventional systems now used for the production of battery cells cannot manufacture a variety of formats or use a wide range of materials. They produce standardized cells that may be of high quality, but are not specifically adapted to the customer's wishes.

Under the AgiloBat research project, agile and modular systems are studied for integrated production. Parallel product and production plant development is aimed at manufacturing battery cells of flexible formats using var-

ious materials. The idea is to optimally adapt the battery system to application and the space available.

AgiloBat is part of the innovation campus "Future Mobility" and is embedded in the "Strategy Dialog for the Automotive Sector in Baden-Württemberg." The project that is scheduled for a duration of four years is funded with up to EUR 4.5 million by the Baden-Württemberg Ministry of Science, Research, and the Arts. Industry contributes at least a million euros. The Federal Ministry of Education and Research provides up to EUR 14 million.





34



35



37



36



42



41



47



46

## NETWORKS FOR BATTERY RESEARCH

### POLiS, CELEST, BATTERY 2030+, and Clusters of Competence

Batteries are key components of many technological developments. Lithium-ion batteries have not only paved the way for the revolution in entertainment electronics, but also are about to enable electric transportation of passengers and goods. Moreover, they contribute significantly to the energy transition and serve to buffer electric power for the efficient use of renewable energy sources, such as solar or wind energy.

For the time being, lithium-ion batteries are the best option, as they offer high voltages at small weight and, thus, reach high energy densities. However, they rely on materials that are far from being sustainable. Extraction of cobalt or lithium, for instance, is associated with political, ecological, and economic risks. The European Commission is concerned about supply shortages due to scarce resources and unstable political situations in some of the countries possessing vast deposits. Often, cobalt mining takes place under inhumane conditions and is associated with excessive environmental pollution.

#### POLiS

The POLiS Cluster of Excellence develops new battery materials and technical concepts required for efficient and environmentally compatible storage of electric power. For this purpose, researchers are identifying sustainable alternatives to lithium and other critical

materials. POLiS studies batteries that are based on sodium, magnesium, calcium, aluminum, and chloride ions. These so-called post-lithium batteries have the potential to store more energy and to be safer. Moreover, they represent a cheaper long-term option for mass application in stationary and mobile electrochemical storage systems.

A concept developed by KIT and Ulm University was successful in the Excellence Strategy Competition of the Federation and the States. POLiS is the only approved Cluster of Excellence for battery research. Associated partners are the Center for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW) and Gießen University. POLiS will be funded with EUR 47 million for a duration of seven years.

#### CELEST

POLiS is embedded in the research platform CELEST (Center for Electrochemical Energy Storage Ulm & Karlsruhe) established for strategic collaboration in 2018 by KIT, Ulm University, and the ZSW. CELEST is one of the world's biggest battery research efforts. 46 working groups from 31 institutes of KIT, Ulm University, and ZSW contribute their complementary expertise to CELEST – from fundamental research to close-to-practice development to technology transfer. Within the framework of

CELEST, for example, the KIT-coordinated EPIC project is aimed at accelerating drying of electrodes for lithium-ion batteries, increasing the energy efficiency of this process, and, hence, reducing the cost of production. In another project, researchers of KIT and of Jilin University in Changchun, China, study lithium-lanthanum-titanate with a perovskite crystal structure that is a promising anode material for future high-performance batteries.

Within the ProLiB research project, KIT develops temperature-controlled and sensor-equipped protective housings for tests of lithium-ion cells under critical conditions.



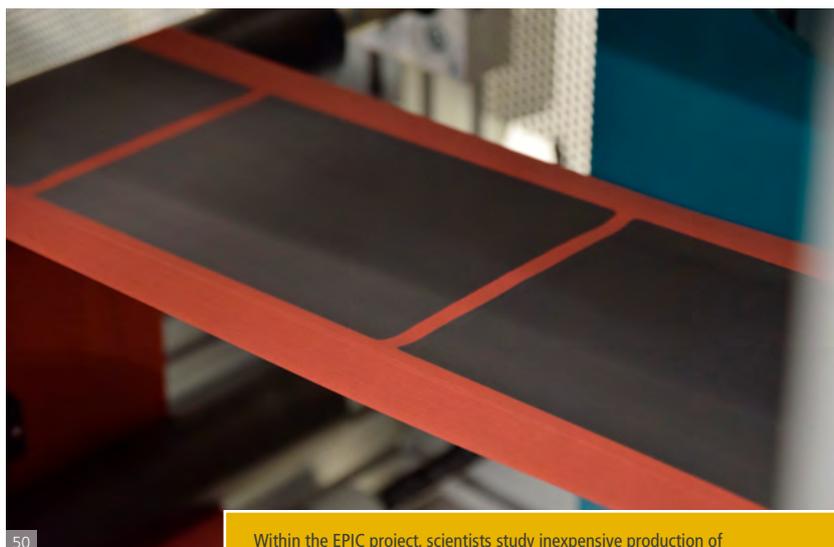
## BATTERY 2030+

Via CELEST, KIT, Ulm University, and ZSW also participate in the consortium known as BATTERY 2030+. Partners from science and industry all over Europe have joined this research initiative to develop tomorrow's batteries. A roadmap published by the partners defines both the properties of tomorrow's batteries and the methods necessary to develop them. Members of the consortium coordinated by the University of Uppsala, Sweden, include the CELEST partners, five universities, several research centers, and industry associations from different European countries.

The first projects proposed in the roadmap for BATTERY 2030+ have already been approved by the EU and are underway. CELEST is an important partner for accelerated development of materials, modeling, data evaluation using artificial intelligence, and the associated autonomous robotics.

### Clusters of Competence for Battery Research

The Federal Ministry of Education and Research (BMBF) funds four new clusters of competence to energetically push battery research in Germany. The clusters of competence are part of the "Forschungsfabrik Batterie"



50

Within the EPIC project, scientists study inexpensive production of electrodes for lithium-ion batteries.

(battery research factory) master concept and are meant to contribute to strengthening battery research in Germany along the entire value chain. BMBF's investment in battery research at universities and non-university research institutions totals EUR 100 million.

KIT is involved in all four clusters. Intelligent battery cell production (InZePro) focuses on flexible production systems. AQua (analytics / quality assurance) aims at improving the performance and service life of batteries. KIT is active in the coordination teams of both of those clusters. KIT's researchers also participate in two other clusters on recycling / green batteries (greenBatt) and battery utilization concepts (BattNutzung). In addition, KIT is involved in the FestBatt Cluster of Competence

for the development of solid-state batteries, which was launched in 2018, and in ProZell for battery cell production, which was started in 2016.



49

Using new materials, such as lithium-lanthanum-titanate with a perovskite crystal structure, KIT will produce safe and long-lived high-performance cells.

## EXCELLENCE IN THE SMALLEST DIMENSIONS

**Additive Manufacture on the Micrometer and Nanometer Scales**

Structures on the micrometer and nanometer scales play an important role in KIT's materials research and in particular in its Cluster of Excellence called 3D Matter Made to Order (3DMM2O). Within the Cluster of Excellence, scientists of KIT and the University of Heidelberg conduct interdisciplinary research into innovative technologies and materials for digital, scalable additive manufacturing processes to enhance the precision, speed, and performance of 3D printing. In addition to funds granted under the Excellence Strategy Competition of the Federation and States, 3DMM2O is financed by the Carl Zeiss Foundation.

The metamaterial printed with the new system consists of a complex three-dimensional lattice structure on the micrometer scale.

51

**News of the Cluster of Excellence 3D Matter Made to Order**

For some years now, two-photon microprinting has been studied extensively, as it can be used to produce micro-optical devices, microscaffolds for experiments with single biological cells, and so-called metamaterials. To extend its spectrum of use, new printable materials, such as photoresists, are required. Photoresists are printing inks used to print the smallest microstructures in three dimensions by so-called two-photon lithography. For printing, a

laser beam is moved in all spatial directions through the initially liquid photoresist. The photoresist hardens at the focal point of the laser beam only. Little by little, complex microstructures can be built in this way. In a second step, a solvent is used to remove the areas not exposed to radiation. What remains are complex polymer architectures in the micrometer and nanometer ranges.

Many applications do not only require precise printing on the micrometer scale, but also a far higher printing speed. Within the 3DMM2O Cluster of Excellence, scientists of KIT and Queensland University of Technology in Brisbane, Australia, developed a system to print highly precise, centimeter-sized objects with submicrometer details at so far unmatched speed.

A voxel is the 3D counterpart of a pixel in 2D printing. Several hundred thousands of voxels per second have been produced with a single laser light spot so far. This is nearly a hundred times slower than graphical inkjet printers. Low speed precludes many applications.

The newly developed system uses special optics to divide the laser beam into nine partial beams that each focus on a different focal point. All nine partial beams can be used in parallel and, thanks to improved electronic control, can be moved precisely at much higher speed. This and other technical improvements enabled the researchers to reach 3D printing speeds of about ten million voxels per second, which corresponds to the speed reached by 2D graphical inkjet printers.

Scientists of the Cluster of Excellence 3DMM2O have also developed a new photoresist for two-photon microprinting. For the first time, it enables printing of 3D polymer microstructures with cavities on the nanoscale, a type of porous nanofoam. This polymer foam has cavities of 30 to 100 nanometers in size, which are filled with air. As in a porous eggshell, the many small air holes in the porous nanoarchitectures make them appear white. Mixing white particles into a conventional photoresist would not have this effect, because the photoresist must be transparent for the laser beam during printing. The new type of photoresist is transparent prior to printing, while the printed objects are white and have a high reflectivity. The researchers from

Karlsruhe and Heidelberg demonstrated this by printing an Ulbricht sphere, an optical component as fine as a hair. Another promising feature is the extremely large internal surface area of the porous material. It may be used for filtration in the smallest spaces, for highly water-repellent coatings, or for the cultivation of biological cells.

### New Functions Thanks to Printed Materials

In the coming years, use of electronic components in commodities, e.g. for the Internet of Things, will increase. This will also result in an increasing volume of electronic scrap. Eco-friendlier production and a more sustainable lifecycle will help save resources and minimize waste volumes. Scientists of KIT were the first to produce biodegradable displays by inkjet printing in a customized, inexpensive, and material-efficient way.

Cameras, light barriers, and motion sensors have one thing in common: They work with light sensors that are indispensable in many applications. In the future, these sensors may also play an important role in telecommunications and enable data transmission via light. Scientists of KIT have reached significant progress at the Heidelberg Innovation Lab: They developed printable light sensors based on semiconductor materials, which may even distinguish colors.

Extremely thin polymer foils with a high light-scattering factor are the result of a new process developed by KIT. The inexpensive material may be applied industrially to various objects to give them an attractive white appearance. The process can help replace titanium oxide as a standard whitening material and make the products environmentally more compatible.

Color change: The right microcylinder printed with the novel photoresist appears white, because light is scattered in its sponge-like structure, whereas the cylinder printed with conventional photoresist appears transparent.

52



## CORONAVIRUS CRISIS

## KIT's Research and Help

In times of the global pandemic, scientists of KIT study the SARS-CoV-2 coronavirus and its impact on life and work in a number of projects. With their innovations, scientific and technical services, or data evaluations to provide a basis for political decisions, they help people and society cope with the pandemic. KIT's researchers also analyze social and technical consequences of the crisis. These selected examples illustrate the large range of topics covered by KIT.

### Data Analysis to Determine the Development of the Pandemic

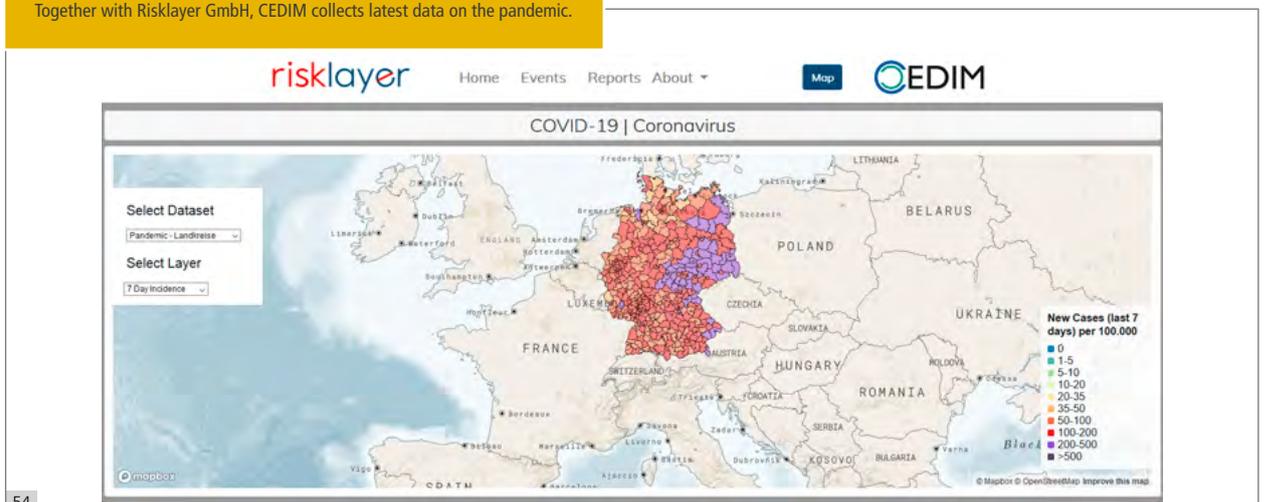
To obtain a quick overview of how the virus spreads in Germany and worldwide, the Center for Disaster Management and Risk Reduction Technology (CEDIM), together with its spinoff Risklayer GmbH, collects the latest data on the development of the pandemic. Interactive maps clearly show the latest numbers of persons infected with Covid-19 as well as other relevant information. Areas at risk can be identified down to the district level. The data are based on official statistics of health ministries and local governments and are also incorporated in the frequently cited figures provided by Johns Hopkins University. In Germany, the Tagesspiegel newspaper and ZDF broadcaster use the data for their news. Latest, precise figures are important to properly assess the extent of the pandemic on a regional scale. They are the basis for decisions made by politicians to protect the population.



53

The inexpensive aerobuster is about the size of a floor lamp and efficiently removes coronaviruses from the air.

Together with Risklayer GmbH, CEDIM collects latest data on the pandemic.



54

### Aerobuster Catches Coronaviruses

Aerosols that carry coronaviruses can spread quickly in space and remain in the air for hours. To remove these pathogens from room air, researchers of KIT have built an inexpensive, yet powerful device, the aerobuster. According to early results, it inactivates about 100% of model viruses. Aerobuster is about the size of a floor lamp and consists of a simple metal tube, a fan, a heating module, and a radiator that emits ultraviolet light of a certain wavelength. The aerosols are dried and the viruses inactivated by UV-C radiation. Aerobuster was developed by the Institutes of Nanotechnology, Data Processing and Electronics, Fluid Mechanics, Thermal Energy Technology and Safety, Meteorology and Climate Research, and Functional Interfaces.

### Short-term Forecasts of Covid Infections

Forecasts of future infections help assess the development of the pandemic. The “German-Polish COVID-19 Forecast Hub” supports these efforts. The online platform was developed by scientists from the Heidelberg Institute for Theoretical Studies (HITS) and KIT’s Institute for Economic Policy Research. The platform pools short-term forecasts of the development of the pandemic in Germany and Poland. Work is aimed at systematically comparing various forecasts, identifying highly reliable models, and estimating which combinations of forecasts produce the most reliable results. The project is supported by an interactive online visualization developed by Robert Koch Institute. 16 international research groups contribute their forecasts from their respective data models. These different data-sets are then pooled in an ensemble forecast.

The Institute for Economic Policy Research also studied the role of rules and habits during the pandemic, such as the willingness to wear masks. In addition, researchers analyzed factors that make people undergo testing. They found that increasing costs caused the demand for tests to decrease strongly. This is a consideration for political decision-makers. Access to testing should be as easy as possible.

55

During the pandemic, CO<sub>2</sub> emissions decreased considerably, while CO<sub>2</sub> concentration in the atmosphere continued to increase.



### Record Decrease in CO<sub>2</sub> Emissions Due to Covid

The pandemic has caused global fossil CO<sub>2</sub> emissions to decrease considerably – this is obvious from the annual balance of the Global Carbon Project (GCP), a worldwide association of climate researchers, in which the Institute of Meteorology and Climate Research is involved. Scientists of GCP analyze annual emissions of greenhouse gases. Their latest report reveals that five years after the Paris Climate Agreement, increase in global CO<sub>2</sub> emissions in the transportation sector in particular slowed down as a result of the restrictions associated with the pandemic. CO<sub>2</sub> concentration in the atmosphere, by contrast, continues to increase. According to the Paris Climate Agreement, CO<sub>2</sub> concentration and its contribution to the greenhouse effect will stabilize only if global emissions approach zero.

## PROGRAM-ORIENTED FUNDING BY THE HELMHOLTZ ASSOCIATION

**KIT Successfully Passes Evaluations for the Next Funding Period**

The Helmholtz Association steers research at its 19 centers by means of programs covering six research fields. These research fields define and shape trend-setting future research and develop system solutions. KIT is involved in eleven programs of the four research fields Energy, Information (previously: Key Technologies), Matter, and Earth and Environment. In addition, KIT will continue to operate the GridKa research facility, the Grid Computing Centre Karlsruhe.

In the past three years, the centers, programs, and research fields of the Helmholtz Association were subjected to a comprehensive two-stage evaluation process. It resulted in a new program structure for the fourth period of program-oriented funding (PoF IV) that started on January 01, 2021.

In connection with the implementation of the KIT 2025 Umbrella Strategy, the subproject "Medium- and Long-term Helmholtz Strategy" was launched as part of the lead project "Research Strategy" in 2017. This subproject served to coordinate KIT's preparations for PoF IV. In an iterative approach, all KIT bodies involved were prepared for the evaluations in constant exchange with each other. The strategic course of KIT's activities in PoF IV was discussed and defined. During the process, the Executive Board kept in close contact with all scientists. Their joint efforts were aimed at including KIT's important strategic research topics in the program structure of the Helmholtz Association and, at the same time, at adapting KIT's science structure to the requirements made by the Helmholtz Association and funding partners.

In the research field Energy, KIT places a focus on the energy transition.



56



In the research field Matter, KIT generates new input by research into energy-efficient accelerators and multi-messenger astroparticle physics.

In the first stage of scientific evaluation, which focused on the scientific quality of research, KIT presented its research activities in so-called "Research Units." From November 2017 to March 2018, these Research Units were evaluated by 86 international experts in the five panels of Earth and Environment, Key Technologies – Materials, Key Technologies – Information, Matter, and Energy. In the second stage of strategic evaluation from October 2019 to January 2020, KIT looked both back and ahead. The results developed in the third funding period (PoF III) were taken as a basis for the new profile in PoF IV. Altogether, the experts rated KIT's research activities as very good.

Strategic evaluation confirmed KIT's program structure for PoF IV. The topics in which KIT participated were mainly given ratings of categories A and B. KIT's great success in this evaluation process was mainly due to the cooperation of scientists of all the Helmholtz centers in the corresponding research fields. They succeeded in convincing the renowned experts of the panels with their results.

The transition from PoF III to PoF IV is associated with several structural changes at KIT: The Key Technologies research field has been strategically realigned and will become the research field Information in the new funding period. Here, KIT's focus is on materials research and in particular on information-based materials science and quantum technologies. Moreover, IT security is of high relevance, which is why KIT has established a new institute in this area. KIT also refocused its activities in the Energy research field and is involved in all four (formerly seven) programs. Research activities relating to renewable energy sources, energy storage systems, and energy efficiency are now pooled in the program "Materials and Technologies for the Energy Transition." In the program "Energy System Design," KIT places a focus on the holistic view of the energy system. The previously established and important programs of "Fusion" and "Nuclear Waste Management, Safety, and Radiation Research" will continue. In the research field Earth and Environment, the Helmholtz Association has pooled what had been five programs into one, which will include atmospheric research and in which urban research will play an important role. In the research field Matter, KIT will generate new input by research into energy-efficient accelerators and new detectors as well as into multi-messenger astroparticle physics. KIT's large infrastructure facilities, such as the Karlsruhe Center for Optics & Photonics (KCOP) that is presently being established or the Energy Lab 2.0, will contribute to the Helmholtz programs.

KIT is involved in two topics under the Helmholtz Program "Changing Earth – Sustaining our Future" in the research field Earth and Environment.

58



KIT's work in the research field Information concentrates on cyber security, quantum technologies, and information-based materials science.

#### KIT Participation in POF IV

##### RESEARCH FIELD ENERGY

- Energy System Design
- Materials and Technologies for the Energy Transition
- Fusion
- Nuclear Waste Management, Safety, and Radiation Research

##### RESEARCH FIELD INFORMATION

- Engineering Digital Futures
- Natural, Artificial and Cognitive Information Processing
- Materials Systems Engineering

##### RESEARCH FIELD EARTH AND ENVIRONMENT

- Changing Earth – Sustaining our Future

##### RESEARCH FIELD MATTER

- Matter and the Universe
- Matter and Technologies
- From Matter to Materials and Life
- GridKa (LK II – Large Research Facility)

## CLOSED CARBON LOOP

**Recycling of Automotive Plastics and Conversion of CO<sub>2</sub>**

In the Paris Climate Agreement of 2015, the global community has committed to limit global warming to less than two degrees Celsius by the end of the century. To reach this goal, global efforts to reduce greenhouse gas emissions must be complemented by solutions to close the carbon loop or to remove carbon dioxide from the atmosphere.

Many components in cars are made of various plastics depending on the requirements they have to meet. Whereas plastics of the same type can often be recycled mechanically, recycling of mixed plastic waste poses a major challenge.

To feed mixed plastics back into a resource-conserving circular system, scientists of KIT's Institutes for Technical Chemistry and for Industrial Production, in cooperation with Audi, have launched the pilot project "Chemical Recycling of Plastics in Automotive Engineering." The project is carried out by the THINKTANK Industrial Resource Strategies, which was established at KIT by the Baden-Württemberg State Government, industry, and academia.

Chemical recycling is the only method suited to convert mixed plastic wastes into products whose quality matches that of new products. Such closed material loops save valuable resources by reducing primary material consumption. For this research, Audi provides plastic components that are no longer needed, such as fuel tanks, wheel trim parts, and radiator grills. The plastic components are then processed to pyrolysis oil by chemical recycling.

Pyrolysis oil from mixed wastes will close the loop for plastics used in automotive engineering.



In the medium run, components based on pyrolysis oil can be used in automobiles again. The pilot project is aimed at establishing smart circular systems for plastics and at using this method to complement mechanical recycling and replace thermal processing for energy production.



An integrated pilot plant will be built on KIT's Campus North to test a new process for reducing CO<sub>2</sub> concentration in the atmosphere.

The research project NECOC (NEgative CarbOn dioxide to Carbon) goes a step further. Its goal is a novel process to generate "negative emissions." The planned test facility will convert CO<sub>2</sub> from ambient air into highly pure carbon black powder that can be used in the electronics, printing, or construction sectors. In this way, a hazardous greenhouse gas will be turned into a raw material for high-tech applications.

NECOC partners are KIT's Institutes for Thermal Energy Technology and Safety and Thermal Process Engineering as well as the companies Ineratec GmbH and Climeworks Deutschland GmbH. The Federal Ministry for Economic Affairs and Energy funds the research project with a total of EUR 1.5 million.

## STRATEGY DIALOG FOR THE AUTOMOTIVE SECTOR IN BADEN-WÜRTTEMBERG

### Future Mobility with Regenerative Fuels

In 2017, the Baden-Württemberg State Government, together with manufacturers, suppliers, employee representatives, scientists, and society at large, initiated the Strategy Dialog for the Automotive Sector in Baden-Württemberg. Since then, the partners have been working on the challenges associated with the transformation of one of the most important sectors in Germany. The aim is to make this change a success for people, industry, and climate protection and tap innovation across industries.



62

The efficient production of renewable fuels is the goal of "reFuels – Rethinking Fuels."

In area VI of the Strategy Dialog "Research and Innovation Environment," KIT directs the lighthouse project "Future Mobility" in collaboration with Stuttgart University. Both institutions are pooling their expertise in fundamental research and technology transfer. Within the framework of the Strategy Dialog, Minister-President Winfried Kretschmann and Professor Dr. Thomas Hirth, KIT Vice-President for Innovation and International Affairs, also launched the project "reFuels – Rethinking Fuels."

The reFuels research initiative of KIT, the Baden-Württemberg Ministry of Transport, another three state ministries, and a number of partners from automotive, suppliers, and mineral oil industries focuses on the efficient production and use of regenerative fuels, or "refuels" for short. The project partners test the refuels in existing vehicle fleets and work to enhance the society's acceptance of these fuels. In addition to the development of electric mobility, regenerative fuels represent a promising option to achieve CO<sub>2</sub>-neutral mobility.

The Innovation Campus "Future Mobility" (ICM) will create new, pioneering technologies in the areas of mobility and production. The first two pilot projects cover zero-emission drives and additive manufacture, i.e. use of 3D printers to produce high-quality and operational (light-weight) components as well as components with novel functions. KIT and Stuttgart University join forces to think

about new forms of mobility, flexible production technologies, and future value networks and to study them across disciplines. The ICM addresses the transformation process in the mobility sector. Excellent fundamental research and new, innovative processes will give rise to disruptive technologies and innovative leaps in the areas of "Advanced Manufacturing" and "Zero-emission Mobility."

In 2019, the Baden-Württemberg Ministry of Science, Research, and the Arts funded the ICM with EUR 10 million for five years (in early 2021, the funding was increased by another EUR 50 million).

## INDEPENDENT IN OLD AGE

**New Generation of Humanoid Robots for the Elderly**

Staying independent and in familiar surroundings as long as possible in old age – this is the wish of most of us. And it is one of the most pressing challenges faced by society. Achieving this wish may be made possible by humanoid assistance robots that help people cope with everyday life and with wearable robots, so-called exoskeletons, that support the movements of the wearer.

To make such futuristic robotic solutions suited for everyday life, researchers of the Institute for Anthropomatics and Robotics are developing a new generation of humanoid ARMAR robots in the project “JuBot – Young at Heart with Robots: Versatile Assistance Robotics for Managing Everyday Life.” The idea is that robot helpers will take over everyday tasks in the household, such as fetching objects, loading dishes into the dishwasher, or communicating via various channels with the relatives of the person they care for. In addition, researchers plan to study and develop wearable robots, or exoskeletons, that not only support personal mobility of the elderly, but also enable specific training of motor and cognitive skills.

Through interaction with humans, the JuBot robots will learn continuously and adapt to human needs and habits. The ARMAR robots already perform complex tasks in a kitchen environment. They learn from and interact with humans using natural language. A human-centered approach enhances versatility and customization of the systems as well as guiding tests in everyday surroundings. The robots will first be trained in a human-robot apartment at KIT and later tested at a retirement home in Karlsruhe. The JuBot team will not only push research into intelligent assistance robotics, but also seeks a breakthrough in supporting a self-determined life of elderly people.

When using assistance robots in human-robot living spaces, it is also important to consider such aspects as privacy protection, surrounding edifices, and impact on society. For this reason, KIT experts in robotics, artificial intelligence, human-machine interfaces, IT security, engineering, sports sciences, architecture, and technology assessment are jointly working on this project.

In the program line of “Breakthroughs,” the Carl Zeiss Foundation funded six interdisciplinary research projects on smart solutions for an aging society in 2020. The JuBot project of KIT was granted EUR 4.5 million by the Foundation.



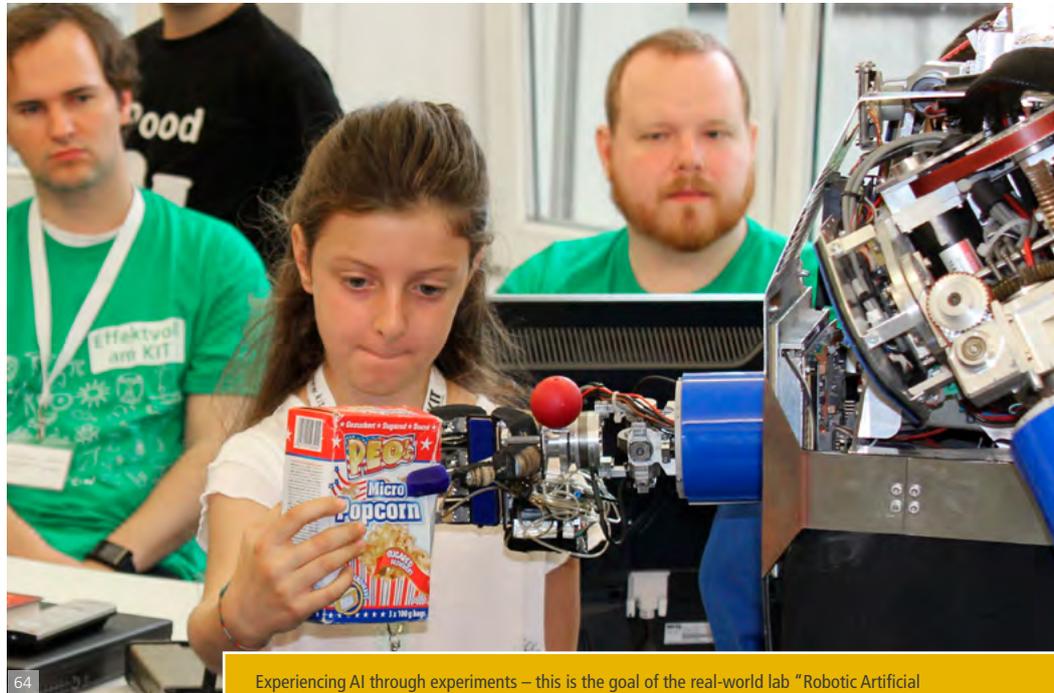
The humanoid ARMAR robots – here ARMAR-III – were developed to take over activities in the household or in industrial environments. The next generation will support the elderly in everyday life.

## NEW REAL-WORLD LAB AT KIT

### Experiencing Artificial Intelligence through Humanoid Robots

Real-world labs foster close collaboration between science and society and their close interaction in addressing a complex problem.

Artificial intelligence, or AI for short, is the stuff of imagination, films, and stories, but it also is reality. The superhuman capacity of AI is obvious in games as well as in image and language processing, in autonomous driving, in digital language assistants, and chatbots. Research into humanoid, i.e. human-like, robots fascinates people, as they give abstract methods of AI a physical appearance that can be experienced.



Experiencing AI through experiments – this is the goal of the real-world lab “Robotic Artificial Intelligence” of KIT.

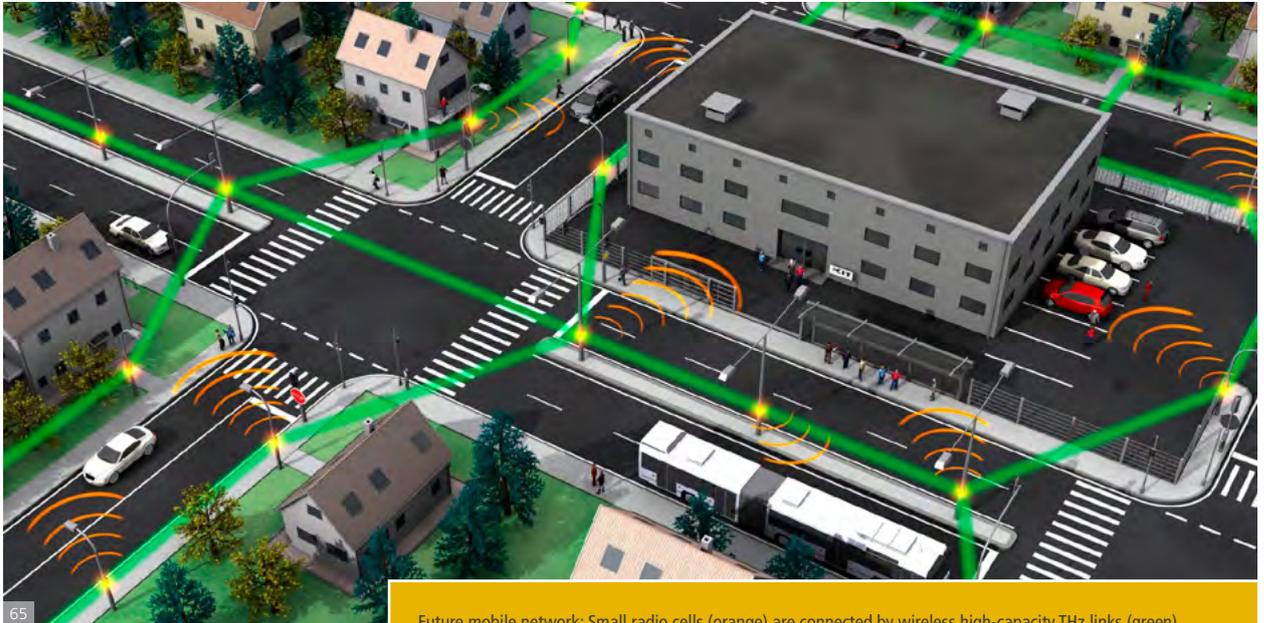
While the JuBot project (see page 32) focuses on the development and testing of technology in everyday life, the new real-world lab “Robotic Artificial Intelligence” at KIT is aimed at making AI tangible in a variety of experiments and different environments. At a new building of the municipal hospital, the next generation of the KIT-developed humanoid ARMAR robots will support hospital staff by, for instance, guiding patients from the reception area to the hospital wards. At the Children’s Universe, the daycare center of KIT, robots will help children who are learning foreign languages. At the municipal library, they will read to children. At the Goethe-Gymnasium and other schools in Karlsruhe, children will learn in a playful way the basic concepts of computer science and AI. At KIT, students from all over the world can use robots to conduct remote experiments. At ZKM – the Karlsruhe Center for Art and Media, humanoid robots will interact with visitors.

Exchange of knowledge and experience at a real-world lab takes place in both directions: Research and application meet on equal footing for subsequent development of technologies that humans need and want. The lab is funded with EUR 800,000 from the Baden-Württemberg Ministry of Science, Research, and the Arts.

AI and robotics for industry, the care sector, and education will change our lives. KIT is working to optimize these opportunities for the betterment of our society. At the same time, it is addressing the potential risks of AI and AI robots.

KIT has a long tradition of operating real-world labs: The new Karlsruhe Transformation Center for Sustainability and Cultural Change (KAT) is directly based on the facilities, expertise, and experiences of KIT’s real-world labs “District Future – Urban Lab” and “Urban Transition Lab 131,” which have already received numerous awards (see page 94).

## TERAHERTZ RECEIVER FOR 6G MOBILE COMMUNICATIONS

**Highest Data Rate in Terahertz Transmission**

65

Future mobile network: Small radio cells (orange) are connected by wireless high-capacity THz links (green).

5G will be followed by 6G: The sixth generation of mobile communications promises even higher data rates, shorter latencies, and greatly increased densities of terminal devices. Moreover, artificial intelligence will be used to coordinate devices in the Internet of Things or autonomous vehicles.

Wireless networks of the sixth generation (6G) will consist of a multitude of small radio cells. In these radio cells, distances are short so that high data rates can be transmitted with minimal energy consumption and low electromagnetic emissions. They will only need small base stations that can be mounted easily to streetlights for example.

To connect the radio cells, high-speed wireless links will be needed for the transmission of data rates of tens or even hundreds of gigabits per second. These may be at frequencies in the terahertz range. In the electromagnetic spectrum, they range between microwaves and infrared light waves. However, terahertz receivers still are rather complex and expensive and often represent a bandwidth bottleneck. In cooperation with Virginia Diodes in Charlottesville, USA, researchers at KIT designed a rather simple and inexpensive receiver for terahertz signals.

The receiver consists of a single diode to rectify the terahertz signal. It is a so-called Schottky barrier diode that is characterized by high speed. It acts as an envelope detector to recover the amplitude of the terahertz signals. Correct decoding of the data signal, however, additionally requires the time-dependent phase of the terahertz wave that is usually lost during rectification. To overcome this problem, researchers use digital signal processing techniques in combination with a special class of data signals, for which the phase can be reconstructed from the amplitude.

Using their new receiver, the scientists achieved a transmission rate of 115 gigabits/s at a carrier frequency of 0.3 terahertz over a distance of 110 m, so far the highest data rate reached by wireless terahertz transmission over more than 100 m. The terahertz receiver developed by KIT stands out due to its simple design and is suited for cost-efficient mass production.

## CATALYST RESEARCH

### TrackAct CRC Covers Theory and Practice

Many important technologies, such as energy conversion, emission reduction, and chemical production work only with the help of suitable catalysts. To further improve heterogeneous catalysts, the complex processes that take place at the active sites on their surfaces must be analyzed.

The vision of the KIT's Collaborative Research Center (CRC) TrackAct approved by the German Research Foundation in November 2020 is to design noble-metal catalysts with atomic precision and to study and control their structure, particularly the active site in the chemical reactor. Catalysts need to be made more active and long-lived. For this purpose, the structure of the noble metals has to be adjusted precisely by specific synthesis under defined reaction conditions. In the future, this will considerably reduce the amount of noble metals consumed.

It is one of the goals of the CRC to model structures and length scales with the help of theoretical models and simulations in order to predict all catalyst properties and ideally adjust the structure and reactor. Consequently, the CRC covers the development not only of new

catalysts, but also of novel preparation, characterization, and digitization methods that will play an important role in future research far beyond catalysis. The spokesman of TrackAct is Professor Dr. Jan-Dierk Grunwaldt, Head of the Institute for Chemical Technology and Polymer Chemistry.

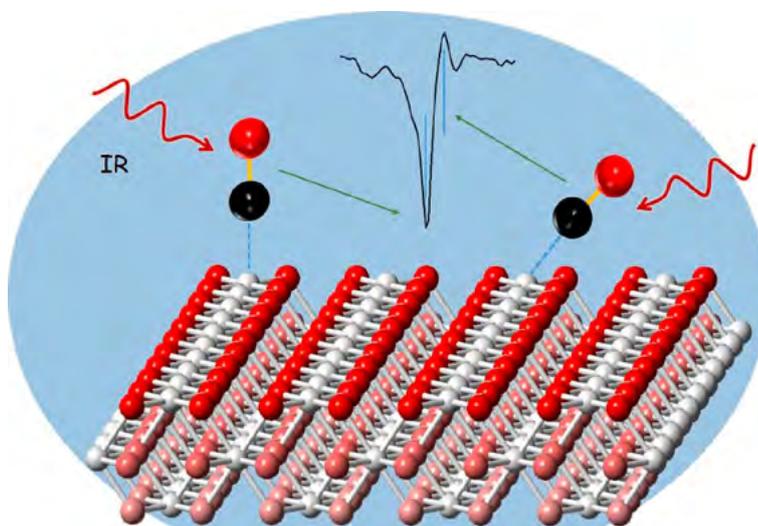
KIT pools various catalysis research activities in the new CRC. In cooperation with colleagues from Spain and Argentina, KIT researchers identified and solved a major problem of theoretical analysis. Processes on the surface of powder catalysts can be studied with the help of probe molecules, such as carbon monoxide molecules, that bind to the powder. So far, the interpretation of experimental data has been difficult, because deviations between theoretical calculations and experiments were too large. The methods being developed now will make the calculations very complex, but also highly precise.

Another group succeeded in visualizing the three-dimensional structure of technical catalysts and in looking into chemical reactors during catalyst operation. Using a special chemical reactor, researchers observed an active catalytic process by tomography and X-ray

spectroscopy and examined the specific structure and function in detail. They determined whether the reactor worked at maximum efficiency and – more importantly – succeeded in understanding the underlying processes.

Cerium oxide catalysts can be analyzed using carbon monoxide probe molecules and infrared reflection absorption spectroscopy.

66



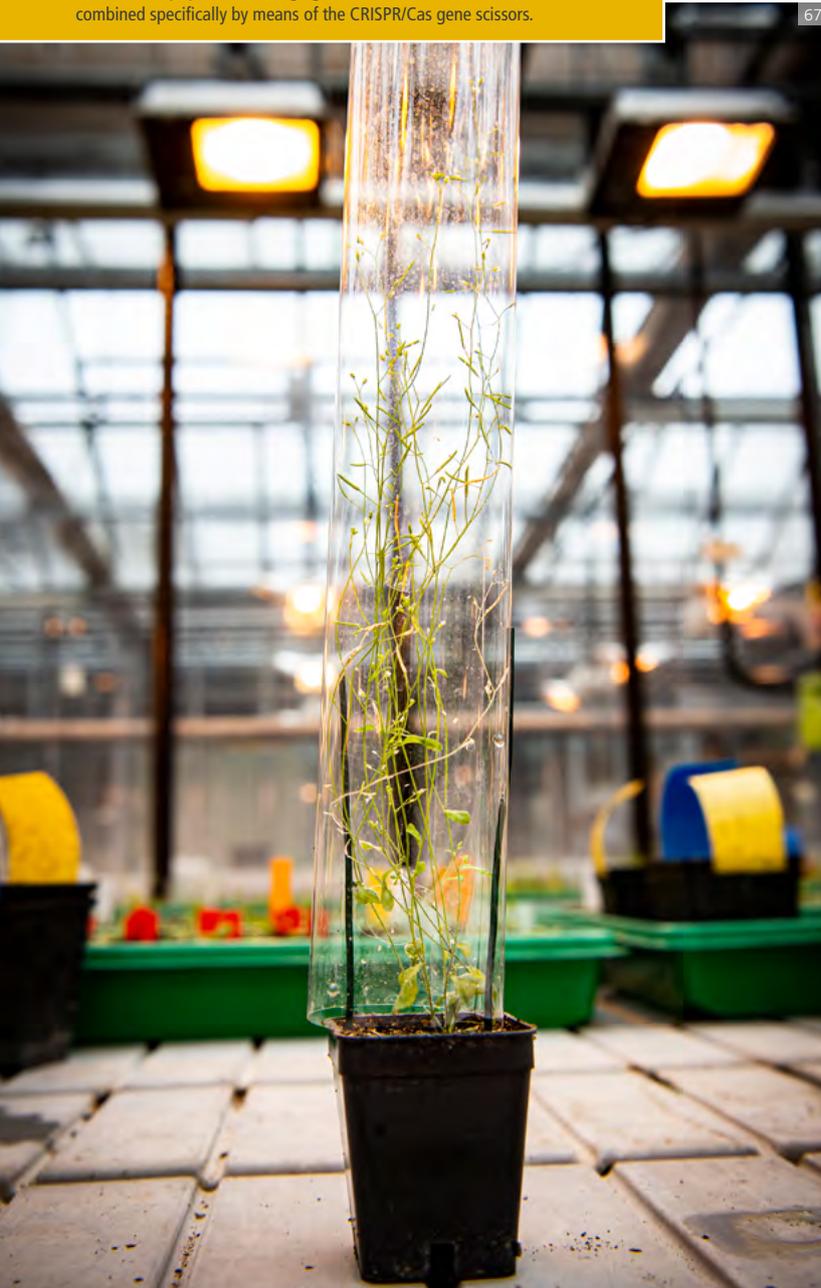
## SPECIFICALLY CONTROLLING INHERITANCE IN PLANTS

**First Recombination of Genes on a Chromosome with CRISPR/Cas**

About 5000 years ago, genetic information of thale cress (*Arabidopsis thaliana*) was modified. To date, it has spread widely and is of major interest to science. On chromosome 4 of the plant, a so-called inversion occurred: The chromosome broke at two points and was reassembled again. The broken-out section was reinserted, but rotated by 180 degrees. As a result, the sequence of genes on this chromosome section was inverted. This chromosome mutation known as Knob hk4S is an example of evolution changing the genetic material of organisms.

To better adapt plants to changing environmental conditions, their traits can be combined specifically by means of the CRISPR/Cas gene scissors.

67



Inversions not only occur in thale cress, but can also be found in crop plants. They are an obstacle to cultivation that uses modifications of the genetic material to produce maximum yields and good taste and to make the plant resistant to diseases, pests, and extreme climatic conditions.

Researchers from KIT's Botanical Institute were the first to succeed in undoing natural inversions and extending the applications of the CRISPR/Cas molecular scissors. They exchanged arms between chromosomes and also recombined genes on a single chromosome. For the first time, they demonstrated that it is possible to directly control inheritance processes. The team achieved genetic exchange in an area where this has been impossible before. Chromosome engineering thus was established as a new type of crop cultivation method.

Together with researchers from the Leibniz Institute of Plant Genetics and Crop Plant Research in Gatersleben and the University of Amsterdam, KIT scientists took the Knob hk4S inversion and demonstrated how it can be undone and how genetic exchange can be achieved in cultivation. The researchers think that it is also possible to use CRISPR/Cas to produce new inversions so as to combine desired traits and eliminate undesired properties in crop cultivation.

CRISPR (stands for Clustered Regularly Interspaced Short Palindromic Repeats) acts on a certain section on the DNA that carries the genetic information. Cas is an enzyme that recognizes this section and cuts the DNA precisely at that point in order to remove, insert, or exchange genes, recombine chromosomes, and, for the first time, modify the gene sequence on them. In 2020, the discoverers of the CRISPR/Cas method were granted the Nobel Prize for Chemistry. Research at KIT now transfers this method to application.

## RESEARCH FOR SOCIETY

# Projects on Radicalization and Urban Mobility and New Study Relating to Consumption Behavior

### Preventing Extremism

KIT researchers are partners in the project “Radicalization Monitoring System and Transfer Platform” (MOTRA). They analyze radicalization processes and identify new IT and communication technologies used to connect extremists, disseminate their ideas, and encourage acts of violence. Security authorities, by contrast, consider these technologies new chances of control and surveillance. The MOTRA project brings together state and non-state institutions to strengthen practical prevention work in Germany.

Studies focus on what happens when both security authorities and potential offenders use digital technologies and cover the impacts of extremist networks on objects of protection, social impacts, and ethical aspects of technology-based prevention options. The German Federal Criminal Office (BKA) coordinates MOTRA, which is funded by the Federal Ministry of Education and Research under the program “Research for Civil Security.”

### Excuses and Indulgence Effects in Consumption

KIT researchers found that a single ethical improvement may make people feel that they no longer need to consider other ethical aspects involved in purchasing and cause them to justify immoral behavior. Based on an example, they documented that customers unconsciously use a single ethical aspect as an excuse for a less moral behavior regarding other aspects of the same product or as related to other people.

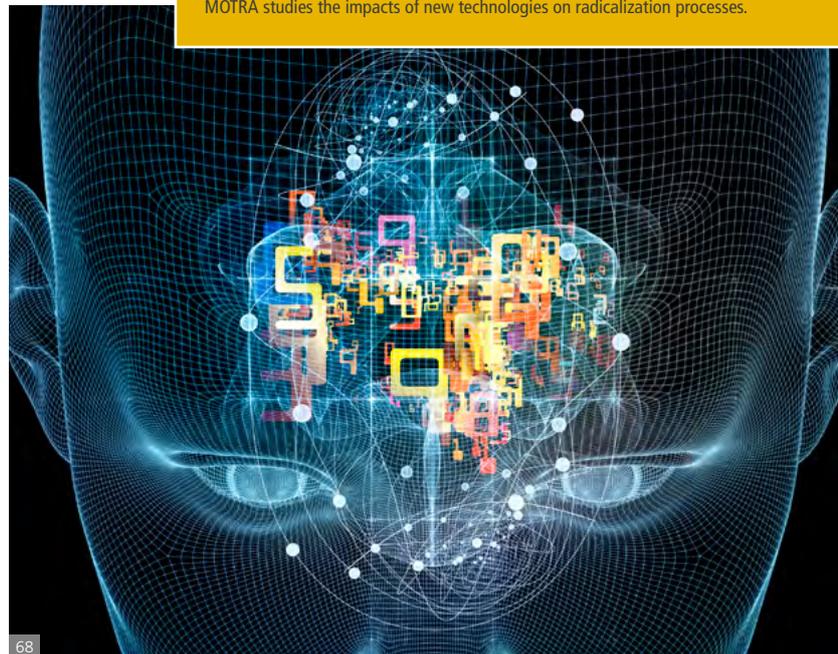
It turned out that test subjects who chose pure organic cotton towels were far less willing to pay for safe work standards than those choosing conventional cotton. This behavior was not limited to just that purchasing situation. The participants used their decision in favor of pure organic cotton even thirty minutes later as an excuse for being more selfish and to donate less to the poor.

### When Cyclists and Pedestrians Meet

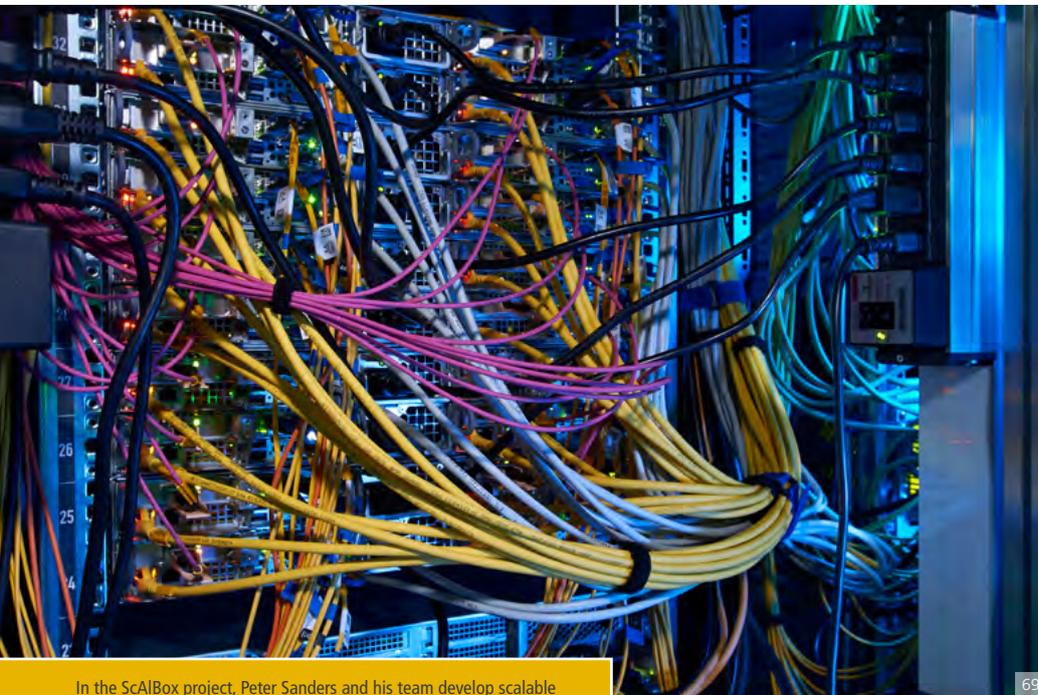
Within the new “Cape Reviso” project, researchers at KIT study how cyclists and pedestrians feel when they meet in urban traffic. The project partners are KIT, the High-Performance Computing Center Stuttgart, and the Allgemeiner Deutscher Fahrradclub e.V. (General German Bicycle Club). Their goals are an analysis using a new methodology and development of innovative instruments for evidence-based, conflict-free urban planning. The expertise pooled by the “Urban Emotions” initiative in Karlsruhe will be used to consider the views of traffic participants.

There are many interfaces between walking and cycling, such as combined sidewalks and cycle paths, and quite a few of them are dangerous. The project that started in October 2020 focuses on how transport areas in cities can be planned to reduce conflicts. The project is financed by the Federal Ministry of Transport and Digital Infrastructure from funds of the National Bicycle Traffic Plan.

MOTRA studies the impacts of new technologies on radicalization processes.



## ERC ADVANCED GRANT FOR SCALBOX PROJECT

**Scalable Algorithms for Many Applications**

In the ScAlBox project, Peter Sanders and his team develop scalable algorithms for parallel processors.

69

As an expert of algorithm engineering, which combines theoretical with experimental approaches, Peter Sanders works on modeling and designing algorithms, their implementation in computer programs, and their experimental evaluation. His research concentrates on parallel computing and processing of big data volumes.

In the past, the scientist and his team succeeded in increasing the capacity of route planners to millions of route calculations per second by the smart use of algorithms. For this, they were repeatedly granted a Google Research Award. Algorithm engineering can also be used to enhance the efficiency of company software in supplying reliable business data.

The ScAlBox project is aimed at providing algorithms and software libraries that can handle big data volumes and be executed on millions of parallel processors. The European Research Council (ERC) funds the project via an Advanced Grant.

The digital revolution has profoundly changed science, engineering, and everyday life. Computer applications process increasing data volumes with ever more complex algorithms. However, progress is now in danger of reaching its limits: Scalability of the programs, i.e. their capacity to grow with their tasks, represents a major challenge.

The performance of individual processors is limited. To solve bigger problems, many processors have to be used in parallel. However, research on parallel algorithms has been neglected for a long time. Software is optimized for existing systems and datasets, but cannot yet be scaled to growing data volumes and an increasing number of processors. This is the point of departure of the project "ScAlBox – Engineering Scalable Algorithms for the Basic Toolbox," headed by Professor Dr. Peter Sanders, Institute of Theoretical Informatics.

With Advanced Grants, the European Research Council funds pioneer projects of established researchers who have made outstanding scientific achievements in the ten years prior to their proposal. The scientists are granted up to EUR 2.5 million for a period of up to five years for their projects.

## ACCELERATING DRUG RESEARCH ERC Synergy Grant for HiSCORE Project

Nuclear magnetic resonance (NMR) is an important tool in drug research because it can quantify and spatially resolve how drugs bind to pathogens. So far, however, NMR has lacked the sensitivity and throughput to efficiently scan large libraries of drug candidates. Within the HiSCORE project, the research teams of Professor Dr. Jan Gerrit Korvink, Director of the Institute of Microstructure Technology, and Dr. Benno Meier, Institute for Biological Interfaces, in cooperation with partners from Paris and Nijmegen, are developing a method for high-throughput screening. This project is funded by a Synergy Grant of the European Research Council (ERC).

Conventional substance screening methods can test up to one million substance candidates per week. These methods provide information of low dimensionality and poor quality, however. NMR provides very rich information, but with a low throughput and at high cost to date. HiSCORE (Highly Informative Drug Screening by Overcoming NMR Restrictions) merges all of the most innovative branches in the field of NMR – including hyperpolarization, microcoils, microfluidics, parallel acquisition, and machine learning – to tackle this pharmacological challenge. This would accelerate the processes by a factor of ten thousand.

KIT scientists use miniaturization technology to conduct a large number of measurements in parallel. Together with Radboud University in Nijmegen, the Netherlands, they develop methods for parallel orientation, or polarization of nuclear spins, in the samples. In this way, nearly all spins will contribute to the signal and signal intensity can be increased by up to four orders of magnitude compared to standard NMR experiments. It is also important to generate these hyperpolarized liquids at a sufficiently high rate. The boost in signal strength enables a significant reduction in

sample size and the amount of material required. This reduction in sample size will pave the way towards parallelization. A team from Paris will improve methods to quantitatively evaluate interactions between biomolecules and drug molecules.

The European Research Council awards Synergy Grants to groups of two to four principal investigators working together and bringing different skills to tackle ambitious research problems.

In HiSCORE, the NMR probe (left) with a miniaturized detector (right) is combined with powerful hyperpolarization to capture binding processes of substance candidates.





## TEACHING

The number of KIT students totaled 23,321 in the 2020/21 winter semester, about 4.3% less than in the previous year. The proportion of international students decreased slightly to 21.6%, while the share of female students remained constant at 29.4%. In the 2020/21 winter semester, KIT's Department of the Humanities and Social Sciences launched a philosophy / ethics course as part of the master's degree program "Lehramt an Gymnasien" (teaching at secondary schools). The pandemic posed a number of new challenges for the students. To help them cope with these challenges, KIT offered numerous support services.

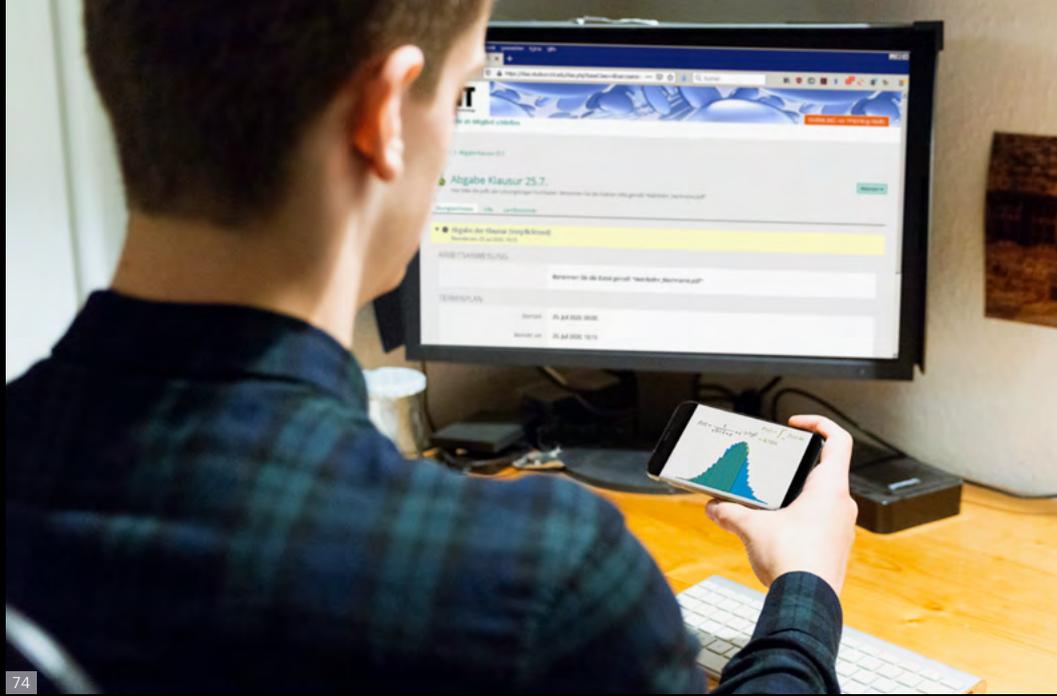


In the summer semester 2020 and in the 2020/21 winter semester, KIT's academic education took place principally online (for more details, see page 44). KIT offered emergency care services for toddlers and pupils of classes 1-7 whose parents work at KIT. These services were also available to students who had to prepare for examinations and could not care for their children.

International students of KIT who were in financial distress after starting their studies because of the pandemic could apply for emergency aid of EUR 500 per month for a maximum of three months with the International Students Office of the Inter-

national Affairs Business Unit. This emergency aid was financed by the Baden-Württemberg Ministry of Science, Research, and the Arts. On request, they were exempted from the payment of tuition fees.

In accordance with the Corona Ordinance of the State of Baden-Württemberg, the KIT Library had to close completely to visitors. However, it offers a wide range of digital services that can be used from home.





75



## STUDIES DURING THE PANDEMIC

**Digital Teaching and Flexibility for Required In-person Courses**

In-person academic education at universities was suspended in mid-March 2020 under the State's Corona Ordinance. The Ordinance, initially valid until April 19, was extended repeatedly and remained effective for the entire 2020 summer semester and the following winter semester 2020/21. Digital courses were permitted. Within a few weeks, KIT's Library, Steinbuch Centre for Computing (SCC), and Center for Technology-Enhanced Learning (ZML) jointly created the IT necessary for a successful online semester in all degree programs. Lectures of the summer semester at KIT started on April 20, 2020 as planned, but in digital form.

Ongoing and planned examinations in the winter semester were initially suspended and postponed. Following the amendment of the infection protection regulations by the State Government on April 20, KIT was permitted to organize oral examinations in the presence of a maximum of five persons or in the form of video conferences. With a detailed room and hygiene concept, written examinations could take place again after May 18. As even the biggest lecture halls of KIT offered space for not more than 36 students when complying with infection protection provisions, KIT moved the examinations to the city's biggest convention halls. There, up to 360 students could write their exams at the same time. In addition, a big tent was put up on Campus South. KIT's

Event Management Group ensured pandemic-compliant organization and smooth proceedings.

Amendment of infection protection legislation by the State in mid-May gave KIT more flexibility. The summer semester that had been purely digital until then was turned into a mix of digital and in-person courses. Excursions, field trips that could not be simulated at home or on the computer, work with expensive or complex measurement instruments, or chemical experiments that could not be executed at home for safety reasons became possible again with certain restrictions.

"Both rapid change to online courses and gradual, responsible resumption of a limited number of on-campus courses were possible only due to the really great commitment of our KIT staff," says Professor Alexander Wanner, KIT Vice-President for Higher Education and Academic Affairs. "Teachers and students coped with the challenges rather well. Of course, we would have preferred many things to be different, but it is a massive crisis – and under these circumstances, we have made the best of it. It is quite true to say that it was no 'lost semester,' but a semester in which students could achieve significant progress."

Students on Campus South: Compliance with the Corona regulations was mandatory both outdoors and indoors.



## LAYING OF FOUNDATION STONE FOR NEW STUDENT RESIDENCE

### Additional Housing for Students of KIT at Schroff Kolleg

As in many other university cities, accommodation for students is in short supply in Karlsruhe. At the start of the winter semester, demand usually is many times higher than supply. Beginning students of the first semester desperately look for accommodation and ultimately are forced either to pay high prices or to live far outside of Karlsruhe. This situation will be eased by a new student residence that will provide additional, affordable accommodation.

With 1,276 rooms, the "Studentenwohnheim des Karlsruher Instituts für Technologie (KIT) e.V." (student residences association of Karlsruhe Institute of Technology) is the largest non-profit provider of student accommodation in Karlsruhe after the Studierendenwerk. With funds of the Schroff Foundations, the association is now building a student residence on Hagsfelder Allee, which will offer accommodation for 103 students. The new building will offer inexpensive housing and enable intercultural living for all students.

The new student residence is named after Ingrid and Gunther Schroff, whose foundation will support construction with an amount of EUR 1 million. The construction budget totals about EUR 9 million. In spring 2022, construction work will be completed. The new residence is located about one kilometer away from Campus South of KIT close to the student residences of the Hans-Dickmann-Kolleg (HaDiKo).

On the occasion of the 25<sup>th</sup> anniversary of their corporate group, Ingrid and Gunther Schroff in late 1984 established the Schroff Foundations with private assets. It was their defined goal to use their entrepreneurial success for relevant scientific and social needs. After the



On Hagsfelder Allee, the Schroff Kolleg will offer accommodation for more than 100 students by spring 2022.

death of Gunther Schroff, who was Honorary Senator of the then Universität Karlsruhe (TH), Ingrid Schroff, Honorary Senator of KIT, continued her sponsorship. The foundation also supported the extension of the HaDiKo-K1 building in 2012, which resulted in additional accommodation for 45 students. Moreover, it endows professorships in innovative areas and international knowledge exchange and funds awards and scholarships for highly talented young researchers of KIT.

The Studentenwohnheim e.V. association was established 68 years ago and, hence, is one of the oldest providers of student residences in Karlsruhe and the biggest private provider of accommodation for students in Germany. So far, residences have been operated at four locations in Karlsruhe with a total of 1276 rooms. Of these, 999 can be found in HaDiKo. The affordable accommodation is very popular among international students. About 35% of the students living there are internationals.

## SYSTEM ACCREDITATION

**Outstanding Quality of Study Programs and Teaching at KIT**

Following the introduction of the bachelor's/master's system within the Bologna process, all study programs of KIT have to be accredited at regular intervals. For this purpose, KIT developed KIT-PLUS, an internal quality management scheme. In past accreditations, an external body, the Accreditation Council, confirmed the appropriateness of this quality management scheme based on national and European regulations.

Regular accreditation of study programs serves to assure their quality. As a rule, each study program is subjected to an accreditation process that includes an external accreditation agency. This process is very complex and costly. Only system-accredited universities having an appropriate internal quality management scheme for higher education are allowed to accredit programs on their own. The internal quality management ensures the high academic quality and formal correctness of the programs.

After KIT was granted system accreditation in 2014, the quality management scheme was evaluated again by an external group of international experts in February 2020. The team consisted of three university teachers from other universities with vast experience in quality assurance in academic education, a student representative, a representative of professional practice, and a representative of the Baden-Württemberg State Ministry of Edu-

cation. Based on the positive findings of the experts, the Accreditation Council declared the system accredited. On October 1, 2020, KIT was again granted the right to accredit its programs on its own and to confirm internationally recognized quality for another eight years.

KIT's quality assurance process KIT-PLUS is organized analogously to external program accreditation and consists of several steps. PLUS stands for "Programm-evaluation Lehre und Studium" (studies and teaching program evaluation). KIT-PLUS helps the KIT departments systematically analyze and further develop the quality of their programs. The analysis is based on a number of quality criteria that account for the perspectives of both students and teachers. Moreover, data on the programs and interviews of students and graduates are considered. All bachelor's and master's programs of KIT are regularly subjected to the KIT-PLUS process.

System accreditation was completed successfully. In the next eight years, KIT will have the right to assure quality of its programs on its own.

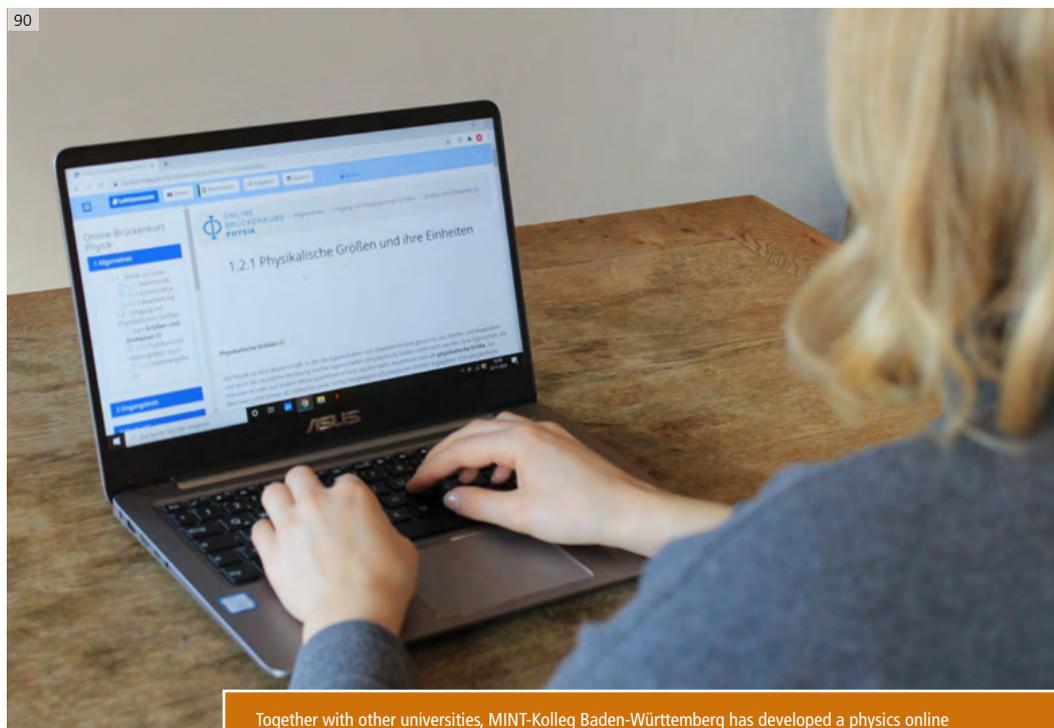


## WELL PREPARED FOR STUDIES

### Physics Online Course Facilitates Start of Studies

Forces and their effects, the concept of electric charge, and the law of reflection and refraction – this and other knowledge of physics is needed when studying engineering or natural sciences. Engineering in particular deals with the development of technical instruments and systems based on the laws of physics.

Prospective students and first-semester students can brush up their knowledge by attending a physics online course. The cost-free e-learning course was developed by the MINT-Kolleg of KIT and Stuttgart University in cooperation with twelve other German universities. The course was certified by TU9 – German Universities of Technology.



Together with other universities, MINT-Kolleg Baden-Württemberg has developed a physics online course for beginning students.

The physics online course is based on a comprehensive online concept and standards for students starting physics study. The MINT-Kolleg coordinated the contents, was responsible for quality management, and developed most of the online modules. Four chapters cover basic issues of physics that are important in the first semesters of engineering or natural sciences study: Mechanics, electromagnetism, optics, thermodynamics.

Texts are complemented by illustrative examples, instructional videos, representations of experiments, and interactive applets. Exercises serve to repeat and deepen the lessons learned. Course participants can pass entrance and final tests in the modules to control progress and to identify knowledge gaps.

The physics online course was developed by MINT-Kolleg Baden-Württemberg in cooperation with RWTH Aachen University, Aachen University of Applied Sciences, Technische Universität Berlin, Technische Universität Dresden, University of Applied Sciences of Reutlingen, the partners of the Hamburg MINTFIT project (University of Applied Sciences Hamburg, HafenCity Universität

Hamburg, Hamburg University of Technology, Universität Hamburg), Ruhr-Universität Bochum, Rosenheim University of Applied Sciences, and Mittelhessen University of Applied Sciences.

MINT-Kolleg Baden-Württemberg is a joint institution of Karlsruhe Institute of Technology and Stuttgart University. Its courses for prospective and beginning students facilitate the start of studies in STEM subjects. The institution is funded by the Baden-Württemberg Ministry of Science, Research, and the Arts as well as by the Federal Ministry of Education and Research. STEM – that corresponds to the German MINT – stands for science, technology, engineering, and mathematics.



## INNOVATION

As in the previous year, the German Startup Monitor ranking of the Association of German Startups ranked the KIT second among the ten best entrepreneurial universities. This means that KIT is one of the universities that produces the most young entrepreneurs.

This is not without reason: Innovation is part of the statutory mission of KIT, on par with research and teaching. Via the KIT Founders Forge, KIT supports startup projects of students, employees, and alumni by a wide range of offers and services, such as funding and upscaling an idea to create a successful business. Work also focuses on



connecting founders with network partners and investors.

One successful startup of KIT is Kimoknow, which began business in May 2020. Kimoknow develops digital assembly assistants based on automatic AI-supported object recognition. Their technology automates the training of algorithms with image data. An object recognition system trained in this way can be used for a variety of applications. An example is augmented-reality glasses that acquire relevant objects in the field of view and provide necessary information about them.

Although pandemic-caused travel restrictions will be lifted sooner or later, travelers have to remain careful for now and will prefer accommodations with strong hygiene and protection features for a long time yet. The startup Hotel Resilient supports hotels worldwide with their cost-free "COVID-READY" service. It includes hygiene and protection standards, self-audit software, an e-learning module, and a certification option.



92



96



99



101



102



100



105



106



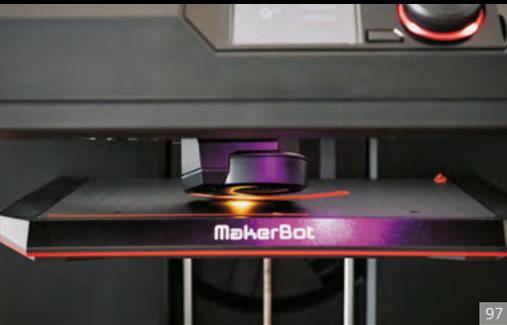
93



94



95



97



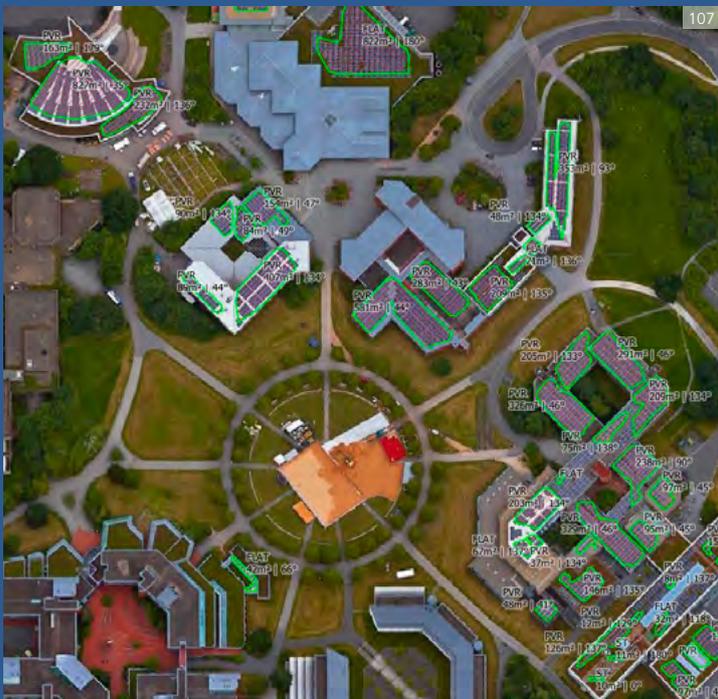
98



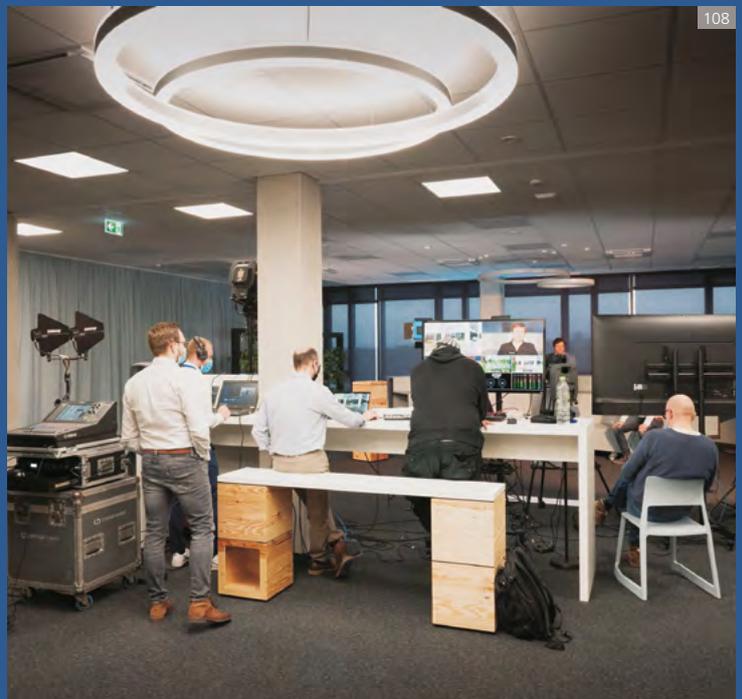
103



104



107



108

## FINDING A DREAM JOB VIRTUALLY

**KIT Career Fair@home Has More than 2,000 Participants**

In 2020, everything was different, and so the KIT Career Fair also entered new terrain. The pandemic made it impossible to welcome students, doctoral researchers, and alumni of KIT in the big fair tent and prevented them from meeting the exhibitors personally. But in spite of all the contact and travel restrictions and social distancing, the 3-day job fair took place – virtually.

In a joint effort, KIT organized one of its first large digital events with about 100 exhibitors from industry by virtually reconstructing major fair locations. On July 15, KIT's Career Service welcomed more than 2,000 registered participants to the first virtual KIT Career Fair@home. They were offered booths with digital job walls and given the opportunity to chat with exhibitors or watch videos about the companies.

Much like the usual KIT Career Fair, the Career Fair@home offered virtual venues for scientific talks and short presentations by the exhibitors about their companies and company cultures. After the presentations, the participants were invited to ask questions via a chat function. After the fair, presentations were kept accessible for registered visitors for four weeks.

At a digital information desk, KIT's Career Service offered information and advice relating to job applications. While the KIT Career Fair@home was online, more than 4,700

log-ins were recorded. On the average, the virtual booths had about 320 "visits." Up to 398 participants listened to the presentations. The short company presentations were attended by up to 232 visitors. About 100 exhibitors were convinced to take part in the virtual KIT Career Fair@home.

KIT's Career Service supports students and doctoral researchers by giving advice on scientific careers, internships, and jobs. Outstanding results in studies are rewarded by grants and awards. Students interested in establishing a business are invited to contact the KIT Founders Forge for personal advice and networking with the startup scene in Karlsruhe. From backpacks for beginning students and information on scientific careers to supporting the alumni network, KIT accompanies students through their entire career and establishes a connection for life.

In 2020, the KIT Career Fair took place in a virtual environment.



## OPEN SPACE FOR KNOWLEDGE TRANSFER

### TRIANGEL Stands for Encounters, Competencies, and Inputs

Research and teaching have a long tradition at KIT. Having defined innovation as the third core task of KIT, knowledge and technology transfer, entrepreneurship, and dialog with the public have gained importance in recent years.

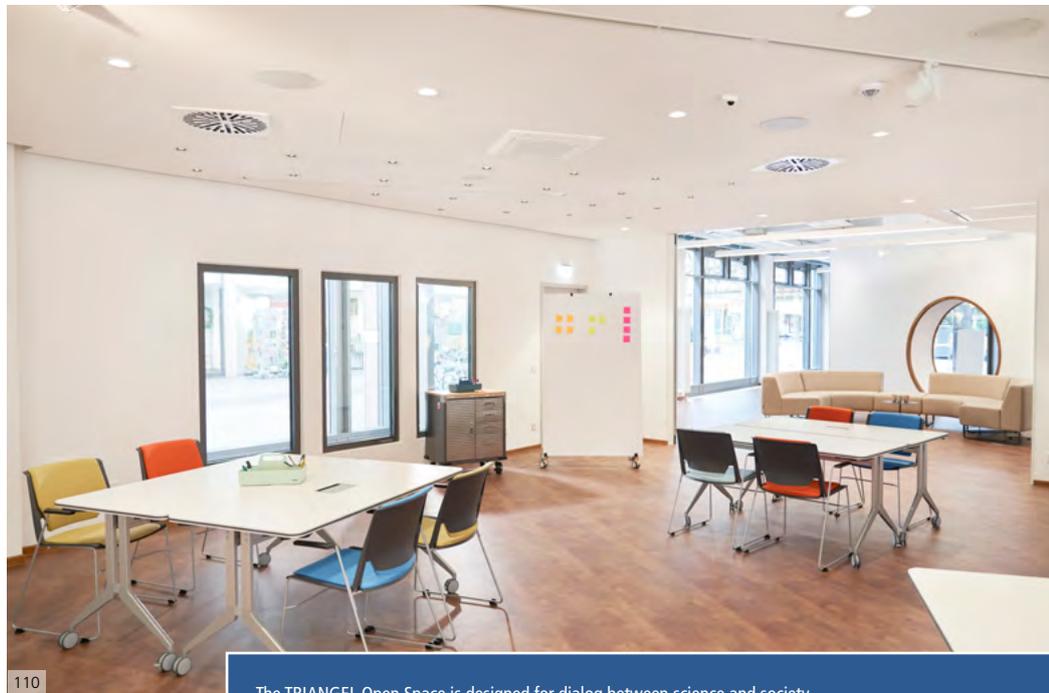
The TRIANGEL Open Space in the city center of Karlsruhe is designed for contact with the public and offers ideal conditions for exchange. The building with its triangular layout will strengthen science communication and transfer culture, training and consulting services to foster creativity and entrepreneurship, as well as dialog with the public. This will help open up new perspectives and initiate projects and partnerships.

TRIANGEL will be open to everybody and will facilitate successful knowledge and technology transfer. Other universities, partners from industry and society, and citizens are invited to feel at home and share their own ideas and initiatives.

TRIANGEL covers an area of 400 square meters and provides insight into relevant scientific topics. Special exhibitions, such as robotics or artificial intelligence, will be organized. Prototype startups will be assessed from the customer's perspective. In addition, workshops will be offered on various topics. People can also come for a cup of coffee.

The latest equipment and creative spaces are available for seminars, workshops, and many other events. Because of the pandemic, the first events were kept small. Regular operation will begin in spring 2021.

One of the new types of events offered there is the Leadership Talent Academy. It is based on a collaboration of KIT and Karl Schlecht Foundation and will be established firmly within the next three years. Students and



110

The TRIANGEL Open Space is designed for dialog between science and society.

doctoral researchers of KIT, who consider themselves to be tomorrow's leaders, will be given the opportunity to sharpen their scientific and personal skills.

Following an application procedure, 30 participants will be selected to take part in the 10-day training program on topics such as personality & communication, health, business ethics, and entrepreneurship. A limited number of highly qualified participants will then be admitted to a seven-day training on "leadership and personality." The program will be complemented by coaching services and meetings with alumni.

## CREATIVE ENVIRONMENT AND NETWORK OF ENTREPRENEURS

**Several Startups Moved into the ZEISS Innovation Hub @ KIT**

The ZEISS Innovation Hub @ KIT offers an excellent environment for innovations.

In January 2020, the optics and photonics company ZEISS, together with KIT, opened the ZEISS Innovation Hub @ KIT on Campus North. The new building, covering an area of 12,000 square meters, is used by ZEISS, KIT, and Nanoscribe, a company operating in the areas of 3D printing and microfabrication, as well as other startups and spinoffs of both partners. Investments of about EUR 30 million produced sufficient space and excellent conditions to push new innovations.

In this highly creative environment, partnerships are initiated between young and established companies. The hub's big network of entrepreneurs and its vicinity to scientists result in ideal conditions for creative minds that want to start something new. The first successful collaborations and projects were established and the first four startups moved in as of spring 2020.

Voxalytic GmbH, a startup of KIT's Institute of Microstructure Technology, produces chip-based microcoils, which are used in NMR systems for the analysis of small samples. microworks GmbH, another spinoff of the Institute of

Microstructure Technology, uses the LIGA process to produce metal microcomponents of the highest precision. It has specialized in manufacturing customized components for X-ray imaging.

Aquarray GmbH, a spinoff of the Institute for Biological and Chemical Systems, offers miniaturized biological and cell-based high-throughput screenings for testing thousands of samples while using a minimum amount of reactants and cells.

HS-Analysis GmbH, a spinoff of the Steinbuch Centre for Computing, offers customized autonomous AI tools for microscopy and image analysis and supports automatic quantification and prediction of medical data.

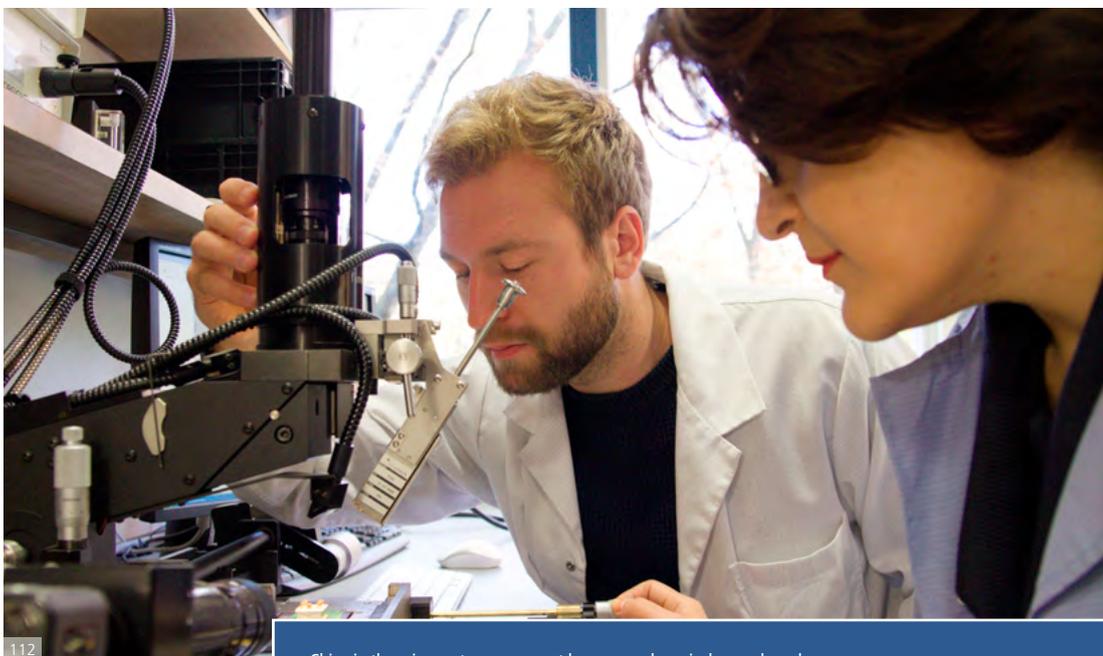
The ZEISS team started a number of projects with academic partners in the areas of medical robotics and distance measurement with integrated photonics. It grew from two to 14 staff members during its first year of work.

For Nanoscribe, a startup established by KIT staff ten years ago, the ZEISS Innovation Hub provides excellent opportunities for research into microfabrication and the development of new customized solutions for research and industry.

## MINIATURIZATION OF RADAR SENSORS

### SATIRE Project Promotes Transfer of Scientific Findings to Industry

Radar sensors have long been used in airplanes and ships. Their use in cars is increasing. Big progress in semiconductor technology in recent years now allows for further miniaturization of radar sensors. Researchers of KIT, in cooperation with the Fraunhofer Institute for Applied Solid State Physics (IAF) in Freiburg and industry partner VEGA Grieshaber KG, developed highly-compact radar sensors of modular design that are excellently suited for industrial use.



112

Chips in the micrometer range must be arranged precisely on a board.

The radar sensors boast unmatched resolution. Because they operate at short wavelengths, their antennas can be integrated on chips or even in the chip housing. In the past, operation at frequencies above 100 gigahertz was prevented by the highly complex assembly and bonding technology required to make the sensors. For a long time, it has been impossible to produce inexpensive integrated modules.

Now, the sensors designed by KIT and Wuppertal University in the project "Real 100G.RF" funded by the German Research Foundation (DFG) are combined with circuits made by Fraunhofer IAF in a scalable miniaturized radar front end. Its commercialization will be explored by VEGA.

The SATIRE project is aimed at producing a scalable, highly integrated 300 gigahertz radar sensor with more than 50 gigahertz bandwidth that enables resolution in the millimeter range. The modules, including lens, have a maximum dimension of 10 x 10 x 7 millimeters and can be connected to a so-called MIMO system on a control board or used individually. MIMO means "Multiple Input Multiple Output" and is a method using several transmitting and receiving antennas for wireless communication. This makes modules highly suited for industrial sensors. The team also uses technical capacities of KIT's research laboratory Mikroelektronik Deutschland.

The project "Scalable THz Miniaturized Radar for Industrial Applications" (SATIRE) is one of six trilateral projects funded at about EUR 5 million by DFG and Fraunhofer-Gesellschaft for three years. These projects are aimed at transferring scientific findings to industry so companies can benefit from research innovations at an early stage.



## PROMOTING YOUNG TALENT

The Karlsruhe House of Young Scientists (KHYS) supports all of KIT's early-stage researchers in fulfilling their many tasks in research, academic education, and management. The Postdoc Office of KHYS established recently is a central contact point offering a wide range of services for postdocs, all young scientists interested in postdoc positions at KIT, and their superiors. The Postdoc Office started operation on January 1, 2020 and is financed from the Initiative and Networking Fund of the Helmholtz Association.

The KHYS Postdoc Office has three main goals: It will provide guidance for career development, offer



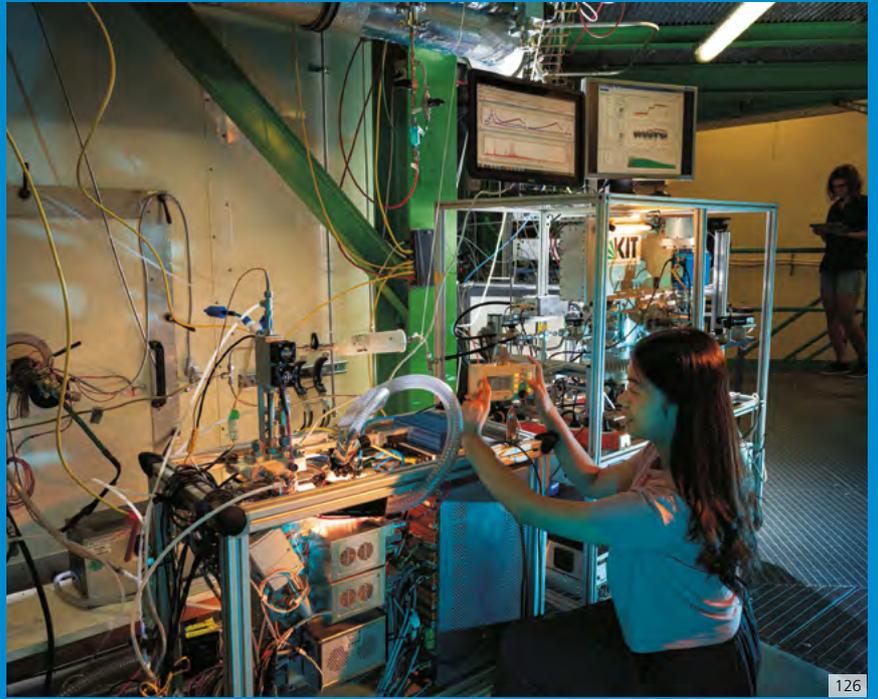
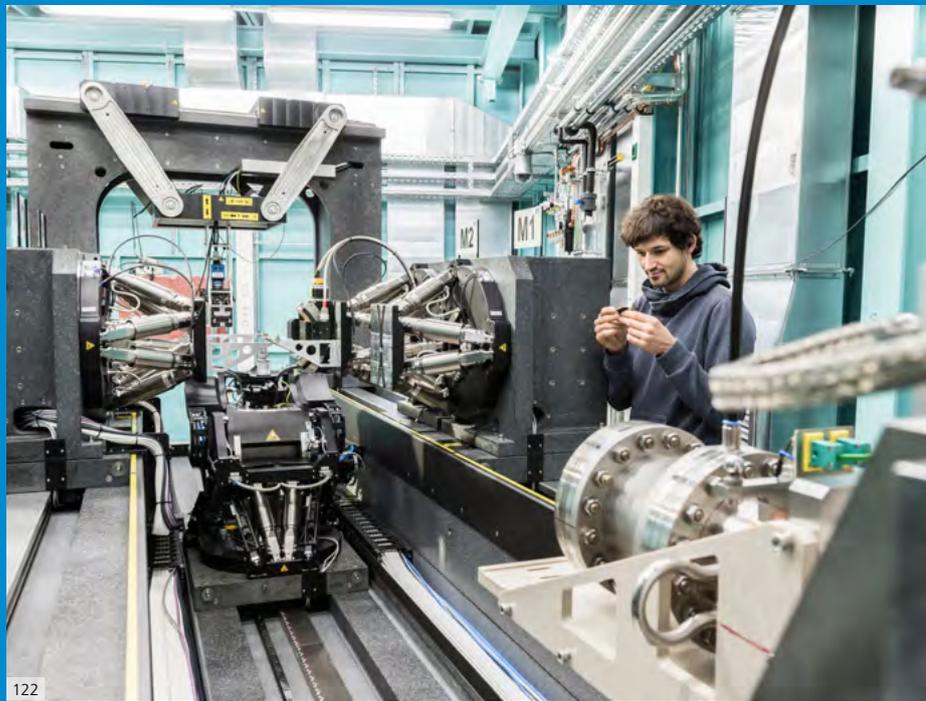
career-specific qualification options, and promote independence and networking within and outside of the university.

Key services include mentoring, a qualification program for postdocs named "Fit for your next career step," and the modular program "Connecting Young Scientists" (ConYS) to help postdocs develop and extend their strategic networks.

In 2020, about 100 postdocs attended training courses on the acquisition of third-party funding, career orientation, and project management within the "Fit for your next career step" program.

For the first time, a Postdoc Day was organized. About 115 persons participated in four online sessions. The range of consulting services was extended considerably and now ranges from advice on the postdoc phase for doctoral researchers to career-related consulting.





EXCELLENT AND HIGHLY QUALIFIED

## Junior Research Groups at Karlsruhe Institute of Technology



The Young Investigator Group Preparation Program (YIG PREP PRO) recruits top-level international postdocs at an early stage.

127

It is KIT's declared goal to attract outstanding early-stage researchers who acquire funding from renowned programs in a competitive process. Various programs promote young scientists and facilitate their scientific careers at KIT.

### Young Investigator Group Preparation Program

The Young Investigator Group Preparation Program (YIG PREP PRO) was launched in connection with the Excellence Strategy Competition. It serves to recruit early-phase top-level international postdocs, who are expected to acquire funding for a junior research group at KIT. Following a two-stage selection procedure, postdocs are admitted to the program and granted new positions at KIT. Alternatively, they remain at the institution where they are working for the moment. Within YIG PREP PRO, they are given major support in writing their proposal for a junior research group and can participate in mentoring programs.

Since the start of YIG PREP PRO in September 2019, 33 young researchers have been recruited. The third call for applications was in late 2020. So far, fellows of the program have submitted 18 proposals for junior research groups. Initial successes have been achieved and further positive feedback is expected. In October 2020, YIG

PREP PRO fellow Dr. Philipp Willke acquired an Emmy Noether Junior Research Group. Another fellow, Dr. Giovanni De Carne, was successful with his proposal for a Helmholtz Young Investigator Group that will start in 2021. Fellows, as well as candidates who do not take part in the program but successfully acquired a junior research group, are admitted to KIT's Young Investigator Network (YIN).

### Emmy Noether Junior Research Groups

The Emmy Noether Junior Research Group is a funding program of the German Research Foundation (DFG) to support highly qualified young researchers and junior professors with a fixed-term employment contract in leading a junior research group of their own for a duration of six years. This will qualify them for a university professorship.

Since July 2020, Dr. Alexander Hinz from the Institute for Inorganic Chemistry has headed an Emmy Noether Junior Research Group on low-coordinate main group compounds and their use in the activation of  $H_2$ ,  $CO$ ,  $CO_2$ , and  $NH_3$ . Research of YIG PREP PRO fellow Dr. Philipp Willke at the Physikalisches Institut covers quantum coherent control of atomic and molecular spins on surfaces.

YIG PREP PRO fellow Philipp Willke from Physikalisches Institut (center, between the Head of Institute Wolfgang Wernsdorfer (left) and Division Head Marc Weber).



128

## Helmholtz Young Investigator Groups

The Helmholtz young investigator groups are a program of the Helmholtz Centers that recruits excellent young researchers. The program supports the independence of young researchers and offers them a reliable career outlook through establishment of a research group of their own. The program addresses young researchers, who were conferred their doctorates two to six years ago and who have worked abroad. The Helmholtz Association's Initiative and Networking Fund provides EUR 150,000 per year for five years. Another EUR 150,000 are paid by the host institution. The young investigator group integrates into one of the research fields of the Helmholtz Association. Upon completion of their projects, successful leaders of young investigator groups are granted permanent employment.

In April 2020, Dr. Emma Järvinen's Helmholtz young investigator group started work at the Atmospheric Aerosol Research Division of the Institute of Meteorology and Climate Research. Her project is entitled "Solving the Cirrus Cloud Puzzle – Do Cirrus Warm or Cool Our Climate?" Dr. Martina Klose from the Troposphere Research Division of the Institute of Meteorology and Climate Research has headed a young investigator group

Emma Järvinen heads a Helmholtz young investigator group on "Solving the Cirrus Cloud Puzzle – Do Cirrus Warm or Cool Our Climate?"

129



130

The Helmholtz young investigator group of Martina Klose conducts research on "A Big Unknown in the Climate Impact of Atmospheric Aerosol: Mineral Soil Dust."

since October 2020. Her research focuses on "A Big Unknown in the Climate Impact of Atmospheric Aerosol: Mineral Soil Dust." In October 2020, Dr. Giovanni De Carne, Head of the Group "Real-time System Integration" of the Institute for Technical Physics and fellow of the Young Investigator Group Preparation Program was successful with his proposal for a Helmholtz young investigator group.

## ERC Starting Grants

Starting Grants awarded by the European Research Council (ERC) support excellent early-stage researchers at the beginning of an independent career. The ERC grants up to EUR 1.5 million for a duration of five years. The ERC funds innovative fundamental and pioneer research within three programs: Interdisciplinary project proposals, research into new areas of science, and application of innovative methods.

## TENURE TRACK

**Plannable Careers for Young Scientists**

Tenure-track professorships are widely implemented for promoting young researchers at KIT.

It is a strategic goal of KIT to attract excellent young researchers. To reach this goal, KIT – The Research University in the Helmholtz Association offers internationally competitive and attractive work conditions as well as reliable career prospects.

This requires a fundamental change in appointment procedures. A tenure-track professorship is implemented to promote young researchers at KIT. Tenure track is a transparent procedure in which young researchers are granted permanent employment after a successful qualifying period. Applicants initially appointed for a fixed term are given the opportunity to embark on a permanent professorship in a quality-assured procedure instead of a classical habilitation with unclear outlooks. The university and the appointed researcher agree on clearly defined and transparent tenure-track criteria at the outset and evaluate progress on these criteria at defined intervals.

Tenure-track professorships at KIT are now being financed from funds acquired in two competitions. Thanks to its compelling concept for promoting young

researchers, KIT acquired funding for 15 tenure-track professorships under the Federal-states Program Promoting Young Scientists in 2017 and 2019.

In addition, KIT was successful with its concept “The Research University in the Helmholtz Association | Living the Change” in the Excellence Strategy Competition of the Federation and the States in 2019. The KIT Excellent Tenure proposed in this concept will considerably increase the number of junior and tenure-track professorships. Every year, about ten young researchers of top international level will be recruited. The Young Investigator Group Preparation Program (YIG PREP PRO, see also page 60) helps potential candidates apply for these posts.

The proportion of female professors to be appointed under the Excellence Concept is projected to be at least 40%. In 2020, this goal was reached for the first time.

## FUNDING OF RESEARCH TRAINING GROUPS

### Composites Have High Potential for Applications in High-temperature Processes

The German Research Foundation (DFG) supports early-stage researchers at KIT. Since April 1, 2020, DFG has funded a joint research training group on high-temperature composites at KIT, TU Darmstadt, and DECHEMA. The research training group “MatCom-ComMat: Materials Compounds from Composite Materials” is scheduled for a duration of four and a half years. Its spokesman is Professor Dr. Martin Heilmair from KIT’s Institute for Applied Materials.

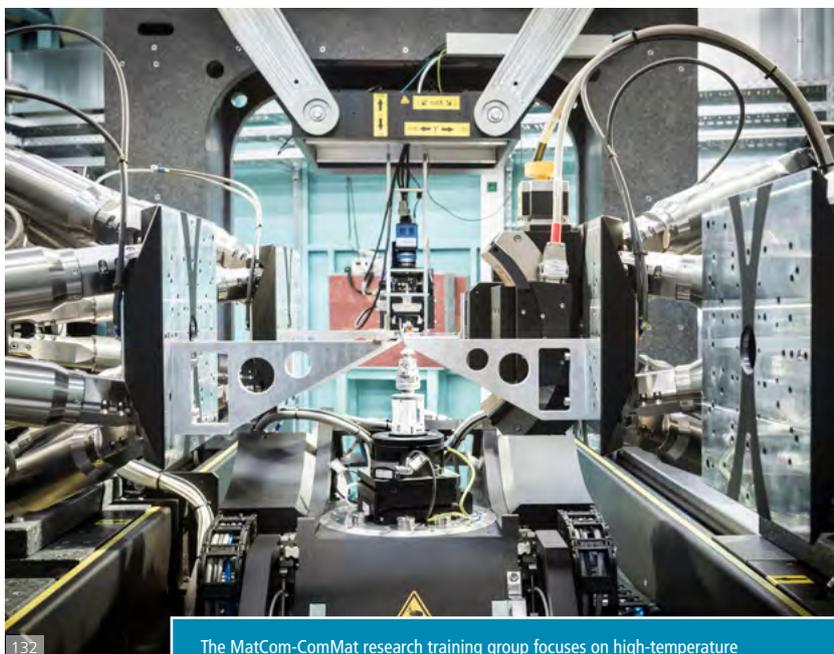
New high-temperature materials may allow for a significant increase in operating temperatures of combustion engines and processes. This will considerably improve efficiency. Promising candidates include novel composites based on metal alloys with a nanoparticle-containing coating based on silicon, oxygen, and carbon. When combined, the properties of these groups of materials complement each other. Fine tuning of their thermal expansion coefficients will reduce stresses during temperature cycles and extend service lives. The research training group develops the basis for a new generation of high-performance materials that will reduce future fuel consumption and emissions of combustion engines.

While KIT develops the metallic substrate materials, work at TU Darmstadt focuses on coating materials. In cooperation with DECHEMA, Frankfurt am Main, high-temperature corrosion of the composites is studied under conditions existing in combustion engines.

Research training groups are established by universities to promote early-stage researchers. They are funded by DFG or the Helmholtz Association, for instance. Such groups are aimed at qualifying doctoral researchers in a focused research program with a structured qualification concept. They prepare doctoral researchers for work in the science sector. At the same time, their early scientific independence is supported.

#### Other Graduate Units Funded

In 2020, funding of two KIT research training groups was extended by five years each. These are the research training group “Energy Status Data – IT Methods for Their Collection, Analysis, and Use,” with spokesman Professor Dr. Klemens Böhm, Institute for Program Struc-



The MatCom-ComMat research training group focuses on high-temperature composites for more efficient combustion engines.

tures and Data Organization, and the research training group “Asymptotic Invariants and Limits of Groups and Spaces” of KIT and Heidelberg University with spokesman Professor Dr. Roman Sauer, Institute for Algebra and Geometry.

In addition, the State of Baden-Württemberg evaluated and approved permanent funding of two KIT graduate schools: The Karlsruhe Graduate School for Optics and Photonics (KSOP) and the Karlsruhe School for Elementary Particle and Astroparticle Physics: Science and Technology (KSETA).

Altogether, KIT has eight graduate schools, ten research training groups, and another six programs for doctoral researchers.



## INTERNATIONAL AFFAIRS

Cultural diversity is essential for KIT. It strengthens understanding, appreciation, and trust among each other and thus contributes significantly to successful international cooperation in research, teaching, and innovation.

KIT therefore actively supports the integration of foreign guests and members. Various welcome offerings and exchange formats coordinated by KIT's International Affairs Business Unit help them get oriented to a new institution in a foreign place.

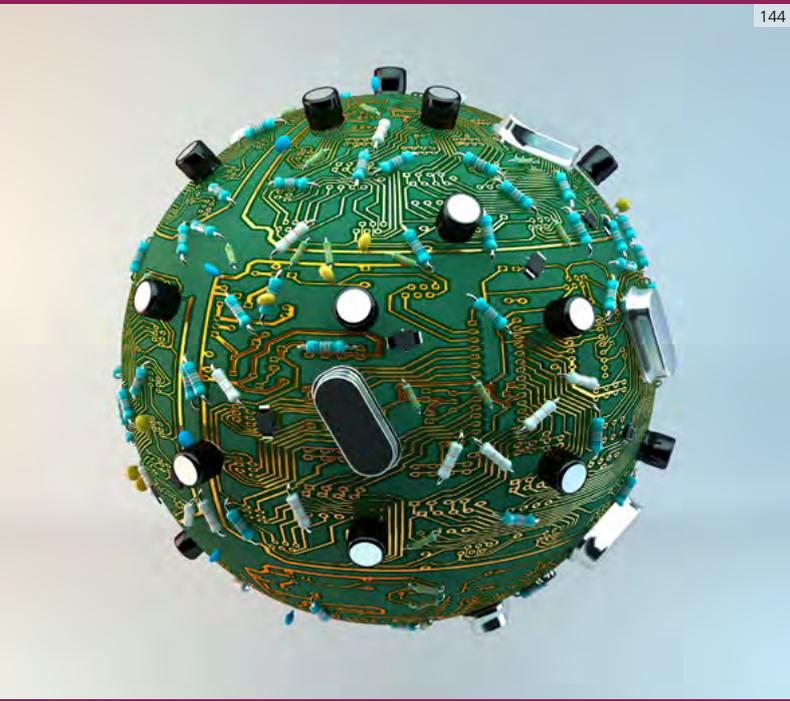
For the International Students Office and the International Scholars & Welcome Office, the biggest



challenge during the pandemic was to provide personal and trust-building opportunities despite the restrictions imposed on physical contacts. This was especially important for refugees and vulnerable students and researchers already in a difficult situation.

Through online counseling, virtual workshops, or traditional dialog via phone and email instead of face-to-face meetings, KIT was able to help international visiting researchers and students who had difficulty gaining entry to Germany because of the pandemic or who had to go into quarantine after entry.

The effort was worthwhile: In the summer semester of 2020, many ERASMUS students were able to do their planned exchange studies despite the pandemic. Most of the foreign students were able to enroll at KIT in 2020 and begin their studies, albeit virtually. New guest researchers found their way to KIT despite all of the adversities. This was enabled thanks to the joint efforts of the KIT business units, the KIT centers, institutes, alumni and alumnae, student groups, and international communities.





137



138



141



142



143



147



148

## EPICUR – THE EUROPEAN UNIVERSITY ALLIANCE

### EPICUR Research – A New Dimension for the European University Association

The project EPICUR Research, approved in 2020 with KIT as consortium leader, expands the existing spectrum of the European University EPICUR by adding the dimensions of research and knowledge transfer to its teaching and innovation domains. EPICUR (European Partnership for an Innovative Campus Unifying Regions) was launched in November 2019. The initial goal of the international alliance of eight European universities was to design a network that enables virtual mobility of students and lecturers between universities, as well as to develop innovative teaching methods and to connect regions.

EPICUR Research now aims to develop a common research and knowledge transfer agenda over the next three years. The European Commission is providing funding of EUR 2 million for this purpose, which will complete the knowledge quadrangle of a classical university - teaching, research, innovation, and interaction with society.

Currently, EPICUR Research is the only European project coordinated by a Helmholtz center in the funding program "Science with and for Society." As in the EPICUR alliance, the project's research partners are the University of Freiburg, Adam Mickiewicz University Poznan, the University of Amsterdam, Aristotle University of Thessaloniki, Université de Haute-Alsace, University of Natural

Resources and Life Sciences in Vienna, Université de Strasbourg, and KIT.

The new range of tasks includes the establishment of EPIClusters, where EPICUR universities and nonacademic regional partners work together on pressing research issues. It also includes the establishment of a so-called EPI-Community, where researchers at early career stages are given the opportunity to network between universities in both analog and digital forms, to use mobility programs, and to present research projects via a database.

"EPICUR embodies the future vision of an interdisciplinary, diverse, and sustainable European university alliance that addresses complex challenges and aims to strengthen cooperation at the European level in the long term," says Professor Dr. Thomas Hirth, KIT Vice-President for Innovation and International Affairs. Michael Zacherle, the project manager for EPICUR at KIT, adds: "We initiate and promote mutual exchange with various representatives of society. The goal is not only to inform them about the results of our research, but to invite them to a dialog in order to incorporate their suggestions into academic research."

EPICUR Research extends the spectrum of the European University EPICUR by adding the topics of research and knowledge transfer.



## INTERNATIONAL COOPERATION DURING THE PANDEMIC

### Strong Partnerships Ensure Successful Digital Exchange

International collaborations between KIT and universities all over the world depend on personal exchanges and intensive cooperation, accompanied by regular meetings. In-person meetings of potential partners are indispensable, especially for initiating new contacts. It is difficult to reach agreements, conduct exploratory talks, or perceive moods during purely written correspondence or video conferences with participants sitting alone in front of computers.

In 2020, the coronavirus pandemic made it difficult to initiate and maintain international collaborations. The effect was particularly enormous for partners who were at an early, sensitive phase and who were disadvantaged by the lack of informal opportunities to exchange views during delegation trips, conferences, or joint dinners.

However, collaborations and projects that had already developed good organizational skills and strong mutual trust proved resilient. "At EUCOR, the transfer to virtual project management and virtual communication went smoothly. The people involved have known each other for a long time, and structures are stable," says Pascale Kohler, Head of International Cooperations and Projects (ICop I) at KIT's International Affairs Business Unit (INTL).

"In some respects, we have even benefited from the virtual formats," adds Oliver Schmidt, Head of International Cooperation and Projects (ICop II). "For example, guests from the USA or Australia, whom we probably would not have reached with a face-to-face event, were able to participate in the virtual EPICUR Forum."

The student program for research internships, MINTernship, was completely suspended for 2020. All participating universities, however, emphasize their eagerness to



150

Despite restrictions due to the pandemic, KIT managed to maintain contact with its international partners.

continue. "For 2021, scenarios have been worked out that allow research internships in virtual, semi-virtual, or physical form, depending on the situation," says Dr. Julia Johnsen, Head of the Mobility Programs team at the International Students Office (IStO) of INTL. Thanks to funding commitments from the participating foundations, all of the available internships have been filled already.

"We are working intensively to keep alive the contacts with our partners despite restrictions and to find suitable formats for this," says Professor Dr. Thomas Hirth, Vice-President for Innovation and International Affairs. "Nevertheless, virtual meetings cannot and should not replace real interpersonal exchange, especially in collaborations with partners in countries where the political situation is unstable or whose relations with Germany are difficult. Therefore, after the pandemic, we will go back to face-to-face contacts as soon as possible, and, as the case may be, offer supplementary digital meetings."

## EUROPEAN ALLIANCES AND NETWORKS

**New Programs and Projects at CLUSTER and CESAER**

The international networks CLUSTER and CESAER strengthen engineering education in Europe.

151

Networks and alliances represent an important development potential for universities, as research, teaching, and innovation do not take place in isolation. In 2020, CLUSTER (Consortium Linking Universities of Science and Technology for Education and Research) focused on the topic of sustainability, while CESAER (Conference of European Schools for Advanced Engineering Education and Research) launched the “Best Idea Competition,” which rewards students’ ideas for tackling global challenges with prize money of up to EUR 20,000. KIT is deeply involved in both networks.



Together with its 13 European universities, CLUSTER aims at training engineers with leadership and entrepreneurial skills to address the major social issues of our time. The focus is not only on establishing and intensifying interaction, cooperation, and programs between the member universities, but also on realizing hands-on partnerships with large European companies.

Since 2020, a new CLUSTER focus has been on the topic of sustainability: Professor Dr. Johannes Orphal, Head of

Division IV – Natural and Built Environment, participates in the newly formed working group on behalf of KIT. Students’ participation is important to the network and since 2019 has been firmly anchored in the governance of CLUSTER. Students thus are present at every meeting of the Steering Committee, organize their own gatherings, and participate in working groups.

**CESAER**

The strong and united voice of universities  
of science and technology in Europe

CESAER includes more than 50 leading universities in science and technology from 25 European countries – eight of nine universities from the TU9 network are represented. Here, too, the focus is on increasing the quality of engineering education in Europe. The network has a weighty voice in European politics and has already been providing the European Commission with highly regarded position papers and statements. Professor Dr. Thomas Hirth, Vice-President for Innovation and International Affairs at KIT, has been a member of the Board of Directors since 2019 and was significantly involved in the conception of the “Best Idea Competition 2021.” He says: “The new generation has to face global challenges that have never existed in this form before. I am proud that KIT students contribute their ideas and participate in reshaping the future.” In 2020, CESAER also appointed new contact persons for equality, diversity, and inclusion at member universities. In addition, explains Dr. Klaus Rümmele, Institutional Liaison for the two networks at KIT and Head of the International Affairs Business Unit, two new offerings opened up practical benefits for the member universities: The “Professional Week,” which aims at sharing knowledge among university employees, and a new monitoring tool, exclusive to members, that includes comprehensive data for comparing universities.

## REFUGEE RELIEF AT KIT

### Support for Vulnerable Students and Researchers

Since the large movement of refugees to Germany began, KIT has been actively involved in the reception and integration of people seeking protection. Following acute assistance at the first reception camps, the Coordination Office for the Integration of Refugees and Migrants at KIT was established in 2016.

It is responsible for the planning and implementation of various activities and administers DAAD funding. This funding enables five initiatives at KIT: Employment of a student assistant who provides advice to refugee students at the social counseling services of the students' union (Studierendenwerk Karlsruhe), implementation of the intercultural Pelican language tandem program, realization of the Buddy program, creation of an internationally oriented student volunteer position, and employment of another student assistant as a study ambassador.

The latter, together with the International Students Office (IStO) and Coordinator for Refugees and Migrants Daniela von Rügen, offers open consultation hours for refugees before and during their studies. "Counseling covers the entire spectrum from initial information on courses and admission to language and subject knowledge requirements, financing of studies, and alternatives to academic studies," says Daniela von Rügen. Although face-to-face formats are optimal for most of the services offered, counseling in 2020 successfully relied on virtual exchanges and on advice given to individuals via phone or email. The number of those seeking advice was low compared to previous years, but has stabilized at a constant level.

Refugee researchers and their families as well as academic mentors are supported by the International Scholars Office (IScO). IScO also coordinates KIT's participation in the Philipp Schwartz Initiative (PSI). This

initiative supports vulnerable researchers in continuing their work at German universities and research institutions. In 2020, four more researchers received funding commitments. Three researchers were able to start their research stays at KIT with 24-month full scholarships. Central topics were defined in a first workshop organized by the newly founded regional network PSI Plus, which includes institutions in Baden-Württemberg and also the Université de Strasbourg: "We want to raise awareness for the special situation of refugee researchers and, together with them, develop future perspectives," says Dr. Petra Roth, Head of IScO. The participants of the workshop were particularly appreciative that they were able to talk personally with Vice-President for Innovation and International Affairs Professor Dr. Thomas Hirth. "Giving vulnerable researchers a real perspective together with our partner institutions is something I see as an important task at KIT," says Hirth. "We not only want to offer them a new home, but also make visible their great value to the scientific community."

KIT supports refugee researchers and students and gives them a perspective.





## KIT AS AN EMPLOYER

With 9,618 employees, KIT is one of the largest employers in the Karlsruhe technology region. The staff consists of 5,397 scientific and 4,221 non-scientific members. The share of women is 37.8 percent. KIT hosts 1,521 foreign employees, the majority of whom are scientific personnel. In addition, there are 378 professors and senior researchers, 14 of whom were appointed in 2020.

The success rate in vocational training was again almost 100 percent in 2020. KIT once more was honored by the Chamber of Industry and Commerce. A total of seven trainees were honored for their special achievements, one DHBW student



completed his dual studies in mechanical engineering as the best in class, and an IT specialist for application development was the first graduate of the "Welcome Program for Refugees" at KIT to successfully complete his training. Due to the coronavirus pandemic, vocational training was changed to online or hybrid formats, the pace of digitization was accelerated, and new formats for learning were created.

In 2019, KIT's Data Protection Staff Unit designed an e-learning data privacy module which was implemented together with the Center for Technology-Enhanced Learning. In 2020, corresponding user

licenses were acquired by two German scientific institutions (TU Dresden and DZNE). The program bwUni.digital is examining how a regional office for all Baden-Württemberg universities and non-university research institutions can be operated on the basis of the model provided by KIT.

In 2020, KIT was awarded the "audit familien-gerechte hochschule" (audit family-friendly university) certificate for the fourth time since 2010 and is now entitled to permanently bear this label honoring sustainable family-friendly working and study conditions.





156



157



161



162

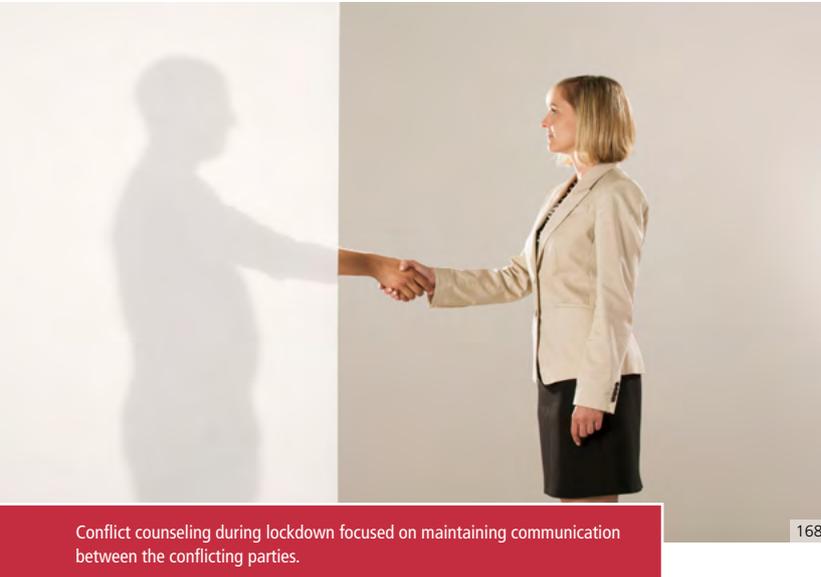


163



167

## HEALTH PROTECTION

**Care for KIT Employees during the Pandemic**

Conflict counseling during lockdown focused on maintaining communication between the conflicting parties.

168

The coronavirus pandemic is a major challenge for all of us, including KIT employees. With protection of health as an overriding goal, a Corona Crisis Unit involving various organizational units was established at KIT early in 2020. In December 2020, this Corona Crisis Unit was replaced by the newly founded Corona Coordination Office run by employees and students. The office derives measures to protect the occupational health and safety of employees and students from continuous monitoring of the epidemiological situation and the regulations and recommendations of the Robert Koch Institute (RKI) and federal and state authorities.

The Conflict Management and Psychosocial Counseling Staff Unit is the central point of contact for employees confronted with professional and private challenges.

169



In addition, numerous support offerings have been created or been continuously adapted to the pandemic conditions by the staff of the KIT Health Network.

The Conflict Management and Psychosocial Counseling Staff Unit (KMB) is the central point of contact for employees confronted with professional and private challenges. Around the time of the lockdown, counseling was expanded to include telephone and video services. This made it possible to support employees with anxieties while avoiding personal contact. In addition to individual counseling, the unit created online tips and new online courses, such as on mindfulness, to increase psychological balance. All psychosocial counseling offerings were disproportionately taken up by employees, which reflects a high level of need.

In conflict management, the focus during lockdown was on maintaining communication between conflicting parties. The partners in the Conflict Management Network made use of various communication formats, including online mediation. To share experiences, KMB organized four online workshops on conflict management during the pandemic.

Through regularly updated intranet pages of the Medical Services (MED) and through Corona FAQs, the Corona Coordination Office also provided information on aspects of the pandemic affecting KIT's on-campus routines.

MED advised, for example, on increased individual risk, on specific occupational safety measures, on the procedure to be followed in the event of a quarantine order, and on the behavior of travelers returning from risk areas. Executives were asked to seek advice from MED in cases when an infected person was identified in their area of responsibility. This cooperation between MED and the KIT organizational units enabled accelerated contact person management to prevent infections.

For individuals with suspicious symptoms, an isolated treatment room with separate access was established at MED's outpatient clinic on Campus North. The approved rapid antigen tests that became available at the end of 2020 were used on defined occasions.

For executives, individual and collegial coaching services were converted into online formats and continued to be in high demand. Leadership training during the pandemic was addressed through two online workshops on “Effective Leadership at a Distance,” organized by the Human Resources Development and Vocational Training Business Unit and the Health Network. These two workshops, which were quickly fully booked, aimed at, on the one hand, becoming aware of and strengthening the participants’ own resources and, on the other hand, reflecting on the special aspects to be taken into account in virtual leadership situations and on addressing employees’ needs.

Overall, participation in leadership workshops was significantly higher. At the same time, corporate meetings for institutes and business units, team building retreats,



170

Corona-specific online workshops on topics such as “Effective leadership at a distance” were quickly fully booked.

and moderated events for groups of up to 70 people were converted into online formats with great success.

New challenges also arose in 2020 for KIT’s experts on occupational safety. Where possible, workplaces were relocated and staff were asked to work from home. This

The Corona FAQs compiled by the Corona Coordination Office provided information on pandemic aspects relevant to KIT.

171

KIT - Das KIT - Medien - News

https://www.kit.edu/kit/25911.php

Home Leichte Sprache Impressum Datenschutz Barrierefreiheit Sitemap Intranet KIT EN

Das KIT Themen Studium Forschung Innovation Karriere

Karlsruher Institut für Technologie > Das KIT > Medien > News > mehr

## Fragen und Antworten zum Umgang mit dem Coronavirus

Das KIT ist vorbereitet und handlungsfähig. FAQ bieten Informationen über aktuelle Regelungen und Empfehlungen am KIT.

Letzte Aktualisierungen: Weiterhin umfassendes Homeoffice (Stand: 24.03.2021)

Die Gesundheit seiner Mitarbeiterinnen und Mitarbeiter sowie seiner Studierenden steht für das KIT an erster Stelle. In der gegenwärtigen, von dem neuartigen Coronavirus SARS-CoV-2 ausgelösten Pandemie ist das KIT vorbereitet und handlungsfähig. Um die Coronakrise bestmöglich zu bewältigen, hat das Präsidium des KIT in Nachfolge des Krisenstabs die Koordinierungsstelle Corona eingerichtet, die dafür sorgt, dass Maßnahmen, die am KIT im Zusammenhang mit der Ausbreitung des Coronavirus ergriffen werden, unter Beachtung des Subsidiaritätsprinzips koordiniert stattfinden. Das KIT informiert über die Homepage des KIT, die Studierendenseite im Internet, das Intranet (Mitarbeitendenportal), das Studierendenportal und gegebenenfalls weitere Kanäle über Maßnahmen und Handlungsempfehlungen.

English Version

Allgemein Mitarbeiterinnen & Mitarbeiter Studium & Lehre Information & Kontakt

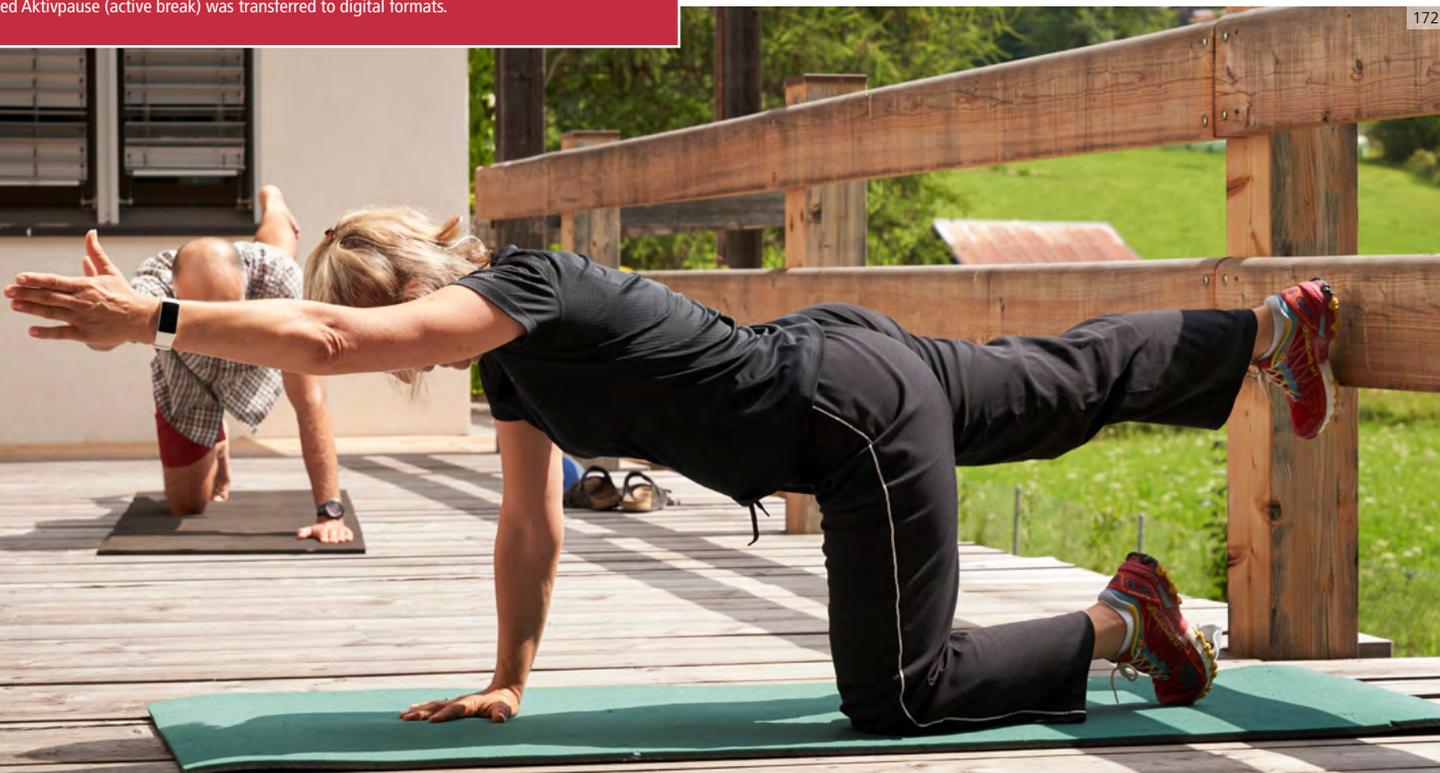
way of working was new to many of the employees and led to increased inquiries (insurance coverage at home, work equipment, ergonomics, etc.). Existing risk assessment schemes were either supplemented or adapted to this new type of risk. Face-to-face instruction or meetings were largely turned into online training sessions or video conference calls. In addition, the number of site inspections was reduced to the absolute minimum to avoid contacts.

During the pandemic, KIT's Equal Opportunities Commissioners provided numerous counseling sessions for employees. Due to bottlenecks in childcare, parents increasingly had to care for their children and work at the same time. Executives and responsible superiors responded by allowing employees to work from home. Affected employees reported that past gender roles were resumed in that situation and that childcare was left mainly to the mothers. Studies, including one in the scientific journal *Nature*, showed that the publication output of female researchers decreased considerably last year, whereas male researchers published more in some cases. In discussions with members of the Executive

Board, heads of division, and program spokespersons, the Equal Opportunities Commissioner suggested that the issue of performance-based funding allocation be reconsidered for 2020 to avoid disadvantages for female researchers with caregiving responsibilities.

The lack of exercise caused by fewer work-out opportunities and elimination of commutes to the workplace was countered by teams of Aktivpause (active break) and the Institute of Sports and Sports Science. They provided numerous online offerings, which remain in high demand today. The offerings range from tips for workplace exercise to compensate for tension in the body to advice on encouraging exercise among children. In addition, Aktivpause was transferred to digital formats, such as live formats via Zoom, Aktivpause To Go, and Instagram account @aktivpause\_kit.

The so-called Aktivpause (active break) was transferred to digital formats.



## EQUAL OPPORTUNITIES

### Evaluation and Follow-up Project Gender Equity 1

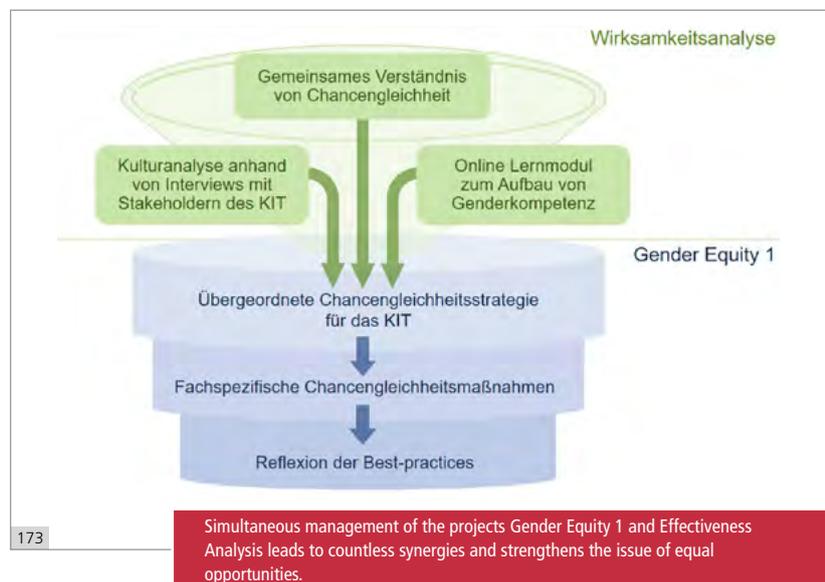
The promotion of equal opportunities and diversity is an important cross-cutting issue of high strategic importance at KIT. In order to identify starting points for strengthening equal opportunities, KIT had its equal opportunities policy evaluated in 2018 by the Center of Excellence Women and Science (CEWS). Among its findings, the CEWS team identified four main recommendations:

- Development of a common KIT-wide understanding of equal opportunities
- Reflection on and development of a culture of appreciation at KIT focusing on equal opportunities
- Clarification of the governance of the equal opportunities policy at KIT
- Reflection on and increase of the gender competence among KIT employees

Since 2019, these recommendations have been implemented in the Effectiveness Analysis project managed by Vice-President for Human Resources and Law Christine von Vangerow.

With this project, KIT is pursuing the goals of creating transparent and efficient guidelines and processes for equal opportunities work, generating further synergies between actors in equal opportunities work, creating broad awareness of and appreciation for the topic, and increasing gender competence among employees, especially at management and executive levels.

Simultaneously with the implementation of the evaluation of its equal opportunities policy, KIT drafted the proposal "Living the Change" for the Excellence Strategy of the German federal and state governments. This proposal included the project Gender Equity 1. This project, which is designed to run for seven years, ensures that the main issues identified by the evaluation will continue to be addressed beyond the term of the "Effectiveness Analysis" project (until June 2021). Gender Equity 1 consists of three different formats that address the issue of equal opportunities, both top-down and bottom-up:



- In a vision and culture workshop, the members of the Executive Board and the heads of divisions developed an overall strategy for strengthening equal opportunities.
- So-called think tanks for the five scientific disciplines and the domain of administration, infrastructure, and technology will develop ideas for equal opportunity measures that address specific situations in each respective discipline or domain and among its subjects. Following the think tank workshops, applications for financial support for the planned activities can be submitted.
- The successful applicants will meet with other parties in a so-called meta-forum to reflect on their projects and exchange best practices.

The two projects are interlinked optimally and significantly strengthen the role of equal opportunities. The diagram illustrates the synergies between selected results of the two projects.



## LIFE AT KIT

In 2020, the coronavirus pandemic affected KIT and its staff in multiple ways. In those times, “business as usual” was sometimes impossible: Work took place with rules set up to protect each other or was carried out from home while on-campus teaching had to be changed to online teaching (see page 44). Meetings were held online whenever possible. This required not only the willingness of all staff members to deal with the new situation, but also an enormous extension of the necessary technical infrastructure. At KIT, the challenging pandemic became a catalyst for digitization.



At first, scientific conferences and symposia were postponed or canceled. Soon thereafter, structures and formats were developed to host these kinds of events in a virtual space. Even though personal encounters were sorely missed, this allowed scientific exchanges to continue.

KIT events like Colloquium Fundamentale organized by ZAK | Center for Cultural and General Studies, and the welcome ceremony for new students took place online, same as the staff assemblies and Staff Council meetings that were streamed live onto the staff members' computers.

In October, the InnovationFestival@karlsruhe.digital of ZKM took place as a hybrid event. The event's livestream was followed by about 2,000 people from 16 countries. Companies and institutions from Karlsruhe displayed the exceptional diversity of the "Digitalstandort Karlsruhe" (Digital Location Karlsruhe). KIT reported about its measures to manage the crisis and its scientific and technical inventions in several keynote speeches.



175



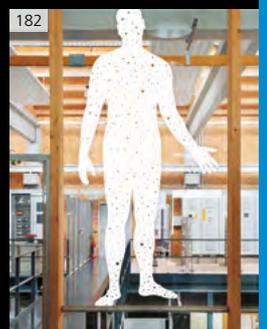
179



180



181



182



185



186





176



177



178



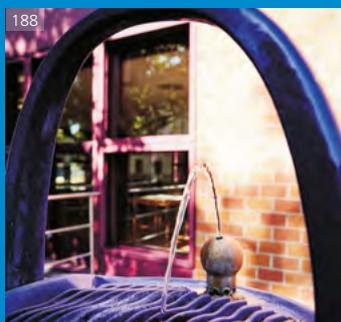
183



184



187



188



189

## CHALLENGING TIMES

### New Concepts for Daily Life at KIT

The most important part of containing the coronavirus is safe distancing. KIT observed the development of the pandemic early on and introduced successive restrictions to deal with this new reality. Finally, on March 16, it was decided to offer employees the option of working remotely from home.

Thanks to the great effort of experts from the Steinbuch Centre for Computing (SCC), KIT's information technology center, as well as of many other KIT organizational units, new IT-based tools and services integrated into the KIT infrastructure were established for digital teamwork in research, administration, and online teaching at KIT.

Based on previous experience with mobile work and telework, it was clear that it would not be possible to extend the modified concept to all staff members using existing structures and resources. Therefore, SCC multiplied the possibilities for using VPN (Virtual Private Network) services for external access into KIT's IT infrastructure. Taking data and information security into account, the software MS Teams was introduced as a working platform, which allowed staff members to keep working, communicating among each other, and accessing the IT infrastructure during lockdown. MS Teams was also used during the online semester for 4,000 lecturers and 25,000 students. All in all, it was accepted well and quickly proved itself in activities ranging from project work to the daily chat at the virtual coffee machine.

All kinds of events designed for information exchange – talks, conferences, meetings, seminars – could be realized as digital or hybrid events. These formats saved time and costs, were accessible for a broader circle of participants, and also were environmentally friendly. They were not only an answer to the pandemic but also concepts for the future.

KIT's Chief Information Officer (CIO) is the president, Professor Dr.-Ing. Holger Hanselka. In August 2020, he transferred the CIO's duties to Chief Digital Officer (CDO) Dr. Julia Winter. Prior to this, a representative for information processing and supply (IV-B) had been appointed. Due to the pandemic, incumbent Professor Dr. Hannes Hartenstein had extended his term beyond March 31 until April 20, 2020, when Dr. Martin Nußbaumer temporarily took over office until the transfer to the CDO.

In order to utilize the possibilities of virtual encounter more widely and test new forms of exchange, KIT started a new regular feature: Since November 30, staff members can join the video conference "Sag doch mal... zu Tisch mit Präsident Hanselka" (Tell Me... Lunch Break with President Hanselka). The meeting thrives on questions, insights, and feedback from participants and allows a direct and personal exchange with the president. It is open to all members of staff and takes place every second Monday. Dates and links for the event are published on the Intranet.

The KIT staff assembly on December 10 was totally digital for the first time.



## INFORMATICS AND SCIENCE COMMUNICATION UNDER ONE ROOF

### Klaus Tschira Foundation Builds InformatiKOM for KIT

Since spring 2020, the Klaus Tschira Foundation has been in the process of erecting InformatiKOM, two unique new institute buildings to be used by KIT. On Campus South east of Adenauerring, a novel kind of forum for exchange between academia and society is being created, bringing together institutes of informatics with facilities of science communication and applied cultural studies. In addition to lecture rooms and work rooms for students and researchers, the six-story main building InformatiKOM 1 will have a variety of areas that will be used for dialog with the public. Together with the smaller InformatiKOM 2, which is located somewhat farther to the east, KIT will have about 10,000 square meters of additional usable space in the immediate vicinity of the main entrance to Campus South, the library, and the Audimax lecture hall.

After an estimated construction period of three years, InformatiKOM will provide a new home to KIT institutes and scientific facilities. When designing the building, the Klaus Tschira Foundation, in coordination with KIT, attached particular importance to the interaction of research and knowledge transfer as well as to dialog with the public. The spectrum of future users is composed accordingly. The Robot Design Atelier, which seeks to harmonize the latest AI technology with societal needs, further institutes of informatics, the degree program Science-Media-Communication, and the Center for Cultural and General Studies (ZAK | Zentrum für Angewandte Kulturwissenschaft und Studium Generale) are among those that will move under one roof.

The three-story InformatiKOM 2 will be built together with the larger main building. It will house the interdisciplinary Study Center for the Visually Impaired, offering innovative solutions for accessible studies, especially STEM subjects, and researching the latest aids for the visually impaired. In a special way, it thus complements the interaction between research and society that will take place in InformatiKOM 1. The building fits into the existing building stock at the rear opposite the main building of the former children's clinic.



The new InformatiKOM buildings at Adenauerring will provide a forum for exchange between academia and society.

InformatiKOM was designed by Darmstadt-based architects Bernhardt + Partner. Its core is the atrium, which extends from the first floor to the fifth floor. Above the open atrium, a transparent air-cushion roof guides daylight deep into the building's interior. Three wide foyer staircases connect the open space areas from the first floor to the third floor and provide additional seating areas. The lower foyer staircase will also be used as a grandstand for public lectures and events.

InformatiKOM forms the central access to the extension of Campus South, which is closely linked to the city center on one side and to the Hardtwald recreation area on the other. The building sections are oriented towards Adenauerring and are bounded by a green space near the residential area to the east and by the open spaces of KIT's Botanical Institute to the north.

## ONE ASSOCIATION OF FRIENDS FOR ONE KIT

### The Newly Merged "KIT Freundeskreis und Fördergesellschaft e.V."

Due to the history of KIT, two sponsoring associations, KIT-Fördergesellschaft e.V. and Freundeskreis des Forschungszentrums Karlsruhe e.V., were standing side by side until 2019. These two associations have now merged to form the KIT Freundeskreis und Fördergesellschaft e.V. (KFG) (Association of Friends of KIT). Chairman of the KFG is Michael Huber, Chairman of the Board of Sparkasse Karlsruhe. President of KIT Professor Dr.-Ing. Holger Hanselka assumes the office of Chairman of the Board of Directors.

The merger of the two predecessor institutions has set the course for a high-performance sponsoring association for KIT. Its main objectives include the promotion of research, teaching, innovation, and academic life at KIT, the promotion of the cultural and social interests of the students, and the promotion of the link between science and practice.

The primary goal is to provide support for programs that cannot be financed from federal and state funds, such as General Studies ("Studium Generale"), scientific conferences at KIT, student excursions and research trips. It also supports the promotion of art and music at KIT and bonuses for special achievements by employees in administration and infrastructure.

The KFG promotes scientific dialog at KIT and in the Karlsruhe region, for example, by funding the Heinrich Hertz Visiting Professorship or supporting young researchers. Another important task is the receipt and fiduciary administration of free donations and special-purpose donations as well as the administration of its own foundations.

The KFG wants to support cohesion and communication at KIT, create close links between science and practice, deepen relations between lecturers and students, and recognize special achievements in science and infrastructure, such as through the Otto Haxel Prizes. In addition, the KFG would like to foster relationships with those who want to participate in and help shape relevant KIT issues.

The KFG offers all those interested in research, teaching, innovation, and academic life the opportunity to actively support KIT and to help shape campus life by becoming a member. Managing the broad range of tasks of the KFG will require a broad membership base in the coming years and will depend on the support of the professors and of all KIT employees.

The Heinrich Hertz Visiting Professorship endowed by KFG was awarded in 2019 by Michael Huber and Holger Hanselka to Martin Brudermüller, Chairman of the Board of Executive Directors of BASF SE (from left to right).



## BIOLOGY MEETS CHEMISTRY

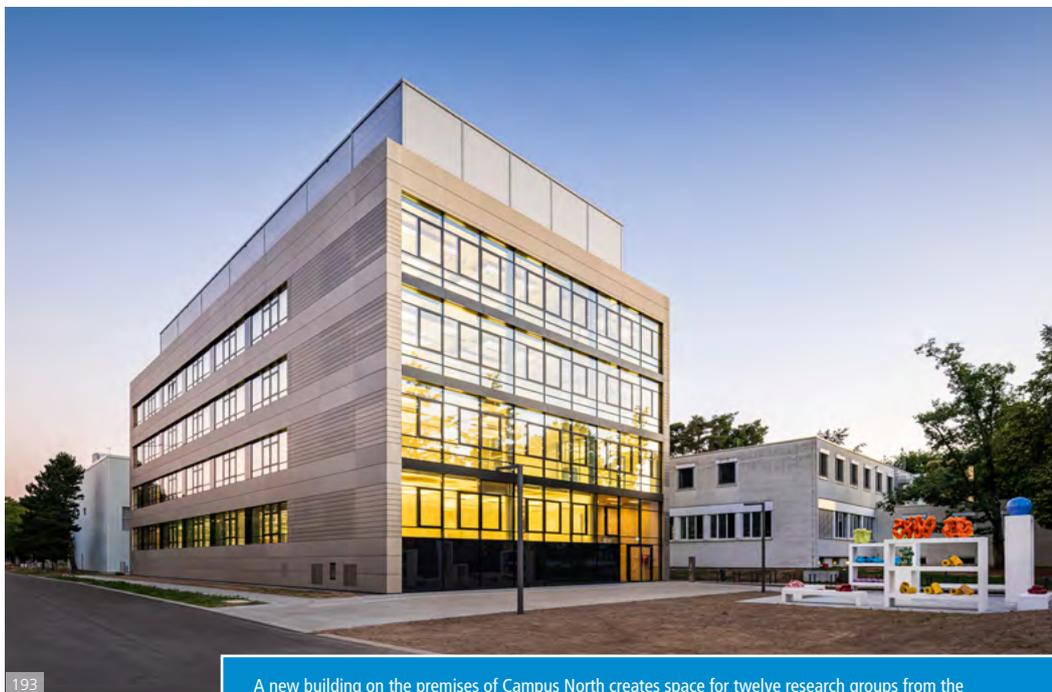
### New Research Building Occupied on Campus North

A new working place for 120 researchers and technical staff has been built on the premises of KIT's Campus North. On four floors with a total area of almost 5,800 square meters, twelve research groups from the scientific fields of biology and chemistry can now collaborate even more intensively. The inauguration ceremony for the new building was on October 29, 2020.

Completed in July 2020, the building mainly houses the Institute for Biological and Chemical Systems, parts of the European Zebrafish Resource Center, and parts of the Institute of Functional Interfaces and the Institute for Biological Interfaces. At the new premises, around 30 bachelor's and master's students and 25 doctoral students will be attended to annually.

The building project was supervised by KIT's Planning and Construction Projects Business Unit. The cost of EUR 20 million was financed by the German Federal Ministry of Education and Research, the German Federal Ministry of the Interior, Building and Community, and the Baden-Württemberg Ministry of Science, Research, and the Arts. Despite the difficult conditions caused by the coronavirus pandemic, it was completed on schedule and on budget.

All institutes housed in the new building are assigned to Division I – Biology, Chemistry, and Process Engineering. The Institute for Biological and Chemical Systems (IBCS) is divided into the two parts "Biological Information Processing" (BIP) and "Functional Molecular Systems" (FMS). The goal of BIP is to map the molecular mechanisms of biological information processing in cells and cellular networks and to make this knowledge useful for applications in information technology, biotechnology, and medicine. The goal of FMS is to improve the understanding of biological processes, such as cellular communication or disease progression, with the help of modern materials and chemical processes.



A new building on the premises of Campus North creates space for twelve research groups from the scientific fields of biology and chemistry.

The KIT-operated European Zebrafish Resource Center is the first central archive for zebrafish strains in Europe. Zebrafish have most organ systems in common with humans. This makes them ideal model organisms for studying the causes of such disorders as cancer and heart diseases.

The Institute of Functional Interfaces conducts research in the fields of bioprocess engineering and biosystems, chemistry of oxide and organic interfaces, mineral interfaces, microbiology and molecular biology, and new polymers and biomaterials.

The Institute for Biological Interfaces is divided into five parts: Biomolecular Micro- and Nanostructures, Molecular Biophysics, Macromolecular Materials, Magnetic Resonance, and Biotechnology and Microbial Genetics.



## SUSTAINABILITY

“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” Since 1987, this has been the definition of sustainable development, according to the United Nations’ Commission on Environment and Development, known as the Brundtland Commission. This approach is becoming increasingly important at KIT and is the declared goal of research, teaching, and innovation as outlined in KIT’s mission of “Knowledge for the Society and Environment.” KIT has been successfully engaged in this for years, however, new challenges such as climate change increase the need for additional action and resources as well as monitoring



and reports. This chapter contains a review and some successful examples.

It begins with a description of the sustainability measures at KIT in 2020, a special year not only because of the highly restricted mobility for KIT's researchers, teachers, students as well as administrative and infrastructural staff, but also because of its importance for the development of KIT's sustainability management.

Concrete examples of sustainable research at KIT in the context of climate change include the KIT-coordinated Helmholtz Programme for Atmosphere and Climate, in which KIT is applying its world-leading,

top-level research. Another cutting-edge form of applied research where the KIT is taking a leading role is real-world labs, a collaboration between science and society with a focus on mutual learning in an experimental environment. Finally, sustainable construction represents another important area for research, teaching, and innovation at KIT.





## SUSTAINABILITY MEASURES

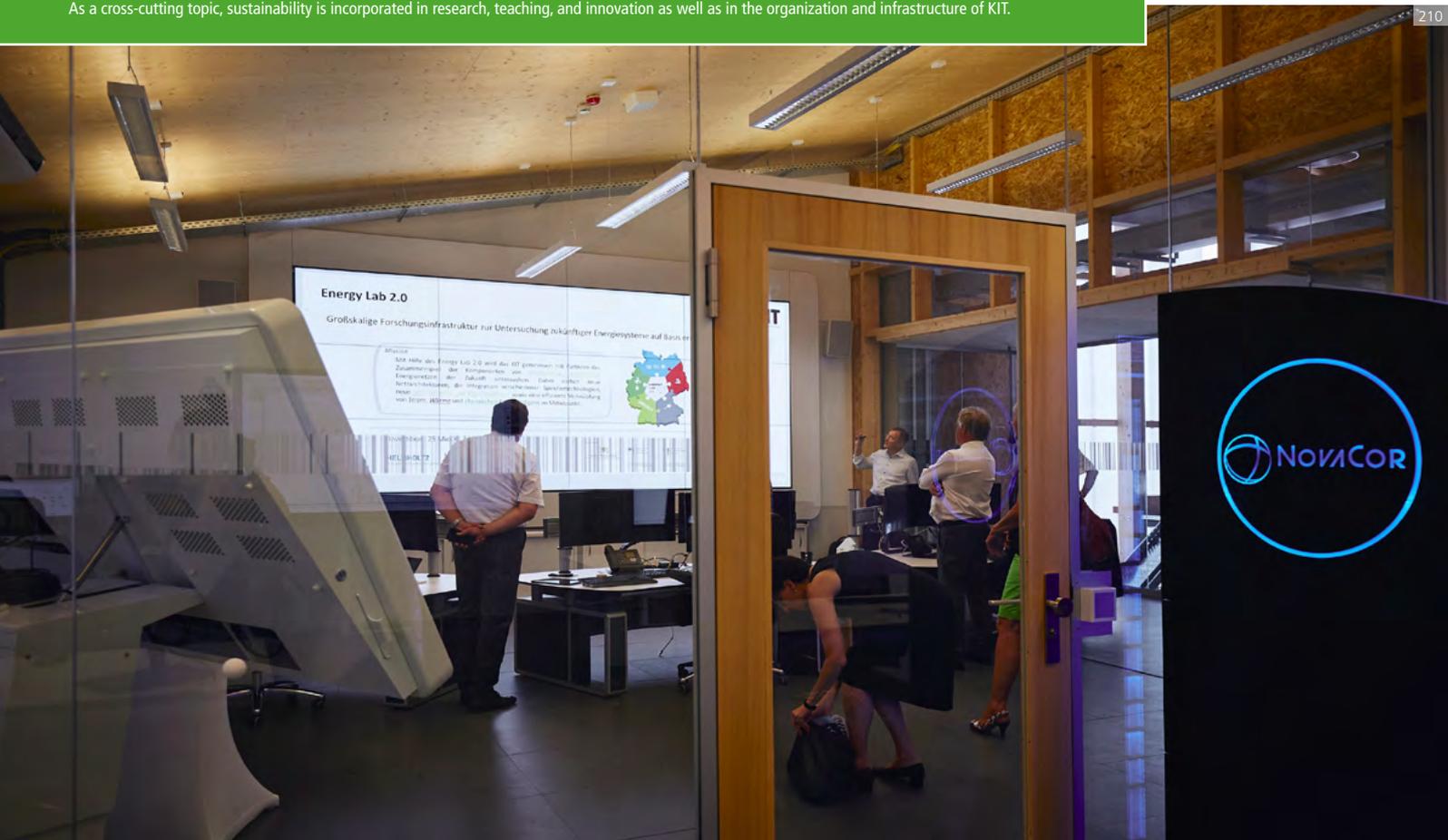
## Structural Implementation, Including the Structure and Development Plan 2022-2026

A series of fundamental structural measures for the strategic and organizational implementation of sustainability have been introduced to account for the increasing importance of this topic at the KIT. These include in particular:

- The formulation of a chapter on “Sustainability Management” in the new Structure and Development Plan (SEP 2022-2026), a strategic foundation for planning and development of KIT.
- The appointment of a Climate Protection and Sustainability Commissioner (KN-B), Professor Dr. Johannes Orphal, Head of Division IV, in March 2020.
- The contribution of KIT to the Helmholtz work group “Sustainability Forum.”
- The installation of a “Sustainability” round table at KIT (first meeting on January 15, 2021).
- The addition of “Sustainability” as an area of action in the 2025 KIT Umbrella Strategy.
- The increased cooperation with the city of Karlsruhe in matters of climate protection and adaption to climate change.
- The creation of a “Sustainability Office” at KIT in 2021.
- More sustainability data in the “Facts and Figures” of the annual report, beginning on page 147.
- And, not least, this new chapter “Sustainability” in the annual report of KIT.

Sustainability is a cross-cutting topic that, due to its wide range and high complexity, represents an enormous challenge for the development of research, teaching, and innovation as well as the organization and infrastructure of KIT. KIT is well prepared to meet this challenge in the coming years.

As a cross-cutting topic, sustainability is incorporated in research, teaching, and innovation as well as in the organization and infrastructure of KIT.



## SUSTAINABILITY IN RESEARCH: THE EXAMPLE OF CLIMATE CHANGE

### Transfer of Top-level Research to Society and Environment



Climate change and its consequences are among the biggest challenges for our modern society.

The Helmholtz Atmosphere and Climate Programme, coordinated by the KIT, has provided a multitude of excellent research results with a variety of applications in society and the environment for nearly two decades. Here are a few especially notable results from 2020:

#### 1. The interaction of climate change with

- Political measures: As shown by KIT researchers, the European "Green Deal" programme affects the world climate negatively despite leading towards a climate-neutral Europe.
- Biodiversity: A significant increase in the rate of biodiversity loss caused by climate change is already being observed and is predicted to continue into the future.
- Agriculture: The deployment of nitrogen fertilizers for food production is predicted to have further negative effects on the climate.

All results have been published in renowned scientific journals.

#### 2. Predictions and adjustments in the region, in Germany, and in Africa. Three projects are being presented here,

for which the KIT received over EUR one million in third-party funds each:

- The BMBF project KARE "Adaption to Climate Change on a Regional Level: Increased Risk for Heavy Rainfall in the Example Case of the Bavarian Oberland" has the goal of increasing the awareness of local authorities for the need to adapt to heavy rainfalls.
- The BMBF project "ClimXtreme – A Research Network on Climate Change and Extreme Events" aims to improve the evaluation of extreme weather events and their changes, uncertainties, and effects in central Europe in the past as well as future decades.
- The BMBF project SaWaM "Seasonal Water Resources Management for Semiarid Regions: Practical Transfer of Regionalized Global Information" intends to provide important information on the future development of water availability, applicable primarily for the management of reservoirs and irrigated agriculture, especially in semiarid regions with long dry seasons.

## SUSTAINABILITY AND REAL-WORLD LABS

**Collaboration of Science and Society**

A reorganization at the Institute for Technology Assessment and Systems Analysis resulted in establishing two research groups: "Sustainability and Transformation of Society" and "Sustainable Bioeconomy." They further extend the profile of the Institute, which has been active in sustainability research for about 30 years.

The "Karlsruhe Transformation Center for Sustainability and Cultural Change" (KAT) will open numerous experiment spaces for research and innovation, the ultimate goal being transformation towards sustainability. KAT will be active in education and teaching, consulting, networking, reflection and contemplation, as well as the culture of sustainability, providing input directly at KIT and in the wider society and scientific communities.

The theoretical and practical advancement of the research and development format "Real-world Lab" plays a central role in these actions. The conceptual and organizational preparations for KAT were completed in 2020, paving the way for a successful rollout of KAT this year.

The Real-world Lab "District Future – Urban Lab" (QZ), in existence since 2012, has been further extended. This project has a transdisciplinary and participatory approach and is collecting knowledge as well as specific contributions to a sustainable development of the city district

"Oststadt" of Karlsruhe. The Lab's current projects and experiments tackle urban research questions about sustainable consumption, participation, energy transition, sector coupling, climate protection in urban life, and resilience of urban tree populations in relation to climate change as well as conditions and forms of collaboration between research institutions and city administrations. Additional projects focus on the interaction of politics, industry, and science as well as the role of transition initiatives as catalysts for sustainable urban development, especially regarding mobility. Another topic are visions of urban transformation for the whole society. Due to the COVID-19 pandemic in 2020, all in-person activities in the city district's Real-world Lab had to be sharply cut back or moved to virtual spaces. The experimental book "Dein Quartier und Du" (Your District and You) about a series of QZ experiments on sustainability from the perspective of researchers and participants met with the community's wide approval. The book is available in the KIT Library as a free download in the form of an open access publication. Alternatively, it can be ordered in bound form in KIT's online shop.

In the course of the participatory application for a "Karlsruhe Real-world Lab for Sustainable Climate Protection" (KARLA), the relationship between KIT and local urban actors in the field of climate protection was strengthened and new partners were added. More than 30 organizations expressed their willingness to participate: The city of Karlsruhe, the Karlsruhe Technology Region, the Chamber of Industry and Commerce, the Chamber of Crafts, the Verkehrsclub Deutschland e. V., and the State Theater, as well as schools and numerous environmental non-governmental organizations. Additionally, a climate pact between the universities and the city of Karlsruhe was initiated during the formation of KARLA.

Since 2012, the Real-world Lab "District Future – Urban Lab" has created input for a sustainable development of the city of Karlsruhe.



## SUSTAINABLE CONSTRUCTION

### The Environment as Deposit and Future Resource Supply

The global population has been growing for decades. At the same time, economic wealth is increasing in many countries, with positive effects on education rates, health-care, and the fight against poverty. On the other hand, both population growth and the rise of economic wealth, in our current economic model, are placing increasing pressure on our natural environment, climate, and resources. For instance, the overwhelming majority of the material used for construction is taken from the earth's crust, used, and then discarded. According to recent surveys by the European Union, the construction industry is responsible for 40% of our emissions of CO<sub>2</sub> and other greenhouse gases, 50% of our primary energy consumption, 50% of our primary resource consumption, and 36% of solid waste production. Additionally, 75% of the European population already lives in cities, and that percentage is trending upward.

Our constructed environment therefore serves a key role and needs to be seen as a deposit and future supply of resources, or a new mine: The urban mine. Viewing this anthropogenic store as a temporary state in an endless cycle of resources represents a radical paradigm shift for the construction sector. The challenge consists of the development of new technologies to transfer the current materials into a new generation of sustainable, high-quality construction materials, which are ecologically harmless, less impure, and economically attractive because of their endless recyclability.

The concept of industrialized construction inside of and respecting uninterrupted natural cycles does not promote a return to the pre-industrial age. Rather, it is looking for new ways to achieve progress in the existing economic setting, to modify it, and eventually to reinvent it.



213

A pavilion designed by students, researchers, and teachers of the Department of Architecture and made of recycled and reused materials was presented at the 2019 Federal Garden Show.

Some of the organic substances that can be used as construction material are currently viewed as undesired or even repulsive by the construction industry. While the pharmaceutical industry for example used bacteria with irrefutable success, such capacities have yet to be capitalized upon in construction and architecture. Bacteria can in fact be utilized very effectively to render mineral construction material and buildings self-repairing and more durable, by using the property of certain bacteria to produce biominerals. A similar case is fungal mycelium. While fungi are viewed as undesired or even damaging organisms in the construction sector, some species can be used to grow construction material. Bamboo is another example of a construction material with potential for industrial cultivation due to the extremely high tensile strength of its fibers, which is even comparable to modern metallic construction materials. The same applies to flax and hemp fibers.



## PRIZES, HONORS, AWARDS, AND APPOINTMENTS

For years, KIT has awarded honorary titles to friends and sponsors committed to supporting KIT in accordance with pertinent regulations.

In 2020, the Executive Board and KIT Senate decided to grant the Medal of Merit to Andreas Lorenz, Chairman of the Executive Board of Volksbank Karlsruhe, for his long years of work as treasurer of the association "Studentenwohnheim des Karlsruher Instituts für Technologie (KIT) e.V." (student residences association of Karlsruhe Institute of Technology) and to Professor Karl Schlecht, Chairman of the Council of the Karl Schlecht Foundation, for supporting the Leadership Talent



Academy of KIT. Schlecht also endowed the 10<sup>th</sup> KIT Doctoral Prize in 2017.

For her long work as Chairwoman of the Supervisory Board of KIT, Dr. Renate Schubert, Professor for Economics at ETH Zurich, was appointed Honorary Citizen of KIT. From November 2011 to September 2019, she was Member of the Supervisory Board and chaired this body beginning in March 2012.

Michael Huber, Chief Executive Officer of Sparkasse Karlsruhe, was appointed Honorary Senator of KIT for his extraordinary and outstanding commitment. In particular, Michael Huber decisively contributed

to the merger of the previously separate associations of friends of KIT's precursory institutions to the "KIT Freundeskreis und Fördergesellschaft e.V." (Association of Friends of KIT). Huber now chairs this association.

KIT honors excellent doctorates and, thus, emphasizes the high priority of early-stage researchers at KIT. The 13<sup>th</sup> KIT Doctoral Prizes of the year 2019/2020 went to Dr. Jasmin Marie Busch, Institute of Organic Chemistry; Dr. Lisa Maria Kohl, Institute of Theoretical Informatics; Dr. Matthias Künzel, Helmholtz Institute Ulm; and Dr. Nicole Ludwig, Institute for Automation and Applied Informatics.



215



216



219



220



223



225

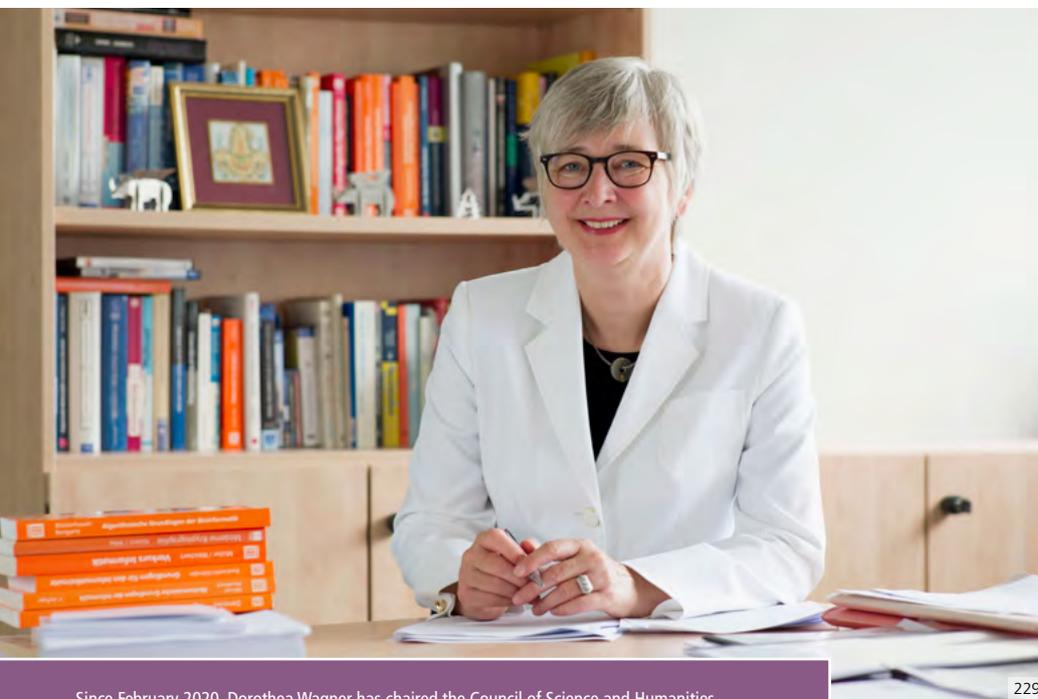


224



DOROTHEA WAGNER CHAIRS THE COUNCIL OF SCIENCE AND HUMANITIES

## KIT Computer Scientist Was Elected Chair of Germany's Premier Advisory Body for Research Policy



Since February 2020, Dorothea Wagner has chaired the Council of Science and Humanities.

Since February 1, 2020, computer scientist Dr. Dorothea Wagner, Professor for Algorithms at KIT, has chaired the Council of Science and Humanities. She has been member of this advisory body for research policy since 2015. From February 2019 to January 2020, she was Deputy Chairwoman of its scientific commission.

The Council of Science and Humanities advises the Federation and States in matters relating to the academic and structural development of universities as well as state funding of research institutions. Together with the German Research Foundation (DFG), the Council for Science and Humanities was responsible for the conceptual development and implementation of the Excellence Strategy Competition of the Federation and States. Moreover, it evaluates the German universities of excellence every seven years.

Dorothea Wagner studied mathematics at RWTH Aachen University, where she was conferred her doctorate in 1986. After her habilitation at TU Berlin in 1992, she held professorships at the Martin Luther University Halle-Wittenberg and the University of Konstanz. Since 2003, she has been Professor for Informatics at KIT.

Her work ranges from theoretical fundamentals to applications of algorithms. Current research focuses on algorithms for problems in the transport sector, such as route planning, algorithms for optimization of energy systems, and algorithms for analysis and visualization of network data.

In the course of her career, Dorothea Wagner was granted numerous honors, including the GI Fellowship (2008), the Google Focused Research Award (2012), the Werner Heisenberg Medal of the Alexander von Humboldt Foundation in recognition of her commitment to international collaboration (2018), and recently the Konrad Zuse Medal for Merits in Computer Science (2019).

In 2013, she was admitted to the Academia Europaea. In 2016, she was elected member of acatech – National Academy of Science and Engineering.

From 2007 to 2014, Dorothea Wagner was Vice-President of the German Research Foundation (DFG) and from 2004 to 2007, Spokeswoman of the DFG Computer Science Review Board. In addition, she worked on a number of scientific advisory boards, including the Selection Committee for Grants of the German Academic Exchange Service (DAAD), the Committee of the Alexander von Humboldt Foundation for Research Awards, the Senate Committee for Strategic Projects of the Leibniz Association, the Helmholtz Think Tank, and the International Expert Commission of the Elite Network of Bavaria.

## KAVLI PRIZE FOR PIONEERS OF ELECTRON MICROSCOPY

### Honors for Maximilian Haider, Harald Rose, Knut Urban, and Ondrej Krivanek

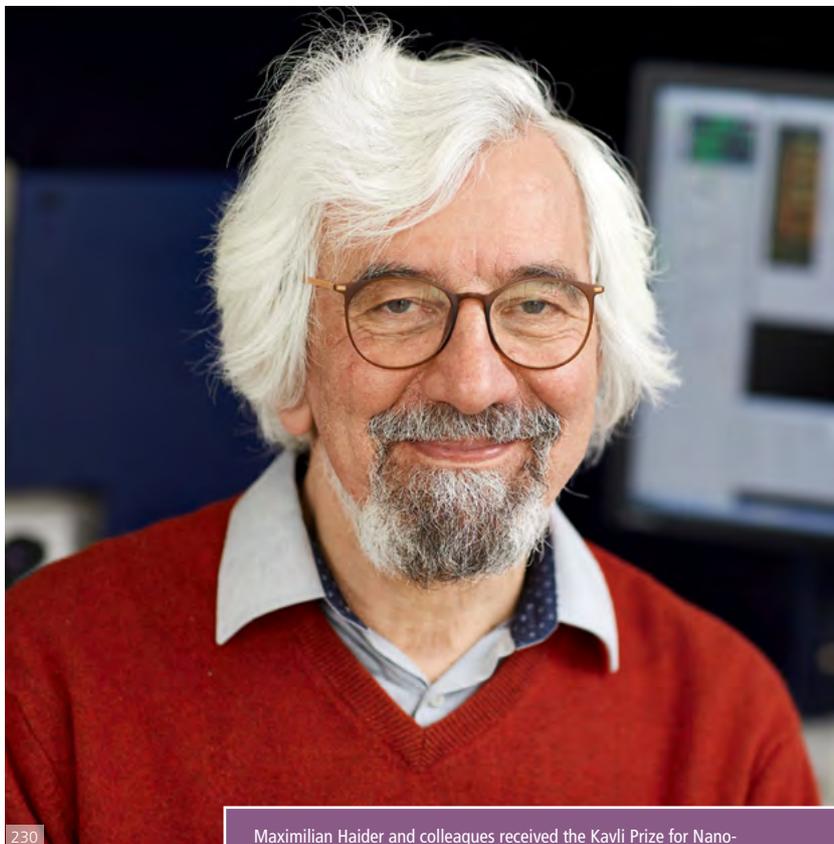
Physicist Dr. Maximilian Haider, Adjunct Professor of KIT and its Laboratory of Electron Microscopy, received the 2020 Kavli Prize for Nanosciences together with Dr. Harald Rose, Senior Professor of Ulm University, Dr. Knut Urban of Forschungszentrum Jülich, and Dr. Ondrej Krivanek, President of Nion Company, USA. The four scientists were honored for their contributions to the development of electron microscopy, which makes it possible to image and study materials with atomic resolution.

In 1990, Maximilian Haider, Harald Rose, and Knut Urban started a collaboration to correct the aberrations of electron optical lenses that had been known for about 60 years. Rose proposed a theoretical concept that Haider succeeded in implementing technically. In 1997, Knut Urban and his team presented their laboratory prototype with significantly improved resolution. Aberrations are corrected by novel “unround” electron optics, consisting of so-called magnetic multipoles. They influence the electron beams to compensate for aberrations of an objective lens. The result is highly improved image resolution.

Electron microscopes provide atomic resolution for the study of novel materials for better data storage systems and processors, the properties of high-performance materials for fuel cells, batteries, or solar cells, and the function of biological macromolecules. Hence, electron microscopes are key instruments of modern materials research and of nano- and microtechnologies.

Maximilian Haider, Harald Rose, and Knut Urban already received a number of prizes for their collaborative research, including the Karl Heinz Beckurts Prize for Innovation (2006), the Japanese Honda Prize (2008), the Wolf Prize in Physics (2011), and the Frontiers of Knowledge Award (2013).

Since 2008, the Kavli Prize has been awarded every two years for outstanding research in the areas of astrophysics, nanosciences, and neurosciences by the Kavli Foundation, the Norwegian Academy of Science and Letters, and the Norwegian Ministry of Education and Research. The Prize was established by Norwegian businessman and inventor Fred Kavli (1927 – 2013). In 2000, he es-



230

Maximilian Haider and colleagues received the Kavli Prize for Nanosciences.

tablished the Kavli Foundation to advance science for the benefit of humankind, to enhance public understanding of science, and to support the work of researchers. Each prize consists of USD 1 million.

## NEW MOLECULES FOR INNOVATIVE HIGH-TECH MATERIALS

**DFG Funds Peter Roesky's Work on Sandwich Compounds within a Reinhart Koselleck Project**

Sandwich compounds are special chemical molecules, whose properties still are largely unknown. The compounds consist of two rings, between which a single metal atom is "trapped." Simply speaking, the compounds look like minute sandwiches. To study whether these molecules may serve as a basis of future innovative materials, Professor Dr. Peter Roesky, Institute of Inorganic Chemistry, and his team produce different types of these sandwich complexes in the laboratory. The German Research Foundation (DFG) funds this groundbreaking study with EUR 500,000 under a Reinhart Koselleck Project.

Various elements from the rare earth group are used as metal atoms in the center of the compounds. The rings consist of carbon and variable proportions of other elements. Variations in the size of the rings also are the subjects of experiments. In this way, structure-effect relationships will be derived.

So far, rare earths have usually been used in solid materials for high-tech applications. The elements can be

found in LED lamps, mobile displays, and magnets of wind turbines. Production of molecular compounds from rare earths is an approach that had hardly been considered previously.

In the ideal case, researchers will obtain molecules behaving like minute magnets. Such compounds are also referred to as single-molecule magnets. When integrated into storage media, they could increase storage capacity considerably. Peter Roesky and his team also test rare-earth elements already used in luminescent materials. Sandwich compounds containing such elements are suited for future production of optimized displays. The project serves to obtain basic understanding of these novel materials.

Within the framework of Reinhart Koselleck projects, DFG funds high-risk projects that might open up new research fields. Researchers with a proven scientific track record are given the opportunity to implement innovative ideas. Across all disciplines, only eight such innovative ideas were funded within Reinhart Koselleck projects

in Germany in 2019. Peter Roesky is the first scientist of KIT to receive such funding. The funds scheduled for a duration of five years may be used freely.



Schematic representation of a sandwich compound with a bottom ring composed of various elements.

## OTHER PRIZES, HONORS, AWARDS, AND APPOINTMENTS

### Persons

■ For his doctoral thesis on innovative approaches for manufacturing novel types of solar cells, **Dr. Tobias Abzieher** received the 2020 Gips-Schüle Young Scientist Award of the Gips-Schüle Foundation.



■ **Professor Dr. Almut Arneth**, Institute of Meteorology and Climate Research, and seven other KIT scientists are among "Highly Cited Researchers," an international ranking published by the Web of Science Group.



■ Macro Group UK honored **Professor Dr. Christopher Barner-Kowollik**, Institute for Chemical Technology and Polymer Chemistry, with a "Medal for Outstanding Achievement" for his excellent achievements in polymer chemistry.



■ The jury of the European Symposium on Algorithms granted a "Test-of-Time Award" each to **Professor Dr. Frank Bellosa**, Institute of Computer Engineering, and Professor Dr. Peter Sanders, Institute of Theoretical Informatics, for their pioneering work.



■ **Maximilian Benz**, Institute of Toxicology and Genetics, received the Carl Roth Prize of the Society of German Chemists (GDCh).

■ **Dr. Akanksha Bhutani**, Institute of Radio Frequency Engineering and Electronics, was granted the Sponsorship Award of the Südwestmetall Association of Employers in Metal and Electronics Industries for her doctoral thesis on "Low Temperature Co-fired Ceramics for System-in-Package Applications at 122 GHz."



■ **Jakob Boretzki**, Research Center for Steel, Timber, and Masonry, is among this-year's winners of the Schöck Construction Innovation Prize.

■ **Professor Dr. Klaus Butterbach-Bahl**, Institute of Meteorology and Climate Research, and seven other KIT scientists are among "Highly Cited Researchers," an international ranking published by the Web of Science Group.

■ **Martin Byrenheid** and Stefanie Roos, Institute of Telematics, were presented the Best Paper Runner-up Award at the Symposium on Reliable Distributed Systems SRDS 2020 for their paper "Secure Embedding of Rooted Spanning Trees for Scalable Routing in Topology-restricted Networks."

■ **Marius Dackweiler**, wbk Institute of Production Science, was granted the ThinkKing Award by the Baden-Württemberg State Agency for Lightweight Construction.

■ **Professor Dr. Barbara Deml**, Institute for Human and Industrial Engineering, and three other scientists of KIT were elected members of the National Academy of Science and Engineering (acatech).



■ **Professor Dr. Achim Dittler**, Institute for Mechanical Process Engineering and Mechanics, was appointed member of the "Aerosols Expert Group" of the Baden-Württemberg Ministry of Science, Research, and the Arts.

■ Facebook honored Professor Dr. Melanie Volkamer, Peter Mayer, and **Reyhan Düzgün**, Institute of Applied Informatics and Formal Description Methods, for their research into secure and user-friendly authentication methods in augmented and virtual reality technology.

■ **Dr. Elisabeth Eiche**, Institute of Applied Geosciences, received the Excellence in Review Award of the journal "Applied Geochemistry" of the International Association of GeoChemistry.

■ **Professor Dr. Maximilian Fichtner**, Deputy Director of Helmholtz Institute Ulm, was appointed Adjunct Professor by the College of Engineering of Swansea University.



■ In recognition of his highly innovative scientific work, **Professor Dr. Herbert Fischer**, apl. Professor of the Institute of Meteorology and Climate Research, was appointed honorary member of the German Meteorological Society.



■ **Professor Dr. Frank Gauterin**, Institute of Vehicle System Technology, and three other scientists of KIT were elected members of the National Academy of Science and Engineering (acatech).



■ **Dr. Christian Greiner**, Institute for Applied Materials, was granted the Adolf Martens Prize by the Bundesanstalt für Materialforschung und -prüfung (Federal Institute for Materials Research and Testing).

■ The members of the National Accompanying Body elected **Professor Dr. Armin Grunwald**, Institute for Technology Assessment and Systems Analysis, one of their two chairpersons.



■ **Professor Dr. Peter Gumbsch**, Institute for Applied Materials, and three other scientists of KIT were elected members of the National Academy of Science and Engineering (acatech).



■ **Dr. Amir-Abbas Haghighirad**, Institute for Quantum Materials and Technologies, and seven other KIT scientists are among "Highly Cited Researchers," an international ranking published by the Web of Science Group.

■ **Professor Dr. Horst Hahn**, Director of the Institute of Nanotechnology, was elected Fellow of the National Academy of Inventors (NAI) in the USA.



■ Physicist **Dr. Maximilian Haider**, Adjunct Professor of Karlsruhe Institute of Technology (KIT), received the Kavli Prize for Nanosciences.

■ **Professor Dr.-Ing. Holger Hanselka**, President of KIT, was re-elected Vice President of the German Federation of Industrial Research Associations (AiF).

■ The German Research Foundation extended the mandate of the Permanent Senate Commission for the Investigation of Health Hazards of Chemical Compounds in the Work Area (MAK Commission) chaired by **Professor Dr. Andrea Hartwig**, Institute for Applied Biosciences.



■ The German Research Foundation admitted **Dr. Alexander Hinz**, Institute for Inorganic Chemistry, to the Emmy Noether Program.

■ In August 2020, **Professor Dr. Marlis Hochbruck** was elected Member of the Senate Committee for Strategic Projects of the Leibniz Association for a term of four years.



■ **Professor Dr. Guanghui Hu**, Beijing Computational Science Research Center, Beijing, China, worked at the Institute for Applied and Numerical Mathematics under an Alexander von Humboldt Fellowship for Experienced Researchers.

■ For her master's thesis "Stadthaus in Mailand" (city house in Milan), **Andra Ionel**, KIT Department of Architecture, received one of three prizes of equal rank in the competition for the third Student Sponsorship Award in Urban Architecture.

■ **Professor Dr. Jürgen Janek**, Justus Liebig University Gießen and Institute of Nanotechnology of KIT, and seven other KIT scientists are among “Highly Cited Researchers,” an international ranking published by the Web of Science Group.

■ **Professor Dr. Michael Kaschke**, Chairman of the Supervisory Board of KIT, was granted the 7<sup>th</sup> German Leadership Award for modern, innovation-oriented employee management in the ZEISS Group.



■ For her participation in investigative research on “Das Gift in uns – der PFC-Skandal in Mittelbaden” (the poison in us – the PFC scandal in the region of Mittelbaden), free journalist **Patricia Klatt**, contract lecturer at the Institute of Technology Futures, received third place in the local journalist prize competition of the Konrad Adenauer Foundation.

■ **Professor Dr. Oliver Kraft**, Vice-President for Research, was re-elected Member of the University Council of Karlsruhe University of Applied Sciences.

■ In addition, **Oliver Kraft** was appointed Member of the Advisory Board of FIZ Karlsruhe – Leibniz Institute for Information Infrastructure.

■ **Monika Landgraf**, Head of the SEK Corporate Communications Group and Press Officer of KIT, and four other employees of KIT were appointed members of working groups of #FactoryWisskomm of Federal Research Minister Anja Karliczek.



■ **Professor Dr. Gisela Lanza**, Member of the Board of Management of wbk Institute of Production Science, was elected Member of the Senate of the German Research Foundation (DFG). She is the second KIT scientist working in the central scientific body of DFG.



■ In addition, **Gisela Lanza** was appointed Fellow by the International Academy for Production Engineering CIRP in recognition of her commitment to CIRP and her scientific work.

■ **Professor Dr. Annette Leßmöllmann**, Institute of Technology Futures, was appointed Member of the Working Group “University Communication” of the German Rectors’ Conference (HRK).



■ In addition, **Annette Leßmöllmann** and four other employees of KIT were appointed members of working groups of #FactoryWisskomm of Federal Research Minister Anja Karliczek.

■ **Dr. Patrick Lott**, Institute for Chemical Technology and Polymer Chemistry, received the Excellence Award of the VAA Foundation for his outstanding doctoral thesis that is of relevance to industrial applications.

■ **Beatrice Lugger**, Director of the National Institute for Science Communication NaWik of KIT, and four other employees of KIT were appointed members of working groups of #FactoryWisskomm of Federal Research Minister Anja Karliczek.



■ **Dr. Stefan Maier**, Scientist of the Institute of Experimental Particle Physics, was granted the “Detector Award” of the CMS tracking detector.

■ **Professor Dr. Uttam Manna**, Indian Institute of Technology (IIT), Guwahati, India, worked at the Institute of Nanotechnology under an Alexander von Humboldt Fellowship for Experienced Researchers.

■ Facebook honored Professor Dr. Melanie Volkamer, **Dr. Peter Mayer**, and Reyhan Düzgün, Institute of Applied Informatics and Formal Description Methods, for their research into secure and user-friendly authentication methods in augmented and virtual reality technology.

■ In the architectural competition “Stadt im Wandel – Stadt der Ideen” (changing city – city of ideas) on sustainable circular concepts for planning and construction in Berlin-Brandenburg, **Wenzel Meyer**, KIT Department of Architecture, ranked first with his master’s thesis “Paradigmenwechsel – Transformation Kaufhaus Darmstadt” (change of paradigms – transformation of the Darmstadt shopping center).

■ For his graduation thesis “Dynamische Hindernisvermeidung für autonome Radlader” (dynamic obstacle avoidance for autonomous wheel loaders), **Lukas Michiels**, student of mechanical engineering, was granted the Excellence Award for the best graduates of the integrated bi- and trilingual DFH programs by German-French University (DFH).

■ **Dr. Go Mishima**, Scientist of the Institute for Astroparticle Physics, was presented the “Particle Physics Medal: Young Scientist Award in Theoretical Particle Physics” by the Japanese Physical Society.

■ **Allen Mohammadi**, Institute for Entrepreneurship, Technology Management, and Innovation, won the World Championship Title at the Start-up World Cup (Green-Tech Category) with his startup PlasticFri.



■ **Gabriela Molinar**, Institute for Information Processing Technology, received third place in the Energy Campus 2020 organized by the Foundation for Energy and Climate Protection.

■ **Professor Dr. Jörn Müller-Quade**, Head of the Competence Center for Applied Security Technology KASTEL, was appointed member of an interdisciplinary commission for pandemic research newly established by the German Research Foundation.



■ **Dr. Philipp Niemann**, Scientific Director of the National Institute for Science Communication NaWik of KIT, and four other employees of KIT were appointed members of working groups of #FactoryWisskomm of Federal Research Minister Anja Karliczek.

■ **Dr. Claudia Niessner**, Institute of Sports and Sports Science, was granted the first “Open Data Impact Award” by the Stifterverband. She received third place for her project “More Data,” one of the first open data infrastructures for sports science.

■ **Dr. Katrin Ochsenreither**, Institute of Process Engineering in Life Sciences, is a new member of the Future Forum Biotechnology of DECHEMA.

■ The new Chairman of the Environmental Physics Division of the European Physical Society is **Professor Dr. Johannes Orphal**, Head of Division IV – Natural and Built Environment.



■ **Professor Dr. Stefano Passerini**, Director of Helmholtz Institute Ulm, and seven other KIT scientists are among “Highly Cited Researchers,” an international ranking published by the Web of Science Group.



■ **Professor Dr. Dmitry Pelinovsky**, McMaster University, Canada, was granted the Research Award by the Alexander von Humboldt Foundation. He was nominated by the Institute for Analysis and, hence, will spend several months for research at KIT.

■ **Professor Dr. Holger Puchta**, Head of the Botanical Institute, and seven other KIT scientists are among “Highly Cited Researchers,” an international ranking published by the Web of Science Group.

■ Head of Division I, **Professor Dr. Andrea Robitzki**, was appointed Member of the Advisory Board on Sustainable Bioeconomy of the Baden-Württemberg State Government.

■ Martin Byrenheid and **Stefanie Roos**, Institute of Telematics, were presented the Best Paper Runner-up Award at the Symposium on Reliable Distributed Systems SRDS 2020 for their paper “Secure Embedding of Rooted Spanning Trees for Scalable Routing in Topology-restricted Networks.”

■ The jury of the European Symposium on Algorithms granted a “Test-of-Time Award” each to Professor Dr. Frank Bellosa, Institute of Computer Engineering, and **Professor Dr. Peter Sanders**, Institute of Theoretical Informatics, for their pioneering work.

■ **Professor Dr. Eri Saikawa**, Associate Professor in Environmental Sciences at Emory University, Atlanta, USA, worked at the Institute of Meteorology and Climate Research under an Alexander von Humboldt Fellowship for Experienced Researchers.

■ **Professor Dr. Wilhelm Schabel**, Institute of Thermal Process Engineering, was appointed Edwards Fellow by the Edwards Centre for Soft Matters of Cambridge University.



■ **Lür Schäfer**, KIT Department of Architecture, reached first place in the BauNetz Campus Masters July/August 2020 with his graduation thesis “House of Water.”

■ **Philipp Schrögel**, Institute of Technology Futures, and four other employees of KIT were appointed members of working groups of #FactoryWisskomm of Federal Research Minister Anja Karliczek.



■ **Max Schemmer**, Institute of Information Systems and Marketing, reached first place in the Young Scientists Competition “Digitalization in Mechanical Engineering” of VDMA (German Engineering Association) with his master’s thesis.

■ **Laura Spitzmüller**, Institute of Applied Geosciences, received the Christian Hecht Prize of the Geothermal Energy Practical Forum of Bavaria.

■ **Tabea Stadler**, Institute of Micro Process Engineering, reached first place in the Energy Campus 2020 organized by the Foundation for Energy and Climate Protection.

■ **Professor Dr. Alexandros Stamatakis**, Institute of Theoretical Informatics, and seven other KIT scientists are among “Highly Cited Researchers,” an international ranking published by the Web of Science Group.

■ **Dr. Johannes Steinmann**, Institute for Beam Physics and Technology, was awarded the Frank Sacherer Prize by the European Physical Society for work associated with his doctoral thesis.

■ **Professor Dr. Uwe Strähle**, Institute for Biological and Chemical Systems, was granted the Christiane Nüsslein-Volhard Award of EuFish-BioMed at the ZEBRAFISH 2020 virtual conference



■ **Professor Dr. Thorsten Strufe**, Institute of Telematics, was granted a Best Paper Award at the International Symposium on Personal, Indoor and Mobile Radio Communications PIMRC 2020.

■ **Professor Dr. York Sure-Vetter**, Institute of Applied Informatics and Formal Description Methods, was appointed Director of the National Research Data Infrastructure (see also page 10).



■ **Professor Dr. Patrick Théato**, Institute for Chemical Technology and Polymer Chemistry, was elected Chairman of the Subcommittee on Polymer Terminology of the International Union of Pure and Applied Chemistry (IUPAC).



■ In addition, **Patrick Théato** was appointed Member of the newly established “Commission of Revision of GDCh Recommendations (2015) for Bachelor’s Studies of Chemistry at Universities” of the Society of German Chemists (GDCh).

■ The second of three prizes of the European Commission’s “SOFT European Prize for Innovation in Fusion Research” in the amount of EUR 25,000 was presented to **Dr. Pavel Vladimirov**, Institute for Applied Materials.

■ **Professor Dr. Melanie Volkamer**, Institute of Applied Informatics and Formal Description Methods, received a Google Faculty Research Award in the category of “Security.”



■ In addition, Facebook honored **Melanie Volkamer**, Peter Mayer, and Reyhan Düzgün, Institute of Applied Informatics and Formal Description Methods, for their research into secure and user-friendly authentication methods in augmented and virtual reality technology.

■ **Professor Dr. Rainer M. Volkamer**, University of Colorado, USA, worked at the Institute of Meteorology and Climate Research under the Friedrich Wilhelm Bessel Research Award Program of the Alexander von Humboldt Foundation.

■ In the category of “MINT-Bildung von Lehrkräften” (STEM education of teachers), **Professor Dr. Ingo Wagner**, Institute of Sports and Sports Science, received second place in the “Laboratory as a Place of Learning Prize” competition for the teaching-learning laboratory “makeScience!” at Karlsruhe University of Education that is supported by him and his team.

■ **Professor Dr. Martin Wegener**, Institute of Applied Physics, Scientific Director of the Institute of Nanotechnology, and Spokesman of the Cluster of Excellence 3D Matter Made to Order, and seven other KIT scientists are among “Highly Cited Researchers,” an international ranking published by the Web of Science Group.



■ **Professor Dr. Wolfgang Wernsdorfer**, Physikalisches Institut, received the Science Award of the Hector Foundation in the amount of EUR 150,000 for his outstanding achievements in the development of quantum computers.



■ In addition, **Wolfgang Wernsdorfer** was granted the Dominique Givord Award of the European Magnetism Association for his contributions to the further development of research in the areas of single molecule magnets, magnetization tunnels, and molecular spintronics.

■ **Professor Dr. Johann Marius Zöllner**, Institute of Applied Informatics and Formal Description Methods, was appointed Member of the Council of Karlsruhe University of Applied Sciences for the next five years.



■ **Professor Dr. Thomas Zwick**, Institute of Radio Frequency Engineering and Electronics, and three other scientists of KIT were elected Members of the National Academy of Science and Engineering (acatech).



## Institutions

■ The **Digital Earth** project of the Helmholtz Association with researchers of the Institute of Meteorology and Climate Research and of the Institute for Water and River Basin Management was granted the Special Prize "Digital Science" in the category of Society of the Digital Leader Awards Competition.



■ **EnergyLab 2.0** won gold in the categories "Institutional" and "Other Architectural Designs" of the International Design Awards Competition (IDA).



■ **Formic Transportsysteme**, a spinoff of wbk Institute of Production Science and the Institute for Materials Handling and Logistics, was granted funding in the amount of EUR 150,000 for its 14-month startup phase from the "Helmholtz Enterprise" program.

■ In the German Startup Monitor issued by the Federal Association of German Startups, **Karlsruhe Institute of Technology** again achieved second place among the top 10 startup universities in 2020.

■ In the Gründungsradar start-up ranking of the Stifterverband, **Karlsruhe Institute of Technology** attained sixth place among the big universities with more than 15,000 students.



■ For the fourth time in a row, **Karlsruhe Institute of Technology** was granted the certificate "family-friendly university audit" for another three years, until 2023.

■ **Karlsruhe Institute of Technology** won second place in the Academic Bicycle Challenge, category Worldwide Absolute.

■ The team of the university group **KITcar** won the Carolo Cup, a competition of Braunschweig Technical University, with its self-driving model vehicle Dr. Drift.



■ The **Network for Nanotechnology Materials** NanoMat passed certification for the silver label of the European Cluster Excellence Initiative (ECEI).

■ KIT's daycare center **nanos!** on Campus North was granted the special prize of the "Climate Hero 2020" competition for their project to make the outdoor area sustainable and bee-friendly.

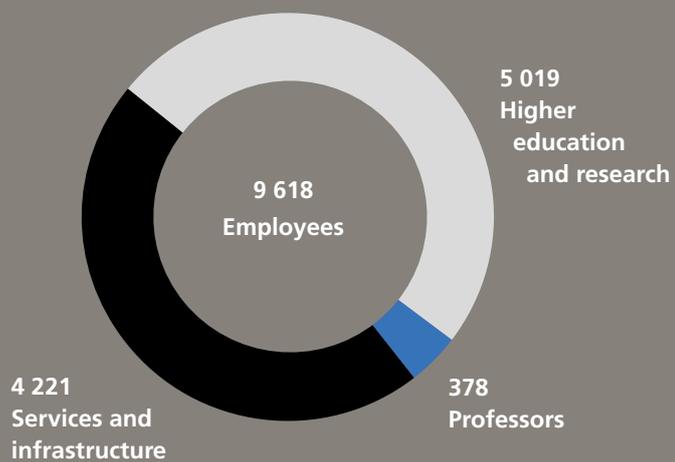


# FACTS AND FIGURES

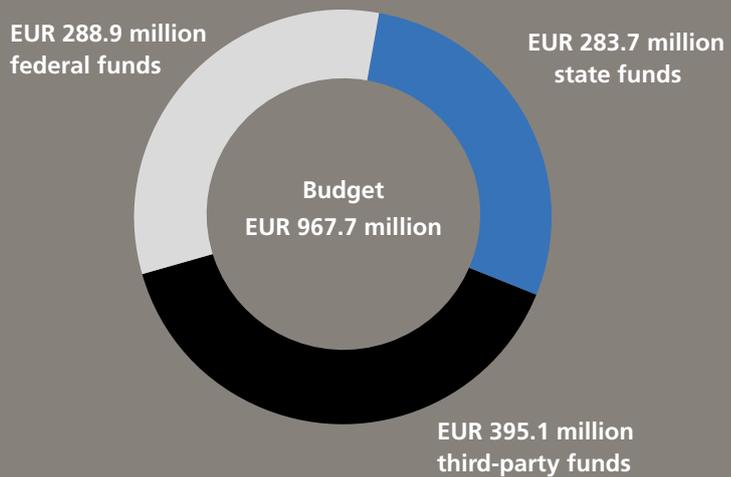
Number of students



Employees 2020



Total budget 2020



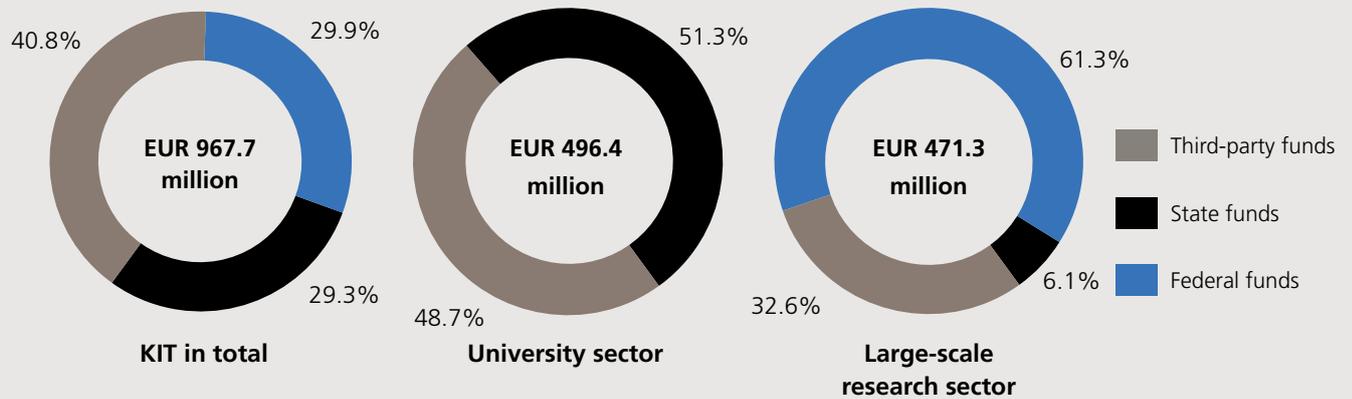
**CONTENT**

FUNDING .....	116
Federal, State, and Third-party Funds Acquired.....	116
Sources of Funding .....	116
Sources of Third-party Funding .....	117
Use of Funds .....	117
PERSONNEL INFORMATION .....	118
KIT Staff in Total.....	118
Habilitations.....	119
Appointments.....	119
Emeriti/Retirements.....	121
STUDENTS .....	122
Students in Total .....	122
Students and Desired Degrees.....	122
Allocation of Students to Subject Groups.....	123
Allocation of Foreign Students to Subject Groups.....	123
Home Countries of Foreign Students (Top 20 of 130).....	124
Student Beginners and Degrees Targeted in the 1 <sup>st</sup> Semester .....	124
Number of Student Beginners in the 1 <sup>st</sup> Semester.....	125
Origin of Students in the 2020/21 Winter Semester .....	125
Number of Graduates .....	126
Doctoral Candidates in the Different Subject Groups .....	126
Study Programs.....	127
RESEARCH .....	131
Coordinated Research Programs.....	131
ERC Grants .....	134
Young Investigators Groups .....	135
Junior Professorships.....	139
Graduate Schools.....	141
Research Training Groups.....	141
INNOVATION.....	143
Innovation Characteristics .....	143
Establishments of New Companies.....	143

AWARDS .....	144
External Awards .....	144
KIT Department Teaching Awards .....	144
Awards for Doctoral Researchers .....	144
MEDIA/PUBLICATIONS .....	145
Development of Visibility in the Media .....	145
Publications .....	145
RANKINGS .....	146
National Rankings .....	146
International Rankings .....	146
SUSTAINABILITY .....	147
CO <sub>2</sub> Emissions of Heating Power Plants on Campus North .....	147
Energy Consumption and Energy Production on Campus North .....	147
Supply and Waste Management Services .....	148
Areas .....	148
CO <sub>2</sub> Emission Factors .....	149
Number of Centrally Administrated KIT Company Cars in 2020, Type of Drive .....	149
Fuel Consumption, Driven Kilometers, and CO <sub>2</sub> Emissions .....	149
Fuel Consumption and CO <sub>2</sub> Emissions of KIT Shuttle .....	149
ORGANIZATIONAL CHARTS .....	150

## FUNDING

## Federal, State, and Third-party Funds Acquired



## Sources of Funding

## KIT in Total

In million euros	2016	2017	2018	2019	2020
Income in total	851.1	901.7	880.9	951.3	967.7
Third-party funds	336.4	358.7	338.0	369.7	395.1
State funds	251.5	255.4	263.0	271.4	283.7
Federal funds	263.2	287.6	279.9	310.2	288.9

## University Sector

In million euros	2016	2017	2018	2019	2020
Income in total	429.6	445.9	440.3	466.7	496.4
Third-party funds	208.1	218.7	206.5	224.4	241.6
State funds	221.5	227.2	233.8	242.3	254.8
Federal funds*	0.0	0.0	0.0	0.0	0.0

\* In the University Sector, federal funds are included in the third-party funds, as they are granted for special projects rather than for basic funding.

## Large-scale Research Sector

In million euros	2016	2017	2018	2019	2020
Income in total	421.5	455.8	440.6	484.6	471.3
Third-party funds	128.3	140.0	131.5	145.3	153.5
State funds	30.0	28.2	29.2	29.1	28.9
Federal funds	263.2	287.6	279.9	310.2	288.9

In the Large-scale Research Sector, federal and state funds also include the revenues/outstanding sums from the previous year. Federation: EUR 62.5 million, State: EUR 5.89 million.

## Sources of Third-party Funding

KIT in Total

In million euros	2016	2017	2018	2019	2020
Third-party funding in total	336.4	358.7	338.0	369.7	395.1
Third-party funding by DFG, incl. CRC	50.3	52.9	51.4	59.9	52.4
Third-party funding by EU	29.4	30.0	25.2	28.5	30.5
Third-party funding by Fed. and State	124.0	140.9	129.2	142.6	169.5
Other income	132.7	134.9	132.2	138.7	142.7

University Sector\*

In million euros	2016	2017	2018	2019	2020
Third-party funding in total	208.1	218.7	206.5	224.4	241.6
Third-party funding by DFG, incl. CRC	41.1	41.4	42.9	45.1	40.1
Third-party funding by EU	11.0	11.9	9.6	11.0	11.6
Third-party funding by Fed. and State	90.6	93.6	83.0	91.2	103.7
Other income	65.4	71.8	71.0	77.1	86.2

\* Third-party funds shall be all income of and grants awarded to the University Sector under the University Funding Agreement I in addition to basic funding.

Large-scale Research Sector

In million euros	2016	2017	2018	2019	2020
Third-party funding in total	128.3	140.0	131.5	145.3	153.5
Third-party funding by DFG, incl. CRC	9.2	11.5	8.5	14.8	12.3
Third-party funding by EU	18.4	18.1	15.6	17.5	18.9
Third-party funding by Fed. and State	33.4	47.3	46.2	51.4	65.8
Other income	67.3	63.1	61.2	61.6	56.5

## Use of Funds

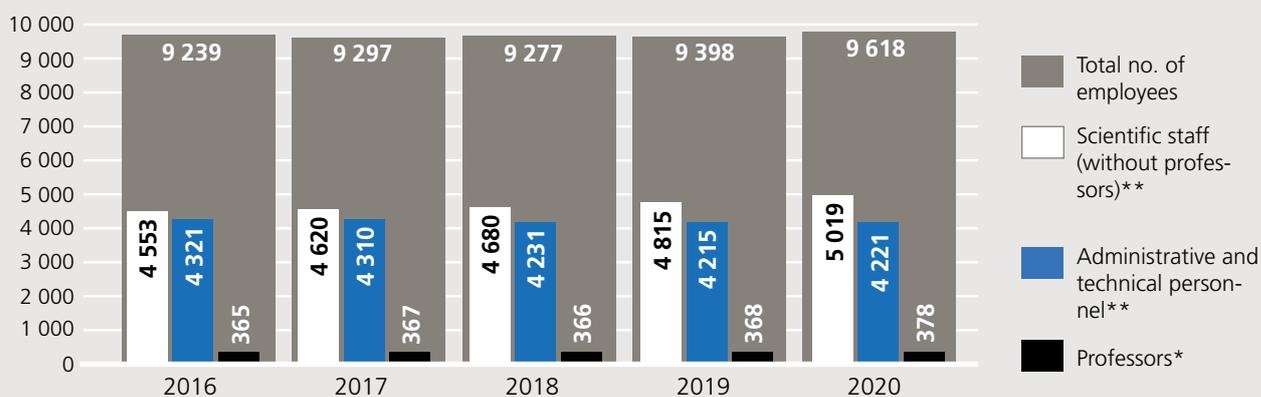
In million euros	KIT in Total	University Sector*	Large-scale Research Sector
Expenses in total	967.7	496.4	471.3
Investments in total	101.7	38.4	63.3
of these, major investments	39.0	19.5	19.5
of these, ongoing investments	62.7	18.9	43.8
Personnel expenses	625.9	355.1	270.8
Material expenses	220.6	83.4	137.2

\* Figures taken from the financial statement corrected by cost items not relevant to expenses (e.g. provisions).

## PERSONNEL INFORMATION

## KIT Staff in Total

Staff (headcount)	2016	2017	2018	2019	2020
Total number of employees	9 239	9 297	9 277	9 398	9 618
of these, female employees	3 373	3 447	3 454	3 553	3 636
Professors*	365	367	366	368	378
of these, female professors	49	49	51	54	59
of these, junior professors	8	7	9	11	17
of these, female junior professors	3	2	3	3	5
of these, international professors	34	36	39	43	44
of these, endowed professors	9	9	7	6	10
Scientific staff (without professors)**	4 553	4 620	4 680	4 815	5 019
of these, female scientists	1 190	1 244	1 255	1 317	1 385
of these, staff financed from third-party funds	2 341	2 408	2 421	2 446	2 543
of these, international employees	950	990	1 035	1 135	1 240
of these, employment contracts of limited duration	3 561	3 585	3 612	3 737	3 925
of these, part-time employees	1 529	1 530	1 587	1 605	1 634
Administrative and technical personnel**	4 321	4 310	4 231	4 215	4 221
of these, female staff	2 134	2 154	2 148	2 182	2 192
of these, staff financed from third-party funds	736	753	785	751	679
of these, international employees	194	205	212	223	237
of these, employment contracts of limited duration	1 056	965	894	845	859
of these, part-time employees	1 112	1 110	1 101	1 149	1 172
of these, trainees and students of Baden-Württemberg Cooperative State University	464	432	396	371	370
of these, female trainees and students	162	152	154	140	140
Trainees' share in the total number of employees [%]	5	5	4	4	4



\* Professors, junior professors, and executive scientists receiving W-type salary according to Article 14 KIT Act.

\*\* Deviations from the 2016 Annual Report due to revision of the category.

### Habilitations

	2016	2017	2018	2019	2020
Total	19	20	7	12	9
Men	16	19	7	10	7
Women	3	1	0	2	2

### Appointments to W-3 University Professor at KIT

Name, division	Professorship	Previous employer institution
Prof. Dr. Sylvia Erhardt, Division I	Molekulare Zellbiologie der Tiere	Heidelberg University
Prof. Dr. Bronislava Gorr, Division III	Werkstoffverhalten unter externen Umgebungsbedingungen	University of Siegen
Prof. Dr. Gudrun Heinrich, Division V	Theoretische Teilchenphysik	Max Planck Institute for Physics
Prof. Christian Inderbitzin, Division IV	Stadt und Wohnen	Technical University of Munich
Prof. Dr. Sebastian Kempf, Division III	Mikro-Nanoelektronische Systeme	Heidelberg University
Prof. Dr. Christoph Kirchlechner, Division III	Nanostrukturierte Funktionsmaterialien	Max-Planck-Institut für Eisenforschung GmbH
Prof. Dr. Ulrike Krewer, Division III	Elektrochemische Energiewandlung und Speichersystemtechnik	TU Braunschweig
Prof. Dr. Pavel Levkin, Division I	Multifunktionale Materialien und Systeme	University of California, Berkeley
Prof. Dr. Michael Mäs, Division II	Soziologie II	University of Groningen
Prof. Dr. Gerhard Neumann, Division II	Autonome lernende Roboter	University of Tübingen
Prof. Dr. Andrea Robitzki, Division I	Hybride Mikrosensorsysteme für die Lebenswissenschaften und die Verfahrenstechnik; Head of Division I	Leipzig University
Prof. Dr. Benjamin Scheibehenne, Division II	Consumer and User Behavior	Geneva School of Economics and Management
Prof. Dr. Kathrin Valerius, Division V	Experimentelle Teilchenphysik	KIT

### Appointments to W-2 University Professor at KIT

Name, division	Professorship	Previous employer institution
Prof. Dr. Markus Ulrich, Division IV	Machine Vision Metrology	MVTec Software GmbH

## PERSONNEL INFORMATION

**Appointment to W-1 University Professor at KIT**

Name, division	Professorship	Previous employer institution
Dr. Thomas Bläsius, Division II	Skalierbare Algorithmik und Verfahren für große Datenmengen	University of Potsdam
Dr. Yolita Eggeler, Division V	Elektronenmikroskopie	University of California
Dr. Claudio Llosa Isenrich, Division V	Geometrie	University of Vienna
Dr. Britta Klopsch, Division II	Schulpädagogik – Lehramt an Gymnasien	Heidelberg University
Dr. Reza Maalek, Division IV	Digital Engineering and Construction	University of Calgary
Dr. Helge Sören Stein, Division I	Angewandte Elektrochemie	California Institute of Technology

**Appointments to Apl. Professor and Honorarprofessor**

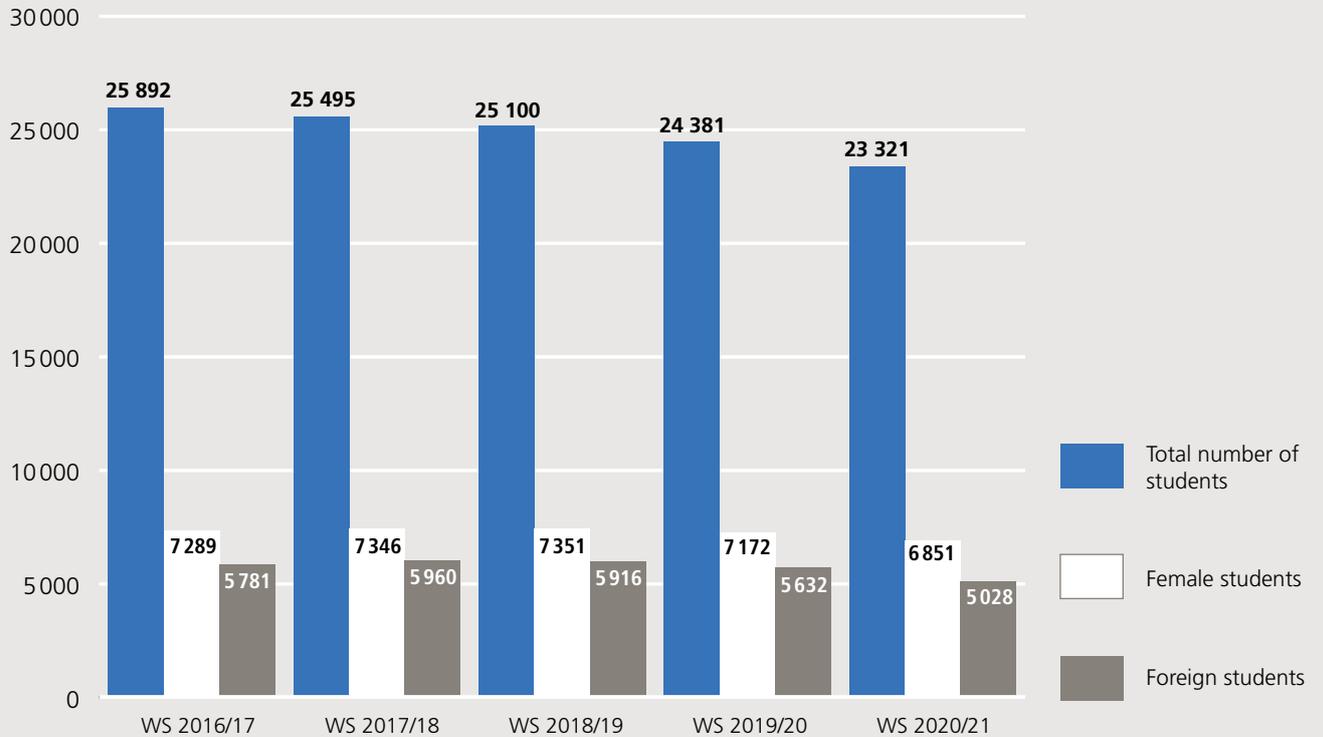
Name	Type	KIT department
Prof. Dr. Gregory Egger	Apl. Professor	Civil Engineering, Geo- and Environmental Sciences
Prof. Dr. Karin Fink	Apl. Professor	Chemistry and Biosciences
Prof. Dr. Lutz Groell	Apl. Professor	Mechanical Engineering
Prof. Dr. Maximilian Haider	Honorarprofessor	Physics
Prof. Dr. Boris Jutzi	Apl. Professor	Civil Engineering, Geo- and Environmental Sciences
Prof. Dr. Bernhard Ulrich Kehrwald	Honorarprofessor	Mechanical Engineering
Prof. Dr. Günter Leister	Honorarprofessor	Mechanical Engineering
Prof. Dr. Oliver Raabe	Apl. Professor	Informatics
Prof. Dr. Markus Reischl	Apl. Professor	Mechanical Engineering
Prof. Dr. Uwe Spetzger	Honorarprofessor	Informatics

**Emeriti/Retirements**

Name	Institute	Division
Prof. Dr. Johannes Blümer	Head of Division V	Division V
Prof. Dr. Michael Braun	Institute of Electrical Engineering	Division III
Prof. Dr. Norbert Henze	Institute of Stochastics	Division V
Prof. Dr. Christoph Kottmeier	Institute of Meteorology and Climate Research	Division IV
Prof. Dr. Michael Siegel	Institute of Micro- and Nanoelectronic Systems	Division III
Prof. Dr. Uwe Strähle	Institute for Biological and Chemical Systems	Division I
Prof. Dr. Walter Tichy	Institute for Program Structures and Data Organization	Division II
Prof. Dr. Doris Wedlich	Head of Division I; Zoological Institute	Division I
Prof. Dr. Georg Weiß	Physikalisches Institut	Division V
Dr. Karl-Friedrich Ziegahn	Head of Division IV	Division IV

## STUDENTS

## Students in Total



## Students and Desired Degrees

Desired degree	WS 2016/17	WS 2017/18	WS 2018/19	WS 2019/20	WS 2020/21
Bachelor	14 245	14 129	13 810	13 495	13 086
Master	9 193	9 424	9 313	8 955	8 548
Teacher (secondary and vocational schools)	823	872	918	952	964
Doctorate	555	475	457	441	355
State examination	23	14	6	0	0
Diploma	462	57	50	32	22
Studienkolleg	230	207	214	185	148
No degree*	361	317	332	321	198
<b>Total</b>	<b>25 892</b>	<b>25 495</b>	<b>25 100</b>	<b>24 381</b>	<b>23 321</b>

\*No degree: In particular exchange students, who do not aim at a degree at KIT.

**Allocation of Students to Subject Groups**

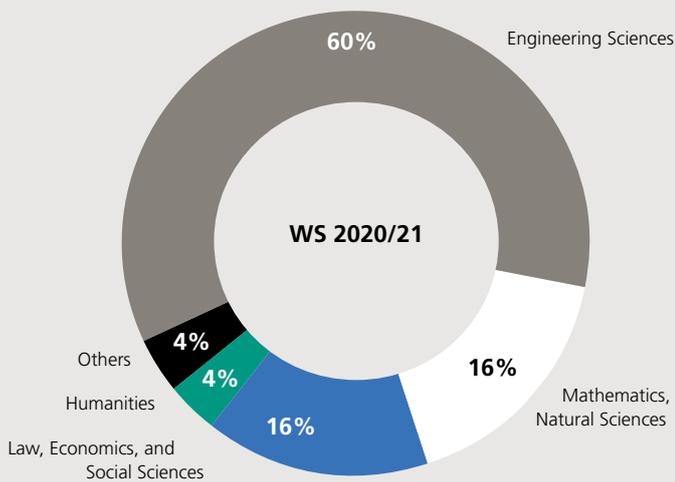
Subject group	WS 2016/17	WS 2017/18	WS 2018/19	WS 2019/20	WS 2020/21
Engineering Sciences	15 785	15 671	15 303	14 729	14 025
Mathematics, Natural Sciences	4 504	4 225	4 156	4 042	3 933
Law, Economics, and Social Sciences	3 889	3 854	3 835	3 833	3 678
Humanities	840	872	889	877	830
Others	874	873	917	900	855
<b>Total</b>	<b>25 892</b>	<b>25 495</b>	<b>25 100</b>	<b>24 381</b>	<b>23 321</b>

**Allocation of Foreign Students to Subject Groups**

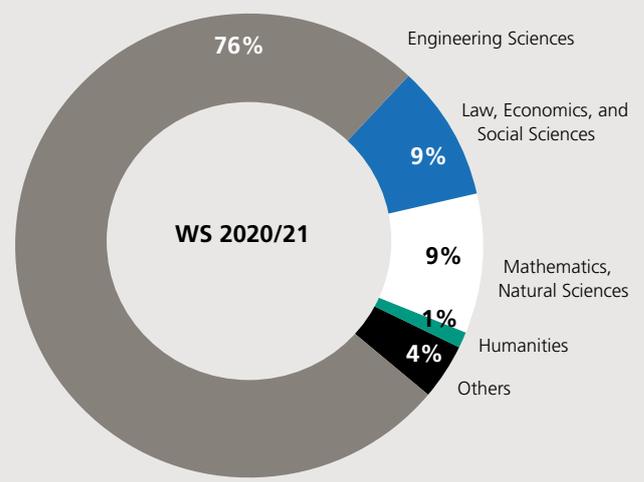
Subject group	WS 2016/17	WS 2017/18	WS 2018/19	WS 2019/20	WS 2020/21
Engineering Sciences	4 483	4 674	4 565	4 267	3 819
Mathematics, Natural Sciences	457	447	473	507	472
Law, Economics, and Social Sciences	508	527	515	529	487
Humanities	83	81	79	78	61
Others	250	231	284	251	189
<b>Total</b>	<b>5 781</b>	<b>5 960</b>	<b>5 916</b>	<b>5 632</b>	<b>5 028</b>

Foreign students: Not of German nationality

**Allocation of Students to Subject Groups**

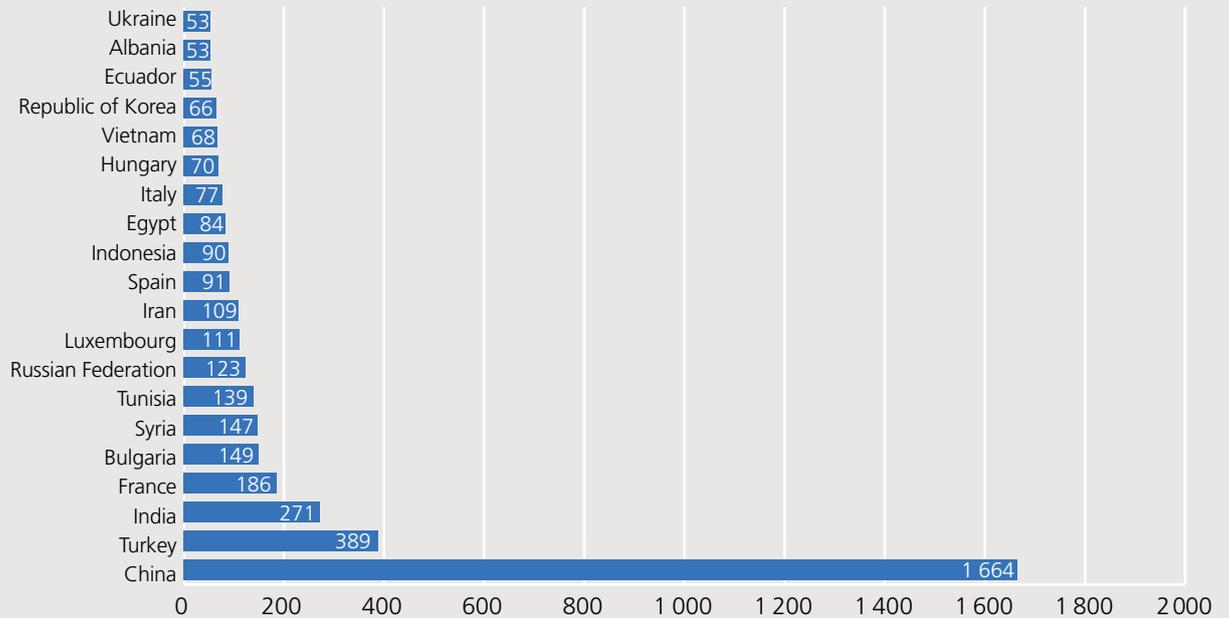


**Allocation of Foreign Students to Subject Groups**



## STUDENTS

## Home Countries of Foreign Students (Top 20 of 130)

Student Beginners and Degrees Targeted in the 1<sup>st</sup> Semester\*

Desired degree	2016	2017	2018	2019	2020
Bachelor	4 439	4 551	4 076	4 038	3 935
Master	3 433	3 390	2 765	2 924	2 602
Bachelor's degree in teaching at secondary schools	168	175	223	211	185
Bachelor's degree in teaching at vocational schools	39	37	28	16	17
Master's degree in teaching at secondary schools	0	0	0	33	50
Master's degree in teaching at vocational schools	17	8	15	27	22
Studienkolleg	285	316	240	260	223
<b>Total</b>	<b>8 381</b>	<b>8 381</b>	<b>7 347</b>	<b>7 509</b>	<b>7 034</b>

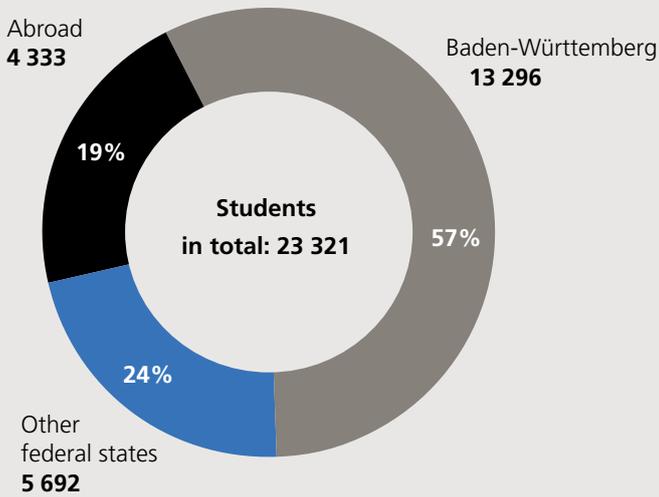
\*Without doctoral students and exchange students, who do not aim at a degree at KIT.

**Number of Student Beginners in the 1<sup>st</sup> Semester\***



\* Without doctoral students and exchange students, who do not aim at a degree at KIT.

**Origin of Students in the 2020/21 Winter Semester\***

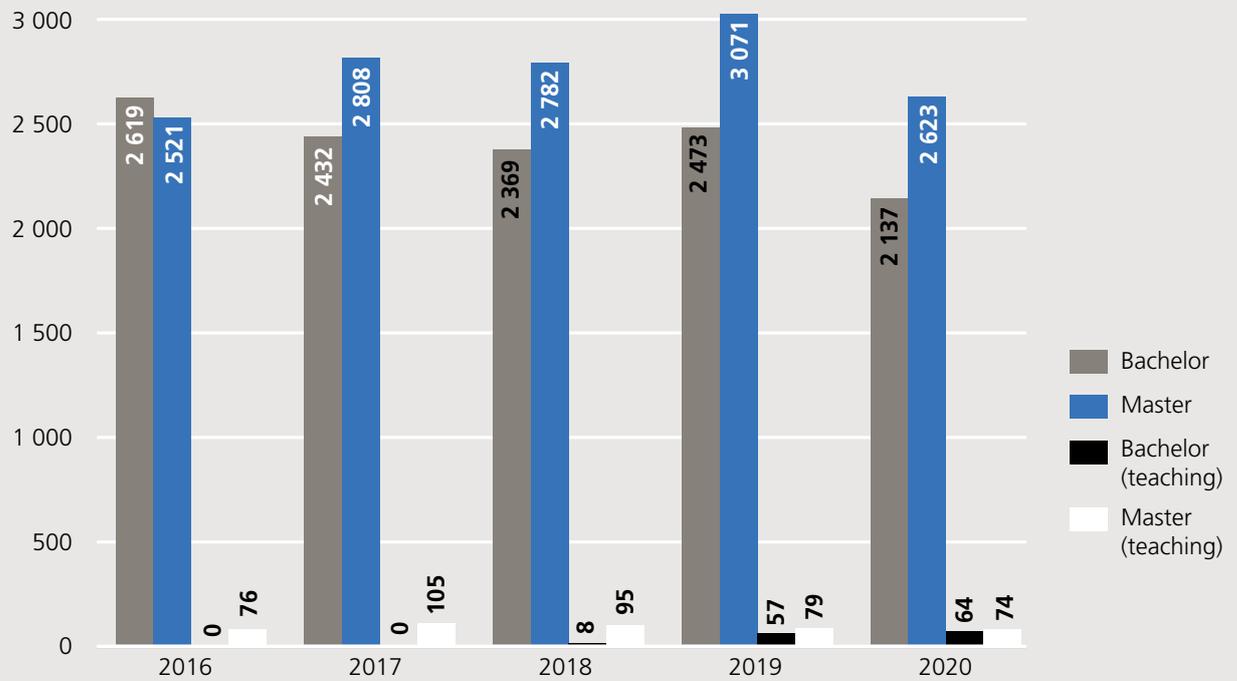


\*Place of acquisition of university entrance qualification.

Region	Students
Karlsruhe city and district	3 884
Karlsruhe Regional Council District	3 591
Rest of Baden-Württemberg	5 821
<b>Baden-Württemberg in total</b>	<b>13 296</b>
Rhineland-Palatinate	1 747
Bavaria	1 010
Hesse	833
North Rhine-Westphalia	874
Lower Saxony	367
Other federal states	861
<b>Germany without Baden-Württemberg</b>	<b>5 692</b>
Asia	2 511
Europe	1 171
Africa	292
America	348
Australia and Oceania	10
Abroad	4 333
<b>KIT in total</b>	<b>23 321</b>

## STUDENTS

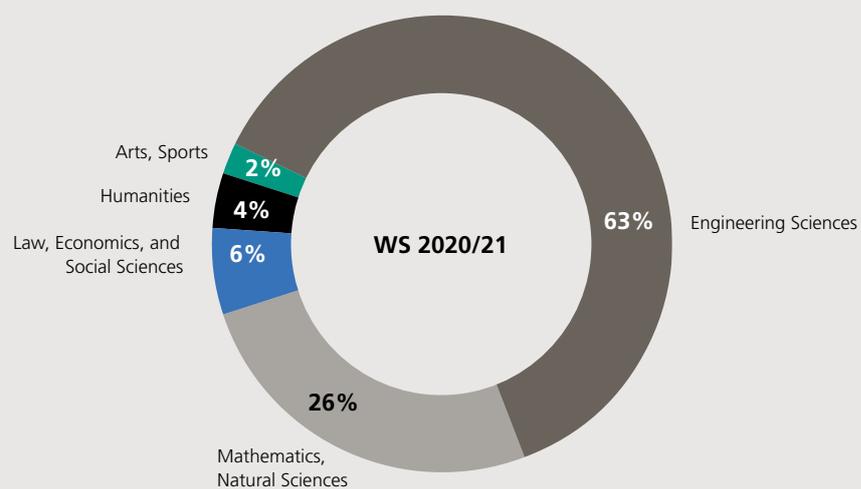
### Number of Graduates\*



\* The number of graduates in 2020 is not yet final.

### Doctoral Candidates in the Different Subject Groups

Subject group	Male	Female	Non-binary	Total
Engineering Sciences	1 659	444	1	2 104
Mathematics, Natural Sciences	507	355		862
Law, Economics, and Social Sciences	124	62		186
Humanities	64	78		142
Arts, Sports	29	35		64
<b>Total</b>	<b>2 383</b>	<b>974</b>	<b>1</b>	<b>3 358</b>



## Study Programs in the Area of Engineering Sciences

Subject (program)	Bachelor	Master (consecutive)	Teacher	Master (cont. education)	Double degree
Architektur	●	●			German-French Double Master ( <i>École Nationale Supérieure d'Architecture de Strasbourg, France</i> )
Bauingenieurwesen	●	●			
Bioingenieurwesen	●	●			
Chemieingenieurwesen und Verfahrenstechnik	●	●			<i>ENTECH Master's Program (IST Lisboa, Portugal; Uppsala Universitet, Sweden; INP Grenoble, France)</i>
Elektrotechnik und Informationstechnik	●	●			German-French Double Degrees B.Sc. and M.Sc. ( <i>Institut National Polytechnique Grenoble, France</i> ) <i>ENTECH Master's Program (IST Lisboa, Portugal; Uppsala Universitet, Sweden; INP Grenoble, France)</i> German-Hungarian Double Bachelor ( <i>Budapest University of Technology and Economics, Hungary</i> )
Energy Engineering and Management				●	
Financial Engineering				●	
Funktionaler und Konstruktiver Ingenieurbau – Engineering Structures		●			
Geodäsie und Geoinformatik	●	●			German-French Double Degrees B.Sc. and M.Sc. ( <i>Institut National des Sciences Appliquées Strasbourg, France</i> )
Remote Sensing and Geoinformatics		●			
Information Systems Engineering and Management				●	
Informatik	●	●	●		Double Master Informatics ( <i>Institut National Polytechnique Grenoble, France</i> ) Double Master Cryptography ( <i>Université de Rennes, France</i> )
Management of Product Development				●	
Mobility Systems Engineering and Management				●	



## STUDENTS

## → Study Programs in the Area of Engineering Sciences

Subject (program)	Bachelor	Master (consecutive)	Teacher	Master (cont. education)	Double degree
Maschinenbau	●	●			<p>German-French Bachelor's and Master's Program (<i>Arts et Métiers ParisTech, France</i>)</p> <p>German-French Bachelor's and Master's Program (<i>Institut National des Sciences Appliquées Lyon, France</i>)</p> <p>German-French Bachelor's and Master's Program (<i>École Polytechnique Paris, Palaiseau, France</i>)</p> <p>Dual Master's Program (<i>Korea Advanced Institute of Science and Technology, South Korea</i>)</p> <p>Double Master Vehicle or Production Technology (<i>CDHK, Tongji Universität, China</i>)</p> <p>Dual Master's Program (<i>Instituto Tecnológico de Buenos Aires, Argentina</i>)</p> <p>ENTECH Master's Program (<i>IST Lisboa, Portugal; Uppsala Universitet, Sweden; INP Grenoble, France</i>)</p>
Mechanical Engineering (International)	●				
Materialwissenschaft und Werkstofftechnik	●	●			
Mechatronik und Informationstechnik	●	●			German-Bulgarian Double Degree B.Sc. ( <i>Technical University of Sofia, Bulgaria</i> )
Mobilität und Infrastruktur		●			
Naturwissenschaft und Technik			●		
Optics and Photonics		●			Double Master's Program ( <i>Aix Marseille Université, France; Ecole Centrale de Marseille, France; Barcelona Universities, Spain; Tampere University of Technology, Finland; Vilnius University, Lithuania</i> )
Production and Operations Management				●	
Regionalwissenschaft		●			<p>German-Chilean Double Master's Program (<i>Universidad de Concepción, Chile</i>)</p> <p>German-Argentinian Double Master's Program (<i>Universidad Tecnológica Nacional, Argentina</i>)</p>
Water Science and Engineering		●			
Wirtschaftsinformatik	●	●			

### Study Programs in the Area of Arts, Art Science

Subject (program)	Bachelor	Master (consecutive)	Teacher	Master (cont. education)	Double degree
Kunstgeschichte	●	●			

### Study Programs in the Area of Mathematics, Natural Sciences

Subject (program)	Bachelor	Master (consecutive)	Teacher	Master (cont. education)	Double degree
Angewandte Geowissenschaften	●	●			
Biologie	●	●	●		
Chemie	●	●	●		
Chemische Biologie	●	●			
Geographie			●		
Geoökologie	●	●			
Geophysik/Geophysics	●	●			
Lebensmittelchemie	●	●			
Mathematik	●	●	●		German-French Bachelor's and Master's Program ( <i>École Polytechnique Paris, Palaiseau, France</i> )
Meteorologie	●	●			
Physik	●	●	●		German-French Double Master ( <i>Université Grenoble Alpes, France</i> ) German-French Bachelor's and Master's Program ( <i>École Polytechnique Paris, Palaiseau, France</i> )
Technomathematik	●	●			
Wirtschaftsmathematik	●	●			

### Study Programs in the Areas of Law, Economics, and Social Sciences

Subject (program)	Bachelor	Master (consecutive)	Teacher	Master (cont. education)	Double degree
Ingenieurpädagogik			●		
Ingenieurpädagogik für Ingenieurinnen und Ingenieure			●		
Pädagogik	●	●			
Technische Volkswirtschaftslehre	●	●			
Wirtschaftsingenieurwesen	●	●			German-French Double Master (M.Sc.) (Institut National Polytechnique Grenoble, France)

### Study Program in the Area of Sports

Subject (program)	Bachelor	Master (consecutive)	Teacher	Master (cont. education)	Double degree
Sport			●		
Sportwissenschaften	●	●			

### Study Programs in the Area of the Humanities

Subject (program)	Bachelor	Master (consecutive)	Teacher	Master (cont. education)	Double degree
Europäische Kultur und Ideengeschichte (European Studies)	●	●			
Germanistik / Deutsch	●	●	●		
Philosophie / Ethik			●		
Wissenschaft – Medien – Kommunikation	●	●			

## RESEARCH

### Coordinated Research Programs

Collaborative Research Centers with KIT Being the Coordinating University

Number	Title	Spokesperson	Duration
SFB 1173	Wellenphänomene: Analysis und Numerik	Prof. Dr. Marlis Hochbruck, Institute for Applied and Numerical Mathematics	2015 – 2023
SFB 1176	Molekulare Strukturierung weicher Materie	Prof. Dr. Michael Meyer, Institute of Organic Chemistry	2016 – 2020
SFB/TRR 257	Phänomenologische Elementarteilchenphysik nach der Higgs-Entdeckung	Prof. Dr. Kirill Melnikov, Institute for Theoretical Particle Physics	2019 – 2022

The typical budget approved for a Collaborative Research Center / Transregio Project is about EUR 1 to 3 million per year of duration. The duration refers to the complete project. Partial projects at KIT may deviate.

DFG-funded Research Units of KIT with KIT Being the Coordinating University

Number	Title	Spokesperson	Duration
FOR 1650	Dislocation-based Plasticity	Prof. Dr. Peter Gumbsch, Institute for Applied Materials	2011 – 2020
FOR 2383	Erfassung und Steuerung dynamischer lokaler Prozesszustände in Mikroreaktoren mittels neuer in-situ-Sensorik	Prof. Dr. Roland Dittmeyer, Institute for Micro Process Engineering	2016 – 2022

The typical budget approved for a DFG-funded research unit is about EUR 0.4 to 1.5 million per year of duration. The duration refers to the complete project. Partial projects at KIT may deviate.

Collaborative Research Centers with KIT Participation

Number	Title	Spokesperson / KIT participation	Duration
SFB TRR 88/3	Kooperative Effekte in homo- und heterometallischen Komplexen (3MET)	Prof. Dr. Gereon Niedner-Schatteburg, TU Kaiserslautern (Spokesperson) Prof. Dr. Manfred Kappes, Institute of Physical Chemistry and Institute of Nanotechnology, KIT	2011 – 2022
SFB TRR 89/3	Invasives Rechnen (InvasIC)	Prof. Dr. Jürgen Teich, Friedrich-Alexander-Universität Erlangen-Nürnberg (Spokesperson) Prof. Dr. Jörg Henkel, Institute of Computer Engineering, KIT	2010 – 2022
SFB TRR 150/2	Turbulent chemisch reagierende Mehrphasenströmungen in Wandnähe	Prof. Dr. Andreas Dreizler, TU Darmstadt (Spokesperson) Prof. Dr. Olaf Deutschmann, Institute for Chemical Technology and Polymer Chemistry, KIT	2015 – 2022



## RESEARCH

## → Collaborative Research Centers with KIT Participation

Number	Title	Spokesperson / KIT participation	Duration
SFB TRR 165/2	Waves to Weather: Wellen, Wolken, Wetter	Prof. Dr. George C. Craig, LMU München Prof. Dr. Volkmar Wirth, JGU Mainz Prof. Dr. Peter Knippertz, Institute of Meteorology and Climate Research, KIT	2015 – 2023
SFB-TRR 288/1	Elastic Tuning and Response of Electronic Quantum Phases of Matter (ELASTO-Q-MAT)	Prof. Dr. Roser Valentí, Universität Frankfurt (Spokesperson) Prof. Dr. Jairo Sinovar, JGU Mainz Prof. Dr. Jörg Schmalian, Institute for Theoretical Condensed Matter Physics, KIT	2020 – 2024

The typical budget approved for a Collaborative Research Center / Transregio Project amounts to about EUR 1 to 3 million per year of duration. The duration refers to the complete project. Partial projects of KIT may deviate.

## DFG-funded Research Units with KIT Participation

Number	Title	Spokesperson / KIT participation	Duration
FOR 1246	Kilimanjaro ecosystems under global change	Prof. Dr. Ingolf Steffan-Dewenter, Universität Würzburg (Spokesperson) Dr. Ralf Kiese, Institute of Meteorology and Climate Research, KIT	2010 – 2020
FOR 1993	Multifunktionale Stoff- und Energiewandlung	Prof. Dr. Burak Atakan, Universität Duisburg-Essen (Spokesperson) Prof. Dr. Olaf Deutschmann, Institute for Chemical Technology and Polymer Chemistry, KIT Prof. Dr. Ulrich Maas, Dr. Robert Schießl, Institute of Technical Thermodynamics, KIT	2013 – 2022
FOR 2063	The Epistemology of the Large Hadron Collider	Prof. Dr. Gregor Schiemann, Bergische Universität Wuppertal (Spokesperson) Prof. Dr. Rafaela Hillerbrand, Institute for Technology Assessment and Systems Analysis, KIT	2016 – 2022



→ DFG-funded Research Units with KIT Participation

Number	Title	Spokesperson / KIT participation	Duration
FOR 2083	Integrierte Planung im öffentlichen Verkehr	Prof. Dr. Anita Schöbel, Georg-August-Universität Göttingen (Spokesperson) Prof. Dr. Dorothea Wagner, Institute of Theoretical Informatics, KIT	2015 – 2021
FOR 2290	Understanding Intramembrane Proteolysis	Prof. Dr. Dieter Langosch, Technische Universität München (Spokesperson) Prof. Dr. Burkhard Luy, Institute of Organic Chemistry, KIT	2015 – 2021
FOR 2325	Interactions at the Neurovascular Interface	Prof. Dr. Ralf H. Adams, Max-Planck-Institut für molekulare Biomedizin, Münster (Spokesperson) Prof. Dr. Ferdinand le Noble, Zoological Institute, KIT	2016 – 2022
FOR 2337	Denitrification in Agricultural Soils: Integrated Control and Modelling at Various Scales (DASIM)	Prof. Dr. Christoph Müller, Justus-Liebig-Universität Gießen (Spokesperson) Prof. Dr. Klaus Butterbach-Bahl, Institute of Meteorology and Climate Research, KIT	2015 – 2022
FOR 2397	Multiskalen-Analyse komplexer Dreiphasensysteme	Prof. Dr. Thomas Turek, TU Clausthal (Spokesperson) Prof. Dr. Ulrike Krewer Institute for Applied Materials, KIT	2016 – 2023
FOR 2589	Zeitnahe Niederschlagsschätzung und -vorhersage	PD Dr. Silke Trömel, Rheinische Friedrich-Wilhelms-Universität Bonn (Spokesperson) Dr. Christian Chwala, Institute of Meteorology and Climate Research, KIT	2018 – 2021
FOR 2730	Umweltveränderungen in Biodiversitäts-Hotspot-Ökosystemen Süd-Ecuadors: Systemantwort und Rückkopplungseffekte (RESPECT)	Prof. Dr. Christian von Savigny, Universität Greifswald (Spokesperson) Prof. Dr. Wolfgang Wilcke, Institute of Geography and Geoecology, KIT	2018 – 2021
FOR 2820	Revisiting The Volcanic Impact on Atmosphere and Climate – Preparations for the Next Big Volcanic Eruption	Prof. Dr. Christian von Savigny, Universität Greifswald (Spokesperson) Prof. Dr. Corinna Hoose, Dr. Gholamali Hoshyaripour, Dr. Bernhard Vogel, Institute of Meteorology and Climate Research, KIT	2019 – 2022
FOR 2936	Klimawandel und Gesundheit in Afrika südlich der Sahara	Prof. Dr. Rainer Sauerborn, Universitätsklinikum Heidelberg (Spokesperson) Prof. Dr. Harald Kunstmann, Institute of Meteorology and Climate Research, KIT	2019 – 2022



## RESEARCH

## → DFG-funded Research Units with KIT Participation

Number	Title	Spokesperson / KIT participation	Duration
FOR 3010	Multifunktionale, grobkörnige, re-fraktäre Verbundwerkstoffe und Werkstoffverbunde für großvolumige Schlüssel-Bauteile in Hochtemperaturprozessen	Prof. Dr. Christos Aneziris, TU Bergakademie Freiberg (Spokesperson) Dr. Torben Boll, Prof. Dr. Martin Heilmaier, Prof. Dr. Michael Hoffmann, Dr. Peter Franke, Prof. Dr. Hans Jürgen Seifert, Dr. Susanne Wagner Institute for Applied Materials, KIT	2020 – 2023

The typical budget approved for a DFG-funded research unit amounts to about EUR 0.4 to 1.5 million per year of duration. The duration refers to the complete project. Partial projects of KIT may deviate.

## ERC Grants

Name, institute, division	Title of project	Duration
Dr. Christian Greiner, Institute for Applied Materials, Division III	ERC Consolidator Grant TriboKey – Deformation Mechanisms are the Key to Understanding and Tailoring Tribological Behaviour	09/2018 – 08/2023
Prof. Dr. Dennis Hofheinz, Institute of Computer Engineering, Division II	ERC Consolidator Grant PREP-CRYPTO – Preparing Cryptography for Modern Applications	07/2017 – 01/2020
Prof. Dr. Corinna Hoose, Institute of Meteorology and Climate Research, Division IV	ERC Starting Grant C2Phase – Closure of the Cloud Phase	04/2017 – 03/2022
Prof. Dr. Christian Koos, Institute of Photonics and Quantum Electronics, Division III	ERC Consolidator Grant TeraSHAPE – Terahertz Waveform Synthesis and Analysis Using Hybrid Photonic-Electronic Circuits	05/2018 – 04/2023
Prof. Dr. Holger Puchta, Botanical Institute, Division I	ERC Advanced Grant CRISBREED – Multidimensional CRISPR/Cas mediated engineering of plant breeding	10/2017 – 09/2022
Prof. Dr. Peter Sanders, Institute of Theoretical Informatics, Division II	ERC Advanced Grant ScAlBox – Engineering Scalable Algorithms for the Basic Toolbox	01/2020 – 08/2025
Dr. Frank Schröder, Institute for Nuclear Physics, Division V	ERC Starting Grant PeV-Radio – Digital Radio Detectors for Galactic PeV Particles	02/2019 – 01/2024
Prof. Dr. Wolfgang Wernsdorfer, Physikalisches Institut, Division V	ERC Advanced Grant MoQuOS – Molecular Quantum Opto-Spintronics	07/2017 – 06/2022

The total budget of an ERC Grant ranges from EUR 1.5 million (Starting Grant) to EUR 2.5 million (Advanced Grant).

## Young Investigators Groups

Emmy Noether Junior Research Groups

Name, institute, division	Title of group	Duration
Dr. Frank Biedermann, Institute of Nanotechnology, Division V	In vitro und in vivo Sensing von (Bio)organischen Analyten mit neuartigen Hoch-Affinitätsrezeptoren	10/2016 – 09/2021
Dr. Manuel Hinterstein, Institute for Applied Materials, Division III	BNT-BT als zukünftige bleifreie Funktionswerkstoffe für PTCR-, Aktor- und Sensoranwendungen	04/2016 – 03/2021
Dr. Alexander Hinz, Institute for Inorganic Chemistry, Division I	Niedrig koordinierte Hauptgruppenelement-Verbindungen und deren Einsatz in der Aktivierung von H <sub>2</sub> , CO, CO <sub>2</sub> sowie NH <sub>3</sub>	07/2020 – 06/2026
Dr. Nadine Rühr, Institute of Meteorology and Climate Research, Division IV	Die Auswirkungen von Extremereignissen auf den Kohlenstoff- und Wasserkreislauf	10/2016 – 09/2021
Dr. Karsten Woll, Institute for Applied Materials, Division III	Pulsed Metallurgy on Metallic Thin Films	01/2017 – 12/2022
Dr. Philipp Willke, Physikalisches Institut, Division V	Quantenkohärente Kontrolle atomarer und molekularer Spins auf Oberflächen	10/2020 – 09/2026

Average total budget of an Emmy Noether Group: EUR 1.2 million to 1.8 million plus valid program lump sum.

Helmholtz Young Investigators Groups

Name, institute, division	Title of group	Duration
Dr. Hartwig Anzt, Steinbuch Centre for Computing, Division II	Fixed-Point Methods for Numerics at Exascale (FiNE)	05/2017 – 04/2022
Dr. Anna Böhmer, Institute of Solid State Physics, Division V	Strain Tuning of Correlated Electronic Phases	10/2017 – 09/2022
Dr. Tom Brown, Institute for Automation and Applied Informatics, Division III	New Methodologies to Master Complexity in Energy System Optimisations	04/2018 – 03/2024
Dr. Christian Grams, Institute of Meteorology and Climate Research, Division IV	Sub-seasonal atmospheric predictability: understanding the role of diabatic outflow	10/2017 – 09/2022



## RESEARCH

## → Helmholtz Young Investigators Groups

Name, institute, division	Title of group	Duration
Dr. Emma Järvinen, Institute of Meteorology and Climate Research, Division IV	Solving the Cirrus Cloud Puzzle – Do Cirrus Warm or Cool Our Climate?	04/2020 – 03/2026
Dr. Martina Klose, Institute of Meteorology and Climate Research, Division IV	A big unknown in the climate impact of atmospheric aerosol: Mineral soil dust	11/2020 – 10/2026
Dr. Benno Meier, Institute for Biological Interfaces, Division I	Hyperpolarized Magnetic Resonance	03/2019 – 02/2025
Dr. Ulrich Paetzold, Institute of Microstructure Technology, Division III	Nanophotonics for Perovskite/Silicon Multijunction Solar Cells	05/2016 – 05/2022
Dr. Manuel Tsotsalas, Institute of Functional Interfaces, Division I	Hierarchically Structured Biomaterials	01/2016 – 12/2021
Prof. Dr. Kathrin Valerius, Institute for Nuclear Physics, Division V	Analysis of KATRIN data to measure the neutrino mass and search for new physics	07/2019 – 06/2020
Dr. Roswitha Zeis, Helmholtz Institute Ulm, Division I	Investigation of Overpotentials in High Temperature Proton Exchange Membrane Fuel Cells	05/2010 – 02/2020

The annual budget of a group typically is EUR 1.25 to 1.8 million.

## Industry Fellowship (IF)

Name, institute, division	Title of group	Duration
Dr. Nicole Stricker, wbk Institute of Production Science, Division III	Robuste Produktionstechnik	07/2019 – 06/2022
Dr. Frederik Zanger, wbk Institute of Production Science, Division III	Optimierte Prozesse und Prozessketten für additiv gefertigte Bauteile (OptiPro <sup>2</sup> Addi)	10/2019 – 09/2022

The annual budget typically amounts to EUR 80 000 plus a non-recurrent investment allowance of EUR 50 000.

## Young Investigators Group

Name, institute, division	Title of group	Duration
Dr. Luise Kärger, Institute of Vehicle System Technology, Division III	Gewichtsoptimierte Fahrzeugstrukturen durch maßgeschneiderte Hochleistungsfaserverbunde (funded by the Vector Foundation)	07/2014 – 12/2021

The annual budget typically amounts to EUR 80,000 plus a non-recurrent investment allowance of EUR 50,000.

## BMBF Junior Research Groups

Name, institute, division	Title of group	Duration
Dr. Gerardo Hernandez-Sosa, Light Technology Institute, Division III	BIOLicht – Gedruckte biologisch abbaubare organische lichtemittierende Bauteile	11/2014 – 10/2020
Dr. Julia Maibach, Institute for Applied Materials, Division III	InSEIde: Grenzflächen in Lithium-Ionen-Batterien verstehen und manipulieren	09/2017 – 09/2022
Dr. Aiko Voigt, Institute of Meteorology and Climate Research, Division IV	Wolken-Strahlungs-Wechselwirkungen mit der nord-at- lantischen Sturmzugbahn (CONSTRain)	09/2016 – 08/2021

The total budget of a group typically ranges from EUR 1.5 to 3.2 million.

## Other Junior Research Groups and Funding Measures

Name, institute, division	Title of group	Duration	Funding
Dr. Dominic Bresser, Helmholtz Institute Ulm, Division I	Neuartige Elektrodenmaterialien für Wiederaufladbare Elek- tro-chemische Energiespeicher (NEW E <sup>2</sup> )	05/2017 – 04/2023	Vector Foundation
Dr. Azad M. Emin, Institute of Process Engineering in Life Sciences, Division I	Extrusion of Biopolymeric Systems	08/2016 – 07/2022	DFG and others
Dr. Benjamin Flavel, Institute of Nanotechnology, Division V	Carbon Nanotube based Solar Cells	11/2018 – 10/2021	Heisenberg position



## RESEARCH

## → Other Junior Research Groups and Funding Measures

Name, institute, division	Title of group	Duration	Funding
Dr. Benjamin Häfner, wbk Institute of Production Science, Division III	Agile Produktionsregelkreise	02/2019 – 02/2024	EU, Carl Zeiss Foundation
Dr. Robert Heinrich, Institute for Program Structures and Data Organization, Division II	Quality-driven System Evolution	03/2018 – 02/2022	MWK and BMBF
Dr. Michael Hirtz, Institute of Nanotechnology, Division V	Dip-Pen Nanolithography and Related Techniques	01/2016 – 12/2020	DFG and others
Dr. Daniel Hoang, Institute for Finance, Banking, and Insurance, Division II	Unternehmensfinanzierung	10/2016 – 12/2021	DFG, Funk Foundation
Dr. Mathias Krause, Institute for Applied and Numerical Mathematics 2/ Institute for Mechanical Process Engineering and Mechanics, Divisions V and III	Lattice Boltzmann Research Group	05/2018 – 04/2024	DFG and others
Dr. Axel Loewe, Institute of Biomedical Engineering, Division III	Computational Cardiac Modelling	11/2018 – 06/2021	DFG and MWK
Dr. Rainer Mandel, Institute for Analysis, Division V	Nichtlineare Helmholtz- gleichungen	05/2017 – 12/2020	Junior Research Group within a CRC
Dr. Ioan M. Pop, Physikalisches Institut, Division V	Supraleitende Quanten- elektronik	10/2015 – 09/2021	Sofja Kovalevskaja Prize of the Humboldt Foundation
Dr. Somidh Saha, Institute for Technology Assess- ment and Systems Analysis, Division II	Sylvanus	08/2019 – 10/2021	BMBF and others
Dr. Ulrike van der Schaaf, Institute of Process Engineering in Life Sciences, Division I	Interfacial properties of pectin-based biopolymers	10/2020 – 10/2022	AiF
Dr. Birgit Schörkhuber, Institute for Analysis, Division V	Singularity Formation in nonlin- ear PDEs	02/2019 – 09/2020	CRC, Klaus Tschira Foundation



→ Other Junior Research Groups and Funding Measures

Name, institute, division	Title of group	Duration	Funding
Dr. Katrin Schulz, Institute for Applied Materials, Division III	Dislocation-based Continuum Theory of Plasticity	01/2016 – 12/2020	Margarete von Wrangell Habilitation Grant of MWK and others
Dr. Philipp Schuster, Institute for Finance, Banking, and Insurance, Division II	Liquiditätseffekte auf Finanzmärkten	05/2017 – 12/2020	DFG and others
Dr. Thomas Sheppard, Institute for Chemical Technol- ogy and Polymer Chemistry, Division I	X-ray Microscopy in Catalysis	02/2020 – 06/2022	BMBF and others
Dr. Penelope Whitehorn, Institute of Meteorology and Climate Research, Division IV	Climate change and land-use impacts on European bumble- bee populations	02/2020 – 03/2021	Baden-Württemberg Foundation and others

**Junior Professorships**

Name, institute, division	Area	Duration
Jun. Prof. Dr. Thomas Bläsius, Institute of Theoretical Informatics, Division II	Tenure-Track-Professur für Skalierbare Algorithmik und Verfahren für große Datenmengen	10/2020 – 09/2026
Jun. Prof. Dr. Andreas Ch. Braun, Institute of Regional Science, Division IV	Risikoorientierte Regionalentwicklung	05/2015 – 05/2021
Jun. Prof. Dr. Yolita Eggeler, Laboratory of Electron Microscopy, Division V	Tenure-Track-Professur für Elektronenmikroskopie	10/2020 – 09/2026
Jun. Prof. Dr. Pascal Friederich, Institute of Theoretical Informatics, Division II	KI-Methoden in den Materialwissenschaften	12/2019 – 12/2025
Jun. Prof. Dr. Lennart Hilbert, Zoological Institute, Division I	Systembiologie/Bioinformatik	10/2018 – 09/2022
Jun. Prof. Dr. Claudio Llosa Isenrich, Institute for Algebra and Geometry, Division V	Geometrie	10/2020 – 09/2026



## RESEARCH

## → Junior Professorships

Name, institute, division	Area	Duration
Jun. Prof. Dr. Britta Klopsch, Institute for Vocational Education and General Education, Division II	Tenure-Track-Professur für Schulpädagogik	04/2020 – 03/2026
Jun. Prof. Dr. Fabian Krüger, Institute for Economic Policy Research, Division II	Empirische Wirtschaftsforschung	10/2019 – 10/2022
Jun. Prof. Dr. Xian Liao, Institute for Analysis, Division V	Analysis Partieller Differentialgleichungen	11/2018 – 11/2022
Jun. Prof. Dr. Reza Maalek, Institute for Technology and Management in Construction, Division IV	Digital Engineering and Construction	11/2020 – 10/2026
Jun. Prof. Dr. Franziska Mathis-Ullrich, Institute for Anthropomatics and Robotics, Division II	Medizinrobotik	04/2019 – 04/2025
Jun. Prof. Dr. Katharina Scherf, Institute for Applied Biosciences, Division I	Bioaktive und funktionelle Lebensmittel- inhaltsstoffe	08/2019 – 07/2025
Jun. Prof. Dr. Matti Schneider, Institute of Engineering Mechanics, Division III	Computational Micromechanics	09/2017 – 08/2021
Jun. Prof. Dr. Helge Sören Stein, Institute of Physical Chemistry/ Helmholtz Institute Ulm, Division I	Tenure-Track-Professur für Angewandte Elektrochemie	06/2020 – 05/2026
Jun. Prof. Dr. Julian Thimme, Institute for Finance, Banking, and Insurance, Division II	Finanzierung	08/2019 – 07/2025
Jun. Prof. Dr. Ingo Wagner, Institute of Sports and Sports Science, Division II	MINT-Fachdidaktik im Division der Fächer Sport und Mathematik oder Physik	10/2018 – 09/2022
Jun. Prof. Dr. Christian Wressnegger, Institute of Theoretical Informatics, Division II	Intelligente Systemsicherheit	12/2019 – 11/2025

### Graduate Schools Funded by the DFG or Helmholtz Association

Graduate School	Funded by	Spokesperson / participant	Duration
Graduate School "Electrochemical Energy Storage"	DFG	Prof. Dr. Jürgen Behm Universität Ulm (Spokesperson) apl. Prof. Christine Kranz Universität Ulm (Co-spokesperson) Prof. Dr. Rolf Schuster Institute of Physical Chemistry, KIT (Co-spokesperson)	2019 – 2025
HEiKA Graduate School "Functional Materials"	DFG	Prof. Dr. Martin Wegener Institute of Applied Physics/ Institute of Nanotechnology, KIT (Spokesperson) Prof. Dr. Uwe Bunz Universität Heidelberg (Co-spokesperson)	2019 – 2025
Graduiertenschule für Klima und Umwelt (GRACE)	HGF	Prof. Dr. Stefan Hinz, Institute of Photogrammetry and Remote Sensing	2011 – 2022

### Research Training Groups Funded by the DFG or Helmholtz Association

Research Training Group	Funded by	Spokesperson / participant	Duration
Elementarteilchenphysik bei höchster Energie und höchster Präzision	DFG	Prof. Dr. Dieter Zeppenfeld, Institute for Theoretical Physics	2011 – 2020
Molekulare Architekturen für die fluoreszente Bildgebung von Zellen	DFG	Prof. Dr. Hans-Achim Wagenknecht, Institute of Organic Chemistry	2015 – 2024
Integrierte Entwicklung kontinuierlich-diskontinuierlich langfaserverstärkter Polymerstrukturen	DFG	Prof. Dr. Thomas Böhlke, Institute of Engineering Mechanics Together with: University of Waterloo, Univer- sity of Western Ontario, Univer- sity of Windsor (all Canada)	2015 – 2024
Energiezustandsdaten – Informatik-Methoden zur Erfassung, Analyse und Nutzung	DFG	Prof. Dr. Klemens Böhm, Institute for Program Structures and Data Organization	2016 – 2025



## RESEARCH

## → Research Training Groups Funded by the DFG or Helmholtz Association

Research Training Group	Funded by	Spokesperson / participant	Duration
Asymptotische Invarianten und Limiten von Gruppen und Räumen	DFG	Prof. Dr. Roman Sauer, Institute for Algebra and Geometry Together with: Prof. Dr. Anna Wienhard, Mathematisches Institut, Ruprecht-Karls-Universität Heidelberg	2016 – 2025
Simulation mechanisch-elektrisch-thermischer Vorgänge in Lithium-Ionen-Batterien	DFG	Prof. Dr. Thomas Wetzel, Institute of Thermal Process Engineering	2017 – 2021
Tailored Scale-Bridging Approaches to Computational Nanoscience	DFG	Prof. Dr. Marcus Elstner, Institute of Physical Chemistry	2019 – 2023
MatCom-ComMat: Materials Compounds from Composite Materials for Applications in Extreme Conditions	DFG	Prof. Dr. Martin Heilmaier, Institute for Applied Materials	2020 – 2024
Energy Scenarios – Construction, Assessment and Impact	HGF	Prof. Dr. Armin Grunwald, Institute for Technology Assess- ment and Systems Analysis	2011 – 2020
Mechanisms and Interactions of Climate Change in Mountain Regions (MICMoR)	HGF	Prof. Dr. Hans Peter Schmid, Institute of Meteorology and Climate Research	2012 – 2020
Helmholtz International Research School for Astroparticle Physics and Enabling Technologies (HIRSAP)	HGF	Prof. Dr. Ralph Engel, Institute for Nuclear Physics	2018 – 2024
Helmholtz Information and Data Science School for Health (HIDSS4Health)	HGF	Prof. Dr. Ralf Mikut, Institute for Automation and Applied Informatics	2019 – 2025

## INNOVATION

### Innovation Characteristics

Year	Invention disclosures	Priority-establishing patent applications	Property rights (existing)	Royalties [million euros]	New companies (spinoffs)	Participation in spinoffs
2016	127	55	2 000	1.70	21 (10)	7
2017	124	55	1 965	1.44	29 (10)	7
2018	115	63	1 949	1.57	21 (7)	9
2019	97	40	1 889	1.27	50 (9)	9
2020	105	50	1 772	2.05	28 (7)	9

### Establishments of New Companies

Spinoffs
axxelera UG
empowering sustainable design UG
heliopas.ai GmbH
Kimoknow UG
Kites GmbH
modugen GmbH
preML GmbH

Startups
Articlett GbR
BAIT GbR
CCSystems GbR
Co-Leader GbR
Data Flares GbR
DeBaCode gemeinnützige UG
Discover-e GbR
ErgoOffice GbR
Kemit & Sure (K&S) GbR
Lyn's UG
Mankido GbR
Mothor GbR
Orbis Next UG
Refarm GbR
SCIENCIA GmbH
Stakez UG
TechTeach GbR
TheLocalOne GbR
Traggert GbR
Unedited GbR
UpFlowTech GbR

## AWARDS

### External Awards

(see separate chapter of this Annual Report from page 98)

### KIT Department Teaching Awards

KIT Department	Award winners
Architecture	Prof. Dr. Inge Hinterwaldner
Civil Engineering, Geo- and Environmental Sciences	apl. Professor Dr. Boris Jutzi
Chemistry and Biosciences	Dr. Silke Wolf
Chemical and Process Engineering	Mark Eberhard, Fabian Hüsing, Bernd Michelfelder, Benjamin Niethammer, Simon Wachter
Electrical Engineering and Information Technology	Daniel Grimm, Tim Hotfilter, Gabriela Molinar, Marco Stang, Simon Claus Stock
Humanities and Social Sciences	Lisa Leander
Informatics	Prof. Dr. Martina Zitterbart
Mechanical Engineering	Prof. Dr. Roland Griesmaier, Annalena Albicker, Dr. Tilo Arens, Dr. Elena Cramer, Dr. Felix Hagemann, Dr. Frank Hettlich, Marvin Knöller
Mathematics	Dr. Daniel Weiß, Daniele Corallo, Kevin Ganster
Physics	Dr. Matthias Schröder
Economics and Management	Prof. Dr. Ali Sunyaev

### Awards for Doctoral Researchers

KIT Doctoral Awards

Name	Institute
Dr. rer. nat. Jasmin Marie Busch	Institute of Organic Chemistry
Dr. rer. nat. Lisa Maria Kohl	Institute of Theoretical Informatics
Dr. rer. nat. Matthias Künzel	Institute of Physical Chemistry, Helmholtz Institute Ulm
Dr. rer. nat. Nicole Ludwig	Institute for Automation and Applied Informatics

Other Doctoral Awards

Name	Institute	Institution
Dr.-Ing. Christian Sprau	Light Technology Institute	Sponsorship Award of the Friedrich and Elisabeth Boysen Foundation
Dr.-Ing. Akanksha Bhutani	Institute of Radio Frequency Engineering and Electronics	Südwestmetall Sponsorship Award

## MEDIA/PUBLICATIONS

### Development of Visibility in the Media

	2016	2017	2018	2019	2020
Printed articles	16 916	20 737	20 133	24 739	17 659
Online articles*	18 189	19 196	20 721	19 375	15 627

\*Deviation from previous annual reports due to updated data.

### Publications

Publications in the year	2016	2017	2018	2019	2020
Publications of researchers of KIT	7 655	7 809	8 469	8 637	7 086
of these, books and proceedings	821	871	826	877	858
of these, articles in proceedings	953	1 079	1 305	1 023	755
of these, articles in journals	3 713	3 739	3 969	3 877	3 756
of these, in WoS- or Scopus-referenced journals	3 510	4 113	3 658	3 645	3 537
of these, open access articles	1 044	1 516	1 902	2 122	2 136

## RANKINGS

## National Rankings

		2016	2017*	2018	2019	2020
Wirtschaftswoche	Electrical Engineering	2	–	2	3	5
	Informatics	2	–	1	2	4
	Mechanical Engineering	3	–	2	3	3
	Natural Sciences	7	–	7	8	10
	Business Engineering	2	–	2	2	2

\* In 2017, no ranking was published by Wirtschaftswoche.

## International Rankings

		2016	2017	2018	2019	2020
National Taiwan University Ranking	International – Overall	198	211	216	228	251
	International – Natural Sciences	53	55	62	67	70
	International – Engineering Sciences	80	81	95	106	101
	National – Overall	18	19	19	19	21
	National – Natural Sciences	1	1	1	1	1
	National – Engineering Sciences	1	1	1	1	1
QS World University Rankings	International – Overall	98	107	116	124	131
	International – Natural Sciences	–	29	37	48	58
	International – Engineering Sciences & IT	–	38	51	59	68
	National – Overall	4	4	4	5	6
	National – Natural Sciences	–	3	4	3	4
	National – Engineering Sciences	–	4	4	4	4
Times Higher Education	International – Overall	144	133	135	175	201–250
	International – Natural Sciences	68	61	69	69	70
	International – Engineering Sciences	60	55	54	74	78
	National – Overall	14	14	14	20	22
	National – Natural Sciences	9	7	5	7	7
	National – Engineering Sciences	4	4	3	4	4
Academic Ranking of World Universities	International – Overall	201–300	201–300	201–300	201–300	201–300
	International – Natural Sciences	51–75	–	–	–	–
	International – Engineering Sciences	151–200	–	–	–	–
	National – Overall	15–21	16–22	15–20	11–21	11–19

## SUSTAINABILITY

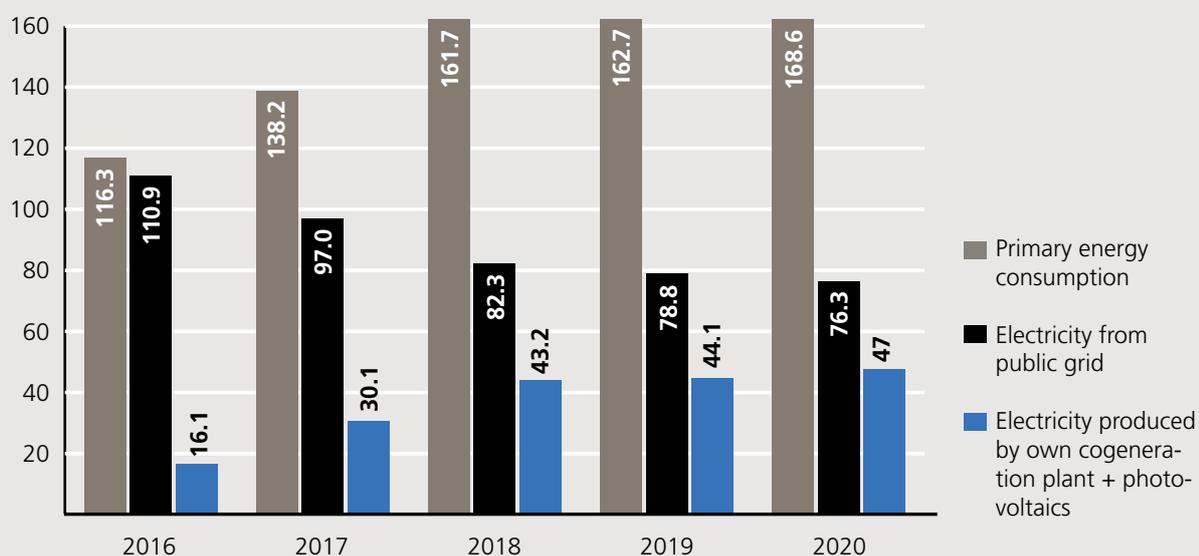
### CO<sub>2</sub> Emissions of Heating Power Plants on Campus North

	2016	2017	2018	2019	2020
Heating plant CO <sub>2</sub> [t/a]	16 361	10 671	8 511	8 025	7 872
Cogeneration plant CO <sub>2</sub> [t/a]	4 205	6 496	4 754	4 210	3 905
Total CO <sub>2</sub> [t/a]	20 566	17 167	13 265	12 235	11 777
Allocated CO <sub>2</sub> certificates [t/a]	9 688*	8 346*	7 047*	5 791	4 581

\* Due to excessive, not needed CO<sub>2</sub> certificates, no further CO<sub>2</sub> certificates had to be purchased.

### Energy Consumption and Energy Production on Campus North

Type of energy	2016	2017	2018	2019	2020
Primary energy consumption [GWh]	116.3	138.2	161.7	162.7	168.6
Electricity from the public grid [GWh]	110.9	97.0	82.3	78.8	76.3
Electricity produced by own cogeneration plant [GWh]	16.1	30.1	43.2	44.1	47
Electricity produced by own photovoltaics facilities [GWh]	1.0	1.0	1.2	0.9	0.9
Heat produced (district heating power plant + cogeneration plant) [GWh]	77.3	78.9	73.1	76.6	76.0
Heat, weather-adjusted [GWh]	77.3	78.1	81.3	79.0	86.4



### Supply and Waste Management Services

Type of service	2018		2019		2020	
	CN	CS*	CN	CS*	CN	CS*
Electricity supply [GWh]	79	55	77	54	74	50
Heat supply [GWh]	38	45	40	49	35	41
Weather-adjusted [GWh]	42	50	42	51	40	46
Water supply [m <sup>3</sup> ]	99 759	229 100	86 058	220 941	74 182	198 573
Waste disposal [t]	19 978**	899	12 370**	1 629	4 664	1 125

\* The data for Campus East and Campus West are included in Campus South.

\*\*The data refer to Campus North in total, including external institutions.

### Areas

Type of area [m <sup>2</sup> ]	KIT in total		Campus South*		Campus North**	
	[m <sup>2</sup> ]	%	[m <sup>2</sup> ]	%	[m <sup>2</sup> ]	%
Office areas (including conference rooms, rooms for copiers and servers)	176 315	36.1%	101 912	35.1%	74 403	37.4%
Laboratories, workshops, experiment halls	170 462	34.9%	82 295	28.3%	88 167	44.4%
Storage and similar facilities	65 342	13.4%	37 090	12.8%	28 252	14.2%
Teaching and studies (lecture halls, seminar rooms, practice rooms)	58 641	12.0%	52 568	18.1%	6 073	3.1%
Library areas (central + decentralized libraries)	13 581	2.8%	11 940	4.1%	1 641	0.8%
Sports areas	4 701	1.0%	4 484	1.5%	217	0.1%
<b>Total usable area</b>	<b>489 041</b>	<b>100.0%</b>	<b>290 288</b>	<b>100.0%</b>	<b>198 752</b>	<b>100.0%</b>
of this, rented areas				19 120m <sup>2</sup>		2 283m <sup>2</sup>

\* incl. Campus East and Campus West

\*\* incl. Campus Alpine

**CO<sub>2</sub> Emission Factors**

Otto fuel [kg CO <sub>2</sub> /l]	Diesel fuel [kg CO <sub>2</sub> /l]	Hydrogen [kg CO <sub>2</sub> /kgH <sub>2</sub> ]
1.34	1.47	14.89

**Number of Centrally Administrated KIT Company Cars in 2020, Type of Drive**

Combustion engine	Hybrid	Battery electric	H2 fuel cell	Total
138	1	18	2	159

**Fuel Consumption, Driven Kilometers, and CO<sub>2</sub> Emissions**

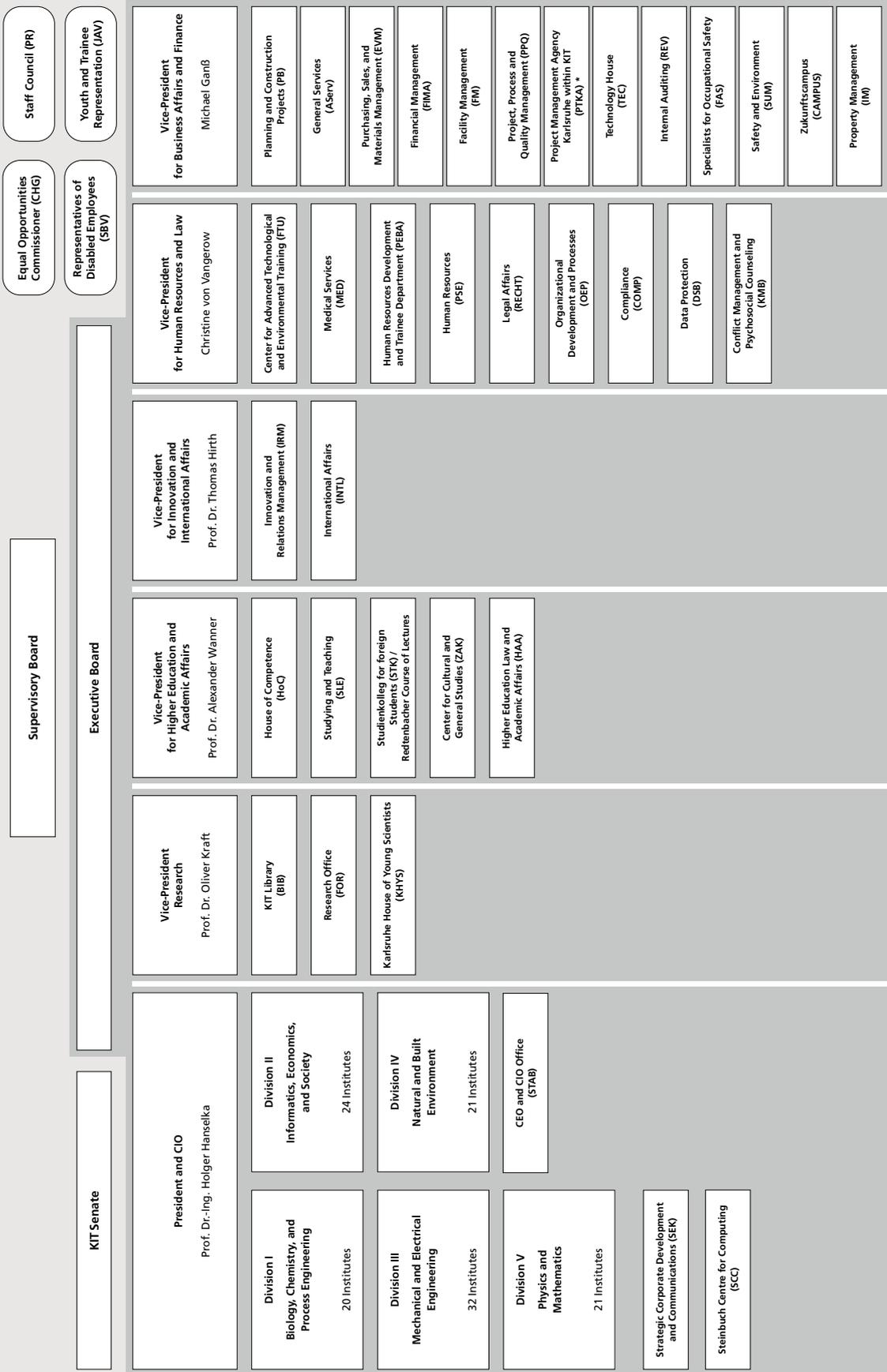
	2017	2018	2019	2020
Otto fuel [l]	23 055.23	24 394.99	22 305.82	16 626.00
Diesel fuel [l]	74 712.01	71 191.93	59 731.55	41 980.00
Driven kilometers [km]	1 199 620.00	1 091 128.00	1 009 567.00	541 073.00
CO <sub>2</sub> emissions [tCO <sub>2</sub> ]	140.35	136.99	117.39	83.78

**Fuel Consumption and CO<sub>2</sub> Emissions of KIT Shuttle**

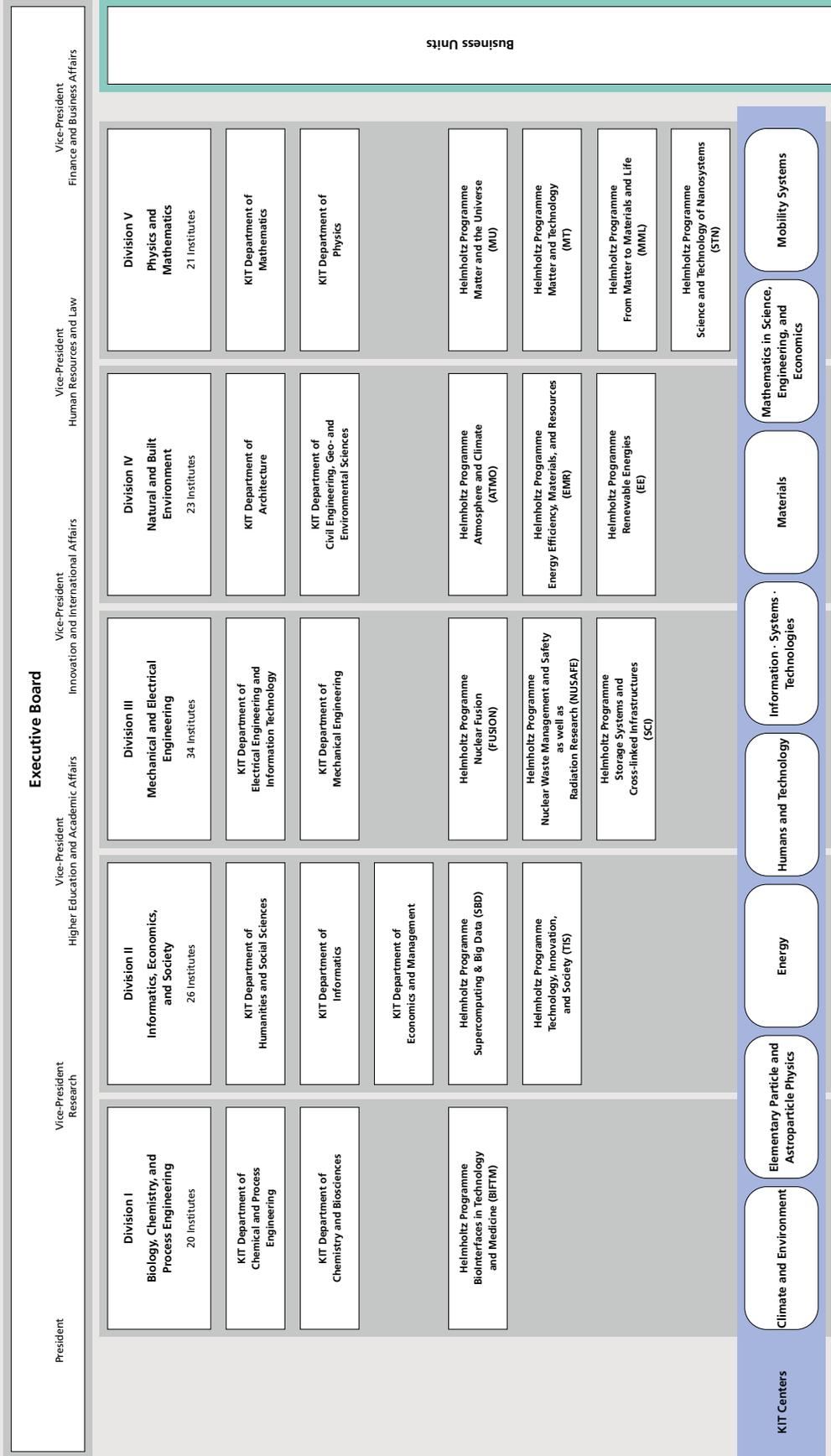
	2016	2017	2018	2019	2020
Hydrogen [kg]	5 975.58	6 255.33	4 231.14	5 038.59	1 829.65
CO <sub>2</sub> emissions [tCO <sub>2</sub> ]	88.97	93.14	63.00	75.02	27.24

ORGANIZATIONAL CHARTS

Organizational Structure



# Science Organization





**Issued by**

Dr. Sabine Fodi, Dr. Joachim Hoffmann (responsible),  
Strategic Corporate Development and Communications (SEK),  
Corporate Communications

Data and figures: Georg Johannes Huber, SEK

Photos (photographer/photo number): Albrecht, Lydia: 8; Altmann; Gerd – pixelio.de: 150; Asfour, Tamim: 63, Ausserhofer, David / DFG: 215; Balzer, Manuel: 3, 95, 142; Bengeßer, Elena: 185; Bernhardt + Partner Architekten PartG mbB, Darmstadt: 191; Bilderfest: 230; Blum, Heiner: 182; Bramsiepe, Amadeus: 11, 19, 31, 44, 47, 48, 59, 62, 78, 99, 103, 110, 114, 117, 118, 123, 137, 151, 153, 154, 155, 156, 158, 159, 165, 167, 172, 174, 181, 190, 205, 206, 207, 216, 218, 226, 228, 245, 254, 255, 258, 260, 261, 262, 266; Braun, Zooey: 213; Breig, Markus: 5, 7, 9, 12, 16, 23, 24, 25, 28, 30, 33, 34, 35, 37, 38, 42, 43, 45, 46, 60, 70, 67, 72, 76, 77, 80, 81, 82, 83, 87, 89, 96, 100, 104, 108, 119, 120, 121, 122, 126, 128, 132, 134, 138, 143, 145, 146, 147, 157, 160, 163, 166, 168, 169, 178, 179, 180, 183, 184, 186, 189, 194, 197, 198, 199, 200, 201, 202, 203, 204, 207, 209, 211, 217, 220, 232, 238, 239, 246, 248, 250, 253, 259, 264, 267; Carambia, Tiziana: 13; Diehm, Ralf: 50; Digital Earth: 265; Drollinger, Andreas: 26, 27, 69, 235, 252; Ernst, Daniel/ stock.adobe.com: 152; Fabry, Andrea: 2, 221, 244; Fotolia: 94, 133, 141, 148, 196, 208; Forschungszentrum Karlsruhe: 57, 214, 257; Fuge, Robert: 32, 268; García-Pando, Carlos Pérez: 130; GEOMAR – Helmholtz-Zentrum für Ozeanforschung Kiel: 58; Google Maps/greenventory: 107; Göttisheim, Sandra: 140, 222, 234, 243; Hahn, Vincent: 51; Hauser, Magali: 4, 56, 79, 101, 125, 161, 188, 210, 223, 224, 225, 227, 236; Hebel, Joachim: 112; HEBERGER Hoch-, Tief- und Ingenieurbau GmbH: 88; Heid, Kira: 41, 53; Heymach, Kerstin: 129; Hohlbaum, Dominic: 93; IFG/KIT: 66; ITCP/KIT: 20; IPQ, Nature Photonics; KIT: 39, 64, 171, 173, 231; Krautwald, Susi, FZI: 263; Langer, Patrick: 115, 240; Leg, Moritz: 61; Maibach, Julia: 49; Meißner, Tanja: 86, 91, 92, 102, 177, 192, 212, 229; Meetyou: 109; Messling, Daniel: 36; MINT-Kolleg/Universität Stuttgart: 90; Mühr, Bernhard/ Quinting, Julian: 14; Offterdinger, Heidi: 17; Ostrovsky, Andrew – Fotolia: 68; Photocase: 135, 149; Prevete, Riccardo: 67; Privat: 15, 18; Rettinger, Markus: 55; Risklayer/ KIT: 54; Ruf, Cynthia: 6, 10, 29, 71, 74, 98, 111, 113, 175, 176; Schmitt, Thorsten – Fotolia: 144; SFB/TRR 288: 21; Sultanova, Anastasiya: 73, 84, 85, 97, 116, 139, 164, 187, 193, 219, 256; Tkotz, Laila: 40, 106, 124, 131, 136, 170, 237, 241, 251, 269; Westermann, Irina: 105, 242, 249; YIG Prep Pro: 127; Zachmann, Gabi: 1, 79, 162, 233, 240, 247; ZAK, KIT: 22; 3DMM20: 52

Photos edited by: Carina Lübben, General Services (AServ) – Documents (Dok) – CrossMedia (CroM), Gabi Zachmann, SEK

Translated by: KIT Translation Services, International Affairs (INTL)

Proofread by: KIT Translation Services, INTL; Byron Spice

Layout: Nicole Gross, AServ – Dok – CroM

Printed by: Systemedia GmbH, Würzburg

Printed on 100% recycled paper with the “Der Blaue Engel”  
(The blue angel) environmental label

Status: December 31, 2020

### **Contact**

Strategic Corporate Development and Communications  
Head: Alexandra-Gwyn Paetz  
Phone: +49 (0) 608-41100  
Email: [info@kit.edu](mailto:info@kit.edu)

### **Issued by**

Karlsruhe Institute of Technology (KIT)  
President Professor Dr.-Ing. Holger Hanselka  
Kaiserstraße 12  
76131 Karlsruhe, Germany

Karlsruhe © KIT 2021

