

# 2023 Annual Report Karlsruhe Institute of Technology



## KIT – The Research University in the Helmholtz Association

### Our Mission

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

From fundamental research to application, we excel in a broad range of disciplines, i.e. natural sciences, engineering sciences, economics as well as 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 mutual respect, cooperation, confidence, and subsidiarity. An inspiring work environment as well as cultural diversity characterize and enrich the life and work at KIT.

### Employees in 2023

Total	10,034
Scientists	5,823
Professors	414
International staff	1,686
Administration and Infrastructure	4,211
Trainees	358

### Students

Winter semester 2023/24	22,816
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### 2023 budget (preliminary figure as of February 5, 2024)

Total	EUR 1,147.6 million
Federal funds	EUR 344.7 million
State funds	EUR 315.9 million
Third-party funds	EUR 487.0 million



Gazing at the night sky has fascinated humanity since time immemorial. The universe's immensity and darkness, and also the light shining from its celestial bodies, are at the root of age-old questions about its origin and about the purpose and future of our existence in it. Those are also questions that guide our research, teaching, and administration at KIT. For example, with the Auger experiment in Argentina (shown on our title page), we seek to fathom the secrets of cosmic rays.

"Our Universe" was the theme of Science Year 2023. "Our Universe" is also both literally and figuratively a fitting theme for this annual report, in which we would like to look back with you on an eventful and successful year at KIT. The cosmos with its many unsolved mysteries has long been just one of KIT's many fields of research. In a broad range of disciplines including natural sciences, engineering, economics, humanities, and social sciences, our scientists are confronting current challenges and developing solutions for the urgent issues that will shape our future.

Interdisciplinary research is crucial to scientific excellence and groundbreaking innovations. Multidisciplinary issues such as digitalization and sustainability, which are of great concern to us in a variety of contexts, pose complex challenges that we can only overcome with a collaborative and interdisciplinary approach. This approach is also being taken by the Collaborative Research Centers established in 2023, Consistency in the View-Based Development of Cyber-Physical Systems and Circular Factory for the Perpetual Product, which involve researchers from the fields of computer science, electrical engineering, and mechanical engineering.

We also see digitalization and sustainability as important issues for our administration and infrastructure and will continue to push forward with them across all institutes in the day-to-day work of all KIT staff and students. At the beginning of last year, these two action areas were assigned to a new Executive Board portfolio headed by Vice President Professor Dr. Kora Kristof.

Also on January 1, 2023, the 2nd KIT Further Development Act took effect, another important step forward for the KIT community. The resulting synergies, which Professor Dr. Holger Hanselka played a key role in shaping during a decade as President of KIT, provide ideal conditions for our researchers. Last August he took a new position as President of the Fraunhofer-Gesellschaft in Munich. Here in Karlsruhe, he has left us with a unified KIT that is among the best universities in Germany and has made significant contributions to the success of the Helmholtz Association with its cutting-edge research.

For our ambitious plans, we have dependable partners at our side in government, industry, academia, and culture. To them, to the Supervisory Board, and to all KIT staff and students, I express my thanks for their constructive dialog and close cooperation during the past year.

And I cordially invite you, dear reader, to spend some time leafing through this report and looking back at 2023 in the "KIT Universe." I hope you enjoy it.

Yours truly,  
Professor Dr. Oliver Kraft (Acting President of KIT)

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## LOOKING BACK ON THE YEAR AT KIT

Germany's Federal Minister of Education and Research, Bettina Stark-Watzinger, and Baden-Württemberg's Minister of Science, Research, and the Arts, Petra Olschowski, celebrated the beginning of a new chapter with the then-President of KIT, Professor Holger Hanselka, the Chairman of the Supervisory Board, Professor Michael Kaschke, and the entire KIT community on February 20, 2023.

Since the 2nd KIT Further Development Act took full effect on January 1, 2023, KIT has enjoyed more autonomy than any other German scientific institution thanks to its status as the combination of a state university and a Helmholtz center, which is unique in all of Germany.

To leverage KIT's strengths in research, teaching, and innovation, the new act removed administrative boundaries and allowed greater flexibility in the use of funds and the allocation of staff. The most important changes are described below.

Instead of its former division into two sectors, KIT now has two equally important University and Large-scale Research Responsibilities.

A new standard staff category allows professors and other teaching staff at KIT to perform both university and large-scale research roles.

Professors can also be directly appointed to large-scale research positions at KIT.

All scientists may participate in both large-scale research and academic activities.

The elected division head is a full-time post established by law, giving KIT a modern and dependable governance structure.

State law now provides a uniform legal framework, simplifying processes for the staff.



### Important Visitors

On February 2, 2023, Baden-Württemberg's Minister-President Winfried Kretschmann visited the POLiS Cluster of Excellence and the CELEST research platform at Helmholtz Institute Ulm (HIU) to learn about battery research. The HIU was established in January 2011 by KIT, as a member of the Helmholtz Association, in cooperation with Ulm University. At the POLiS (Post Lithium Storage) Cluster of Excellence, scientists conduct research on the batteries of the future, which will be more powerful, reliable, sustainable, and environmentally friendly than current lithium-ion batteries. The CELEST (Center for Electrochemical Energy Storage Ulm & Karlsruhe) research platform was founded by KIT, Ulm University, and the Center for Solar Energy and Hydrogen Research Baden-Württemberg to improve communication among researchers and pave the way for new interdisciplinary collaborations. With 31 institutes and 46 working groups among its three partner organizations, CELEST is one of the world's largest research platforms for energy storage.



Minister-President Winfried Kretschmann looking into the state of battery research at the POLiS Cluster of Excellence. [4]

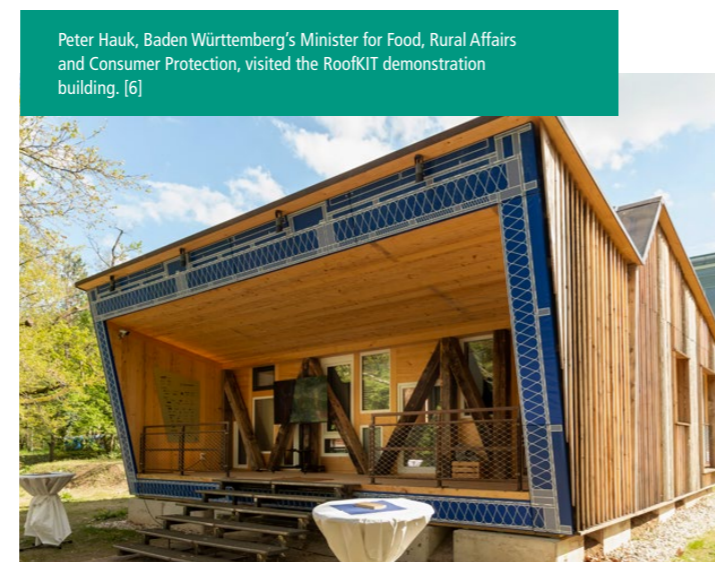
Friedrich Merz, head of the German political party CDU, visited KIT on April 3, 2023. He was accompanied by Thomas Strobl, Baden-Württemberg's Minister of the Interior, Digitalisation and Migration and Deputy Minister-President, and Nicole Hoffmeister-Kraut, Baden-Württemberg's Minister of Economic Affairs, Labour and Tourism. Together they visited the NECOC (NEgative CarbOn dioxide to Carbon) and Energy Lab research facilities to learn about current research on sustainable energy supplies and climate change mitigation. In the Energy Lab, which boasts Europe's largest research infrastructure for renewable energy, scientists investigate methods for intel-

ligent energy generation, storage, and distribution. The NECOC research facility combines negative emissions with the production of a high-tech raw material by extracting the harmful greenhouse gas CO<sub>2</sub> from the atmosphere and using it to produce carbon.



CDU head Friedrich Merz and his delegation learning about energy supplies and climate change mitigation. [5]

Baden Württemberg's Minister for Food, Rural Affairs and Consumer Protection, Peter Hauk, visited KIT to attend the dedication ceremony for the RoofKIT building on April 26, 2023. The RoofKIT project demonstrates how the urban energy transition can be stepped up with sustainable building designs. Directed by Andreas Wagner and Dirk Hebel, professors at KIT's Department of Architecture, over 100 students developed solutions for more sustainable and socially equitable forms of future housing. After the RoofKIT demonstration building won the Solar Decathlon 2021/22 (the world's largest building contest for universities) in Wuppertal, it was erected on Campus South at KIT. Minister Hauk also learned about other research on sustainable construction materials and visited KIT's Research Center for Steel, Timber, and Masonry to find out about current trends and prospects for building with wood.



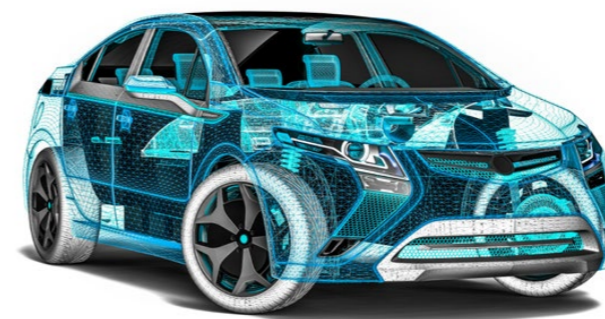
Peter Hauk, Baden Württemberg's Minister for Food, Rural Affairs and Consumer Protection, visited the RoofKIT demonstration building. [6]

### Collaborative Research Centers

Modern cyber-physical systems, such as vehicles, smart homes, and production facilities, are filled with electronic and mechanical components that are controlled by software. They are like puzzles whose pieces are constantly changing. But since the system as a whole only functions when all of its components work together perfectly, continuously maintaining the compatibility of the system architectures is a challenge for the developers of such systems. KIT's new Collaborative Research Center (CRC) 1608, Consistency in the View-Based Development of Cyber-Physical Systems, will work on new solutions for this problem. Over the next four years, the German Research Foundation (DFG) will provide funding of EUR 11 million for the CRC; its spokesperson will be Professor Ralf Reussner of KASTEL – Institute of Information Security and Dependability. Partners include the Technical University of Munich, the Dresden University of Technology, and the University of Mannheim. The CRC also includes a research training group.

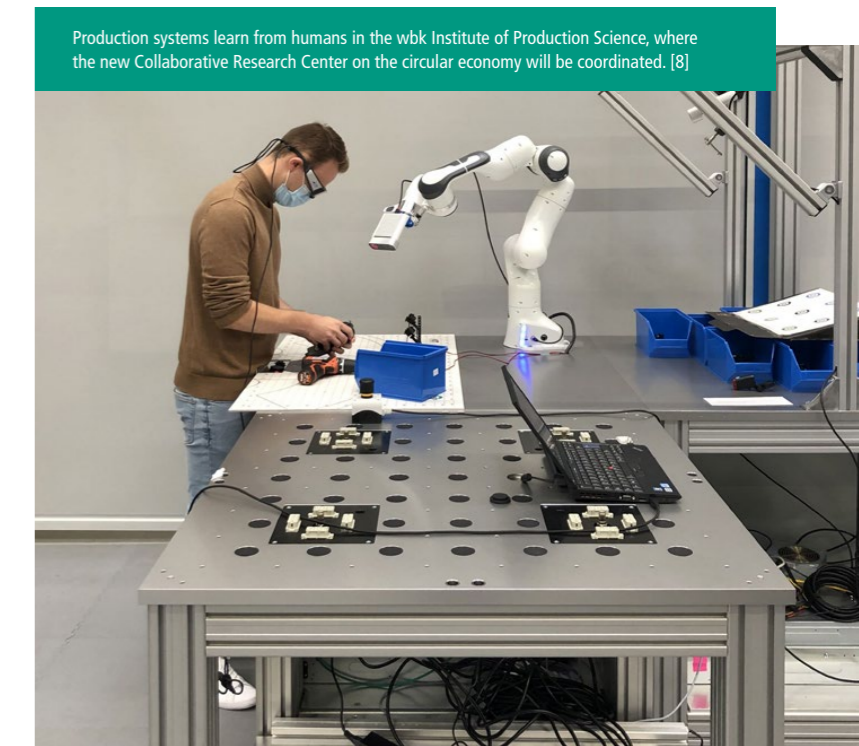
According to the Global Footprint Network, rapidly growing global resource consumption is so excessive that 1.75 Earths would have been needed to sustain it in 2022. Researchers at KIT are looking to fundamentally change the current economic system's "take-make-use-dispose" approach. Their solution relies on closed-loop processes in the circular economy; in a circular factory, used products are reconditioned, using as much automation as possible, so that they can leave the factory as new products.

The German Research Foundation is funding the new Collaborative Research Center with EUR 11 million. [7]



This work is the focus of the new CRC 1574 at KIT entitled Circular Factory for the Perpetual Product, which the DFG is funding with EUR 11 million. The CRC's spokes-

person is Professor Gisela Lanza from the wbk Institute of Production Science. The new CRC involves eight KIT institutes, the Fraunhofer Institute of Optronics, System Technologies, and Image Exploitation from Karlsruhe, Aalen University of Applied Sciences, and the Institute for Artificial Intelligence at the University of Stuttgart.



Production systems learn from humans in the wbk Institute of Production Science, where the new Collaborative Research Center on the circular economy will be coordinated. [8]

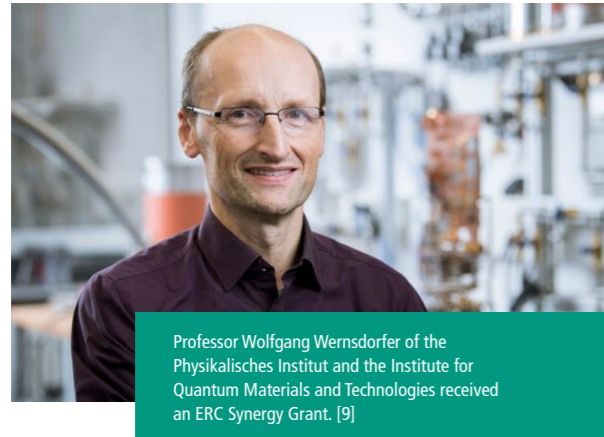
Waves are everywhere. For example, most modern communication is based on electromagnetic waves, and acoustic waves are used for seismic measurements of soil conditions. In KIT's CRC 1173, Wave Phenomena: Analysis and Numerics, mathematicians, physicists, and electrical engineers are working on how waves are propagated and how they can be controlled. Their basic mathematical research is complemented by application-specific studies in optics, photonics, biomedical technology, and applied geophysics. The DFG is funding the existing CRC for another four years with EUR 11.5 million, and its research training group will also continue.

The DFG also decided in 2023 to extend the Tailored Scale-Bridging Approaches to Computational Nanoscience research training group at KIT. In research training groups, doctoral students earn their doctorates in a structured research and training program.



## ERC Grants

KIT scientists obtained six prestigious ERC (European Research Council) grants in 2023.



Professor Wolfgang Wernsdorfer of the Physikalisches Institut and the Institute for Quantum Materials and Technologies received an ERC Synergy Grant. [9]

Professor Wolfgang Wernsdorfer of the Physikalisches Institut is one of the lead investigators in the DarkQuantum (Quantum Technologies for Axion Dark Matter Search) project, which the ERC is funding with a Synergy Grant. The project is searching for axions, hypothetical elementary particles that are potential constituents of the universe's dark matter. Eight European universities and research institutes are involved in DarkQuantum, which is coordinated by the University of Zaragoza in Spain. The leading researchers come from Zaragoza, KIT, CNRS in France, and Aalto University in Finland. The project is set to run for six years. Its funding amounts to EUR 12.9 million, of which KIT will receive around EUR 2 million.



The ERC awarded an Advanced Grant to Uli Lemmer, who heads the Light Technology Institute. [10]

The ERC awarded an Advanced Grant to Professor Uli Lemmer, an optoelectronics expert who heads the Light Technology Institute. His project "Origami-inspired thermoelectric generators by printing and folding" (ORTHOAGONAL) aims to develop and test a cost-effective and scalable process for producing thermoelectric generators, which convert ambient heat directly into electricity and offer considerable potential for recovering unused waste heat. It would also be a sustainable source of energy for wearable electronic devices (wearables) and sensors used by the Internet of Things. The ERC is funding the project with EUR 2.4 million in the next five years.



Frank Biedermann received a Consolidator Grant from the ERC. [11]

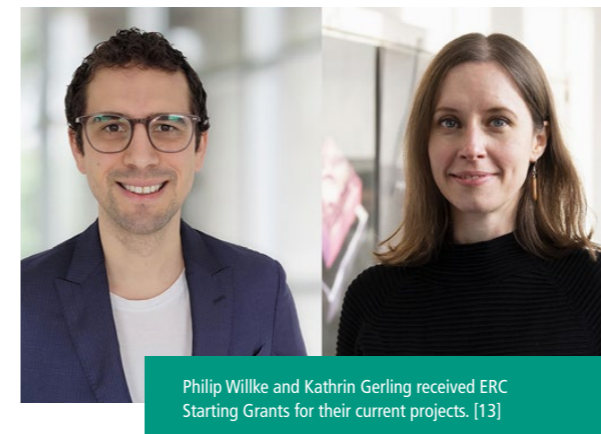
Dr. Frank Biedermann of the Institute of Nanotechnology, who heads an Emmy Noether junior research group, received a Consolidator Grant from the ERC. The aim of his SupraSense (Development of SupraSensors and Assays for Molecular Diagnostics) project is to develop highly specific yet easy-to-produce sensors for medical diagnostics. These "SupraSensors" are based on completely novel materials that mimic the enzyme pockets where the desired molecular recognition and signal generation take place. The aim is to use the sensors in medical practices, hospitals, and private households for molecular diagnostics of urine, saliva, and blood.



Ulrich W. Paetzold also received an ERC Consolidator Grant. [12]

Tenure-track professor Ulrich W. Paetzold of the Institute of Microstructure Technology also received an ERC Consolidator Grant for his photovoltaics project, LAMI-PERO (Laminated Perovskite Photovoltaics), which aims to develop a radical new production process for perovskite solar cells. The project's goal is to establish a fundamental understanding of how perovskite thin films are formed under high pressure and to discover more stable and novel perovskite semiconductor compositions that will enable the fabrication of highly efficient perovskite solar cells and tandem solar cells.

With its Starting Grants, the ERC recognizes outstanding young scientists. Selected projects are funded for five years with up to EUR 1.5 million. Two KIT researchers received Starting Grants in 2023.



Philip Willke and Kathrin Gerling received ERC Starting Grants for their current projects. [13]

Kathrin Gerling, professor for human-machine interaction at the Institute for Anthropomatics and Robotics, is working to eliminate physical, digital, and experience-related barriers with her project, called AccessVR (Developing Experience-Centric Accessible Immersive Virtual Reality Technology), and to make virtual reality more accessible for people with disabilities.

In his ATOMQUANT (On-Surface Atomic Spins with Outstanding Quantum Coherence) project, Philip Willke, a tenure-track professor at the Physikalisches Institut, is working on a new architecture based on atomic force microscopy for quantum information processing and magnetic sensor technology at the atomic level. Spin, an elementary property of magnetism, plays a key role in this technology, enabling the quantum mechanical properties of individual atoms and molecules to be measured.

## Research Infrastructure

The Karlsruhe Center for Optics and Photonics (KCOP) is taking shape. This new ultramodern technology center at KIT, which is currently under construction, will house research groups working on ways to use light – or photons – for a wide range of applications, among them high-efficiency photovoltaics, 6G communications and fiber optic networks, novel quantum sensors, superconducting detectors, extremely fast 3D imaging, and high-resolution microscopy for the life sciences.



Approximately 2,000 square meters of ultramodern clean room and laboratory space will be available to researchers in the new KCOP from 2026. [14]

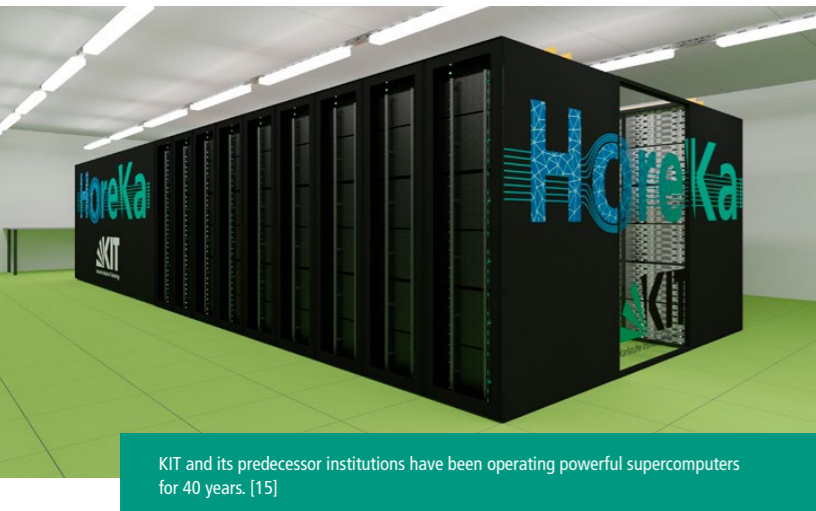
Plans call for the building, which will cost EUR 56 million, to be dedicated in early 2026. Research groups will then have at their disposal a technology platform of international standing with about 2,000 square meters of clean rooms and laboratory areas and a pool of instruments that can be shared for more efficient operation. The technology center will mainly be available to KIT institutes, but external research groups will also be able to work there. The Helmholtz Association is funding the new building with some EUR 50 million; KIT is contributing another EUR 6 million.



## Anniversaries

Karlsruhe has a long history as an important academic supercomputing center. KIT and its predecessor organizations, the University of Karlsruhe and the Karlsruhe Research Center, have operated more than 30 high-performance computers since 1983. Computing centers for use by researchers and students were set up there as long ago as the 1960s. The powerful mainframes and other computers were replaced again and again by more modern and higher-performance models.

Forty years ago, the first supercomputer was finally installed in the computing center at the University of

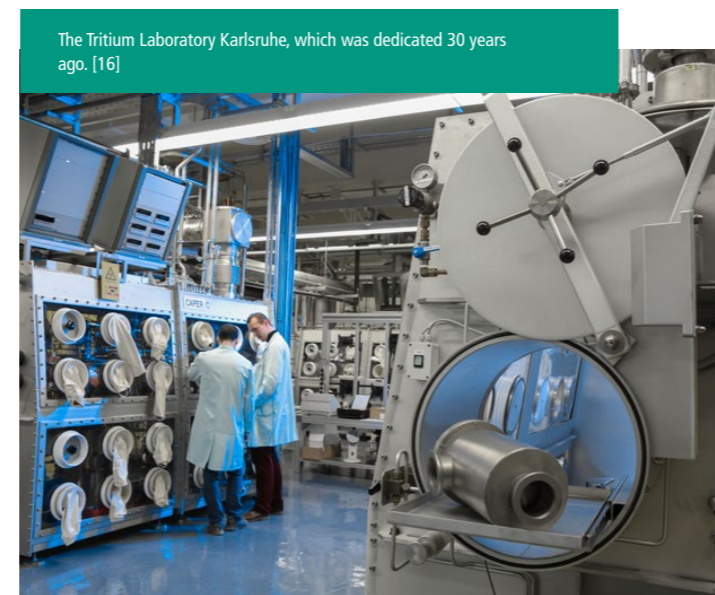


KIT and its predecessor institutions have been operating powerful supercomputers for 40 years. [15]

Karlsruhe – a Control Data Cyber 205. Its processing speed was up to 800 megaFLOPS. For comparison, the speed of a typical PC today is expressed in gigaFLOPS – a unit a thousand times larger. As the need for computing capacity steadily grew, new high-performance computers were procured regularly. The current “Hochleistungsrechner Karlsruhe” (HoreKa) at KIT is capable of 17 petaFLOPS, equivalent to the computing power of 150,000 laptops or about 21 million Cyber 205 systems.

In 1993, the Tritium Laboratory Karlsruhe (TLK) was dedicated. The TLK is a facility for processing and safely confining tritium, the radioactive isotope of hydrogen. With a license to handle up to 40 grams of tritium, a present inventory of about 30 grams, and extensive infrastructure and experimental apparatus, the TLK is nearly unique worldwide; only Japan operates a research facility with a similar tritium inventory, but with a much smaller laboratory. In its early years, the focus at the TLK was on fusion research. After 2000, the WGTS (Windowless Gaseous Tritium Source) was designed, built, and

operated for the Karlsruhe Tritium Neutrino Experiment (KATRIN), which uses electrons from the beta decay of tritium to determine the mass of neutrinos.



The Tritium Laboratory Karlsruhe, which was dedicated 30 years ago. [16]

The Young Investigator Network (YIN) is a support network for the W1 professors and independent junior research group leaders at KIT. The YIN was established in 2008 during implementation of the institutional strategy for the University of Karlsruhe as part of the federal and state Excellence Initiative in advance of KIT's founding. The network celebrated its 15th anniversary in 2023. All told, 222 leading young investigators have benefited from the YIN's offerings since 2008, including 20 ERC grant recipients, 5 of whom brought a grant with them to Karlsruhe. The other 15 were YIN members when they applied for ERC funding. Of the former YIN members, 50 percent were appointed to a W2 or W3 professorship, 37 percent hold management positions at scientific institutions, and 13 percent moved to the private sector.

The Young Investigator Network (YIN) celebrated its 15th anniversary in 2023. [17]



The state parliament of Baden-Württemberg resolved in June 2012 to reinstate the Students Union (“Verfasste Studierendenschaft”), which had been abolished in 1977. This established a legal basis for student representation. A vote on the Students Union's organizational statutes took place in January 2013. The student body, department chairs, and the student parliament were elected for the first time in June 2013, and the first General Students Committee was elected in September 2013. A ceremony was held on October 30, 2023, in Karlsruhe to honor the 10th anniversary of the Students Union's founding.



A ceremony was held on October 30, 2023, in Karlsruhe to honor the 10th anniversary of the Students Union's founding. [18]

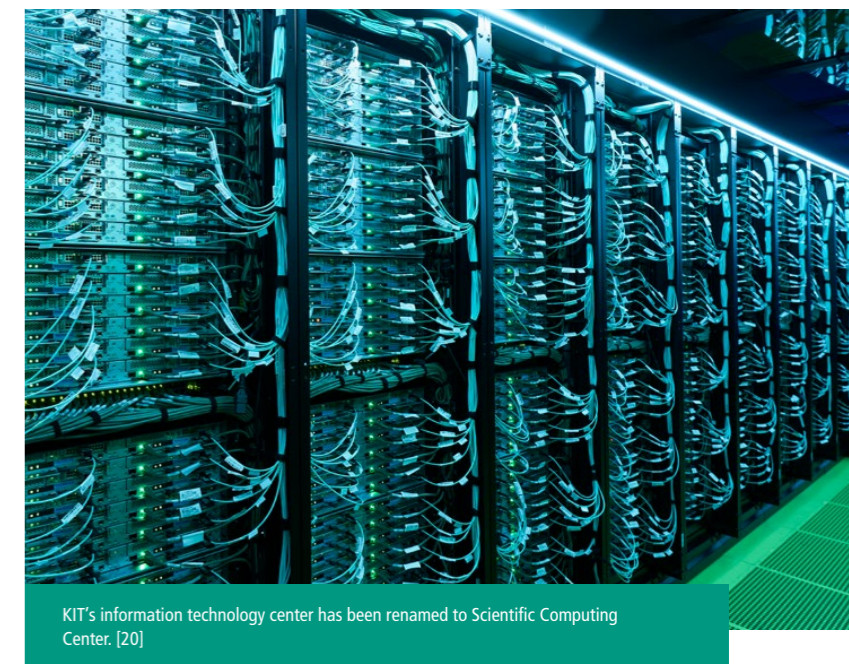
## New Names

The Botanical Institute was renamed at the beginning of 2023; it is now called the Joseph Gottlieb Kölreuter Institute for Plant Sciences. The new name memorializes an important but nearly forgotten botanist from Karlsruhe. In the 18th century, Joseph Gottlieb Kölreuter was the first scientist to study plant reproduction. Kölreuter was born in Sulz am Neckar in 1723 and died in 1806 in Karlsruhe. He was called to Karlsruhe in 1763 by Margrave Karl Friedrich von Baden-Durlach, who appointed him supervisor and director of the royal gardens with the rank and title of a professor of natural history. He was Karlsruhe's first professor in this field and founded its first botanical garden.



The Botanical Institute has had a new name since January 1, 2023: Joseph Gottlieb Kölreuter Institute for Plant Sciences. [19]

KIT's governing committees resolved in November 2023 to rename its information technology center, which as the Steinbuch Centre for Computing had borne the name of computing pioneer Professor Karl Steinbuch. New findings had revealed that Steinbuch, who researched and taught in Karlsruhe, identified as a young man with unacceptable acts of war during the Nazi era. As a result of this new information, KIT is distancing itself from Steinbuch in spite of his scientific achievements and has renamed its information technology center. Effective January 1, 2024, its new name is “Scientific Computing Center.”



KIT's information technology center has been renamed to Scientific Computing Center. [20]



### Awards Granted by KIT

KIT and KIT Freundeskreis und Fördergesellschaft e.V. awarded the 2023 Heinrich Hertz Guest Professorship to Dr. Joachim Nagel. Nagel, who was born in Karlsruhe and is a KIT alumnus, has been President of the Deutsche Bundesbank (Germany's central bank) since 2022. In his public lecture at KIT, "Europa und sein Euro – Fit für die Zukunft?" (Europe and its euro – fit for the future?), he addressed four key questions: Where do we stand after 25 years with the euro? What was the historical mission of monetary union? Which institutional reforms have taken place in the eurozone and which are still pending? What challenges do Europe and the euro face? Nagel also taught a seminar, "Wirtschaftsbeobachtung auf höherer Frequenz" (higher-frequency economic monitoring) for KIT students.



Bundesbank President and KIT alumnus Joachim Nagel was honored with the 2023 Heinrich Hertz Guest Professorship. [21]

Professor Dr. Thalappil Pradeep from the Indian Institute of Technology Madras in Chennai received the first KIT International Excellence Award and the Fellowship of SCHROFF Foundation in 2023. With its award, KIT honored the renowned chemist and his basic research in nanoscience and the application of novel nanomaterials for drinking water purification. The award includes a six-month research stay at KIT. It is part of the International Excellence Grants initiative in KIT's successful University of Excellence concept and is aimed at promoting international collaboration in top-level research and attracting international researchers to KIT.



The Indian chemist Thalappil Pradeep won the first KIT International Excellence Award and the Fellowship of SCHROFF Foundation. [22]

### Awards for KIT Scientists

In addition to the aforementioned ERC Grants, KIT scientists won many distinguished awards.

In research-oriented courses at KIT, Moritz Dörstelmann, a tenure-track professor at the Institute for Building Design and Technology, teaches his students to digitally design building processes that enable circular and resource-saving construction methods. For his innovative approach, which combines digital design methods with application-oriented demonstration projects using innovative materials, Baden-Württemberg's Ministry of Science, Research and the Arts awarded him its 2023 state teaching award worth EUR 50,000 in the innovation/transformation category (see also page 52).

The American Mathematical Society's 2024 Ulf Grenander Prize in Stochastic Theory and Modeling was awarded to Tilmann Gneiting, Scientific Director of the Heidelberg Institute for Theoretical Studies and Professor of Computational Statistics at KIT. Gneiting was honored for his seminal work in environmental and stochastic modeling with applications in computational weather forecasting, and for research in probability theory and mathematical statistics (see also page 115).

Making robots useful to humans outside the laboratory is the goal of Dr. Noémie Jaquier from the Institute for Anthropomatics and Robotics. Jaquier was one of ten newcomers recognized by the Federal Ministry of Education and Research and the Gesellschaft für Informatik e.V. in 2023 for their research work and their outstanding dedication to the field of artificial intelligence. The award was presented at the international KI-Camp 2023 in Berlin (see also page 66).

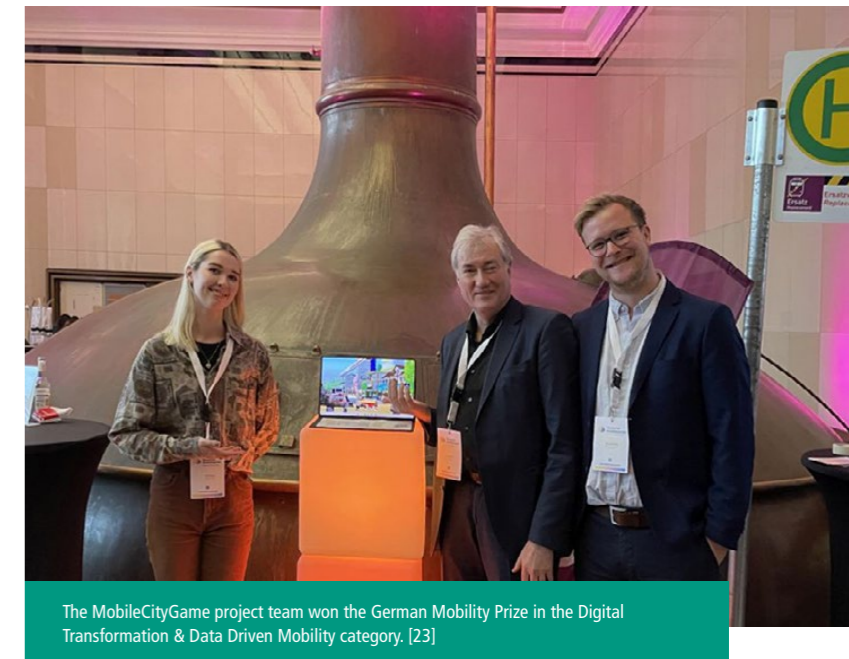
The molecular biology Professor Holger Puchta of the Joseph Gottlieb Kölreuter Institute for Plant Sciences was granted funding in a Reinhart Koselleck project by the German Research Foundation for his work on targeted restructuring of plant genomes. As a pioneer in green genetic engineering, Puchta has been using molecular scissors on plants for many years. His new project aims to use the CRISPR/Cas method to combine genes in crops, for example to help crops adapt better to global warming (see also page 114).

With the MobileCity app in its MobileCityGame project, a consortium of the Fraunhofer Institute for Systems and Innovation Research, the Fraunhofer Institute of Optronics, System Technologies, and Image Exploitation, KIT, and takomat GmbH developed a powerful simulator for planning sustainable and financially viable mobility systems.

Their research project won the 2023 German Mobility Prize in the Digital Transformation & Data Driven Mobility category (see also page 116).

A student team won the Europe-wide ECOTROPHELIA food innovation contest with a beverage made from nettles and ground elder. The jury was convinced by the minimal ecological footprint and "very good taste" of the unusual mixture of regional plants, which today are usually considered weeds. Competing against twelve other teams, the KIT students won first prize, worth EUR 4,000 (see also page 53).

In November 2023, the KIT spinoff nanoshape GmbH won the Karlsruhe Technology Region's NEO2023 Jury Prize worth EUR 20,000 for its surface technology for anti-inflammatory medical implants. In the same competition, researchers from the Institute for Mechanical Process Engineering and Mechanics won the Audience Prize, which was awarded for the first time, for their electrically conductive and printable adhesive that can be used in microelectronics and solar modules.



The MobileCityGame project team won the German Mobility Prize in the Digital Transformation & Data Driven Mobility category. [23]

The German University Sports Federation (adh) designated KIT its University of the Year 2023 in honor of its exemplary work and dedication on campus, in the region, and in the federation, from health promotion to top-class sports. The adh also praised KIT's outstanding efforts in organizing adh competition events and regularly sending athletes to national and international sports events. The adh presented the award at its general assembly in Munich in November 2023.



KIT's university sports team and Vice President Alexander Wanner celebrated their award from the adh. [24]



## Events

The “KIT im Rathaus” (KIT at City Hall) series, which is coordinated by the ZAK | Center for Cultural and General Studies, makes the excitement and diversity of the research conducted at KIT’s nine centers accessible to the general public. Big data, artificial intelligence, and the challenges of data protection and cybersecurity were the focus of the event on January 30, 2023, at which the KIT Center Information · Systems · Technologies presented its work. In keeping with the “Our Universe” theme chosen for Science Year 2023 by the Federal Ministry of Education and Research, researchers from the KIT Elementary Particle and Astroparticle Physics Center presented their current work at the intersection of astrophysics, elementary particle physics, and cosmology on July 3, 2023.

Should we eat algae? Can big data make agriculture more sustainable? What does sustainability mean for people who work in the agricultural sector? Does it make sense to install photovoltaic systems in fields? These and other questions were addressed at the sustainable agriculture project week during the Spring Sustainability Academy held at KIT by the ZAK | Center for Cultural and General Studies from March 27 to 30, 2023. The Spring Sustainability Academy addressed students interested in sustainable development; selected events also addressed the general public.

Trade-offs and conflicts involving productivity and sustainability in agriculture were a key topic at the Spring Sustainability Academy. [25]



The Baden-Württemberg final of the “Jugend forscht” science competition highlighted the ideas of tomorrow. For the final round, held at KIT from March 29 to 31, 2023, 101 young people with 58 projects qualified. Eight winning projects were chosen to compete in the German final. The research projects included a device for cleaning

brooms and brushes, proof of the occurrence of Savi’s pipistrelle (a bat species) in the city of Lörrach, and a system for reducing power losses caused by dirt and shade on photovoltaic systems.

The connection between architecture and resource consumption has never been more important than it is now. The swing from an “anything goes” mentality to much more prudent use of land and building materials is shaping the current discourse in both research and practice. In its Architecture & Building Technology knowledge week, KIT brought this trend to the public’s attention. From April 18 to 22, 2023, lectures, panel discussions, excursions, workshops, and an exhibition offered opportunities to discover sustainable building. Two other knowledge weeks on the themes of Environment & Resources and Mobility followed later in the year (see also page 58).

KIT took part in the Germany-wide Girls Day with in-person events for the first time since 2019. Schoolgirls from 5th grade and up were invited to get acquainted with vocational training and degree programs at KIT on April 27, 2023. Each girl was able to choose her own personal program from among 60 workshops.



Whether for study or vocational training, KIT sparked an interest in technology and natural sciences among schoolgirls in grades 5 and above at Girls Day 2023. [26]

Science Year 2023 “Our Universe” and the future of KIT took center stage at KIT’s annual celebration on April 5, 2023. The mass of neutrinos, the origin of cosmic rays, and the nature of dark matter and dark energy in the universe: KIT conducts research on many fundamental questions about the nature of our universe, sometimes with large-scale experiments designed to reveal the smallest structures of matter or take an especially close look at cosmic events.



At the annual celebration, President Holger Hanselka spoke about highlights from research, teaching, and knowledge transfer and about the future of KIT. [27]

With the Badisches Staatstheater Karlsruhe, the Orchester des Wandels, and the Save the World initiative, KIT made a statement for climate-friendly living with its No Silence before the Storm – Sustainability Days campaign. Leading climate researchers worked with artists on a program featuring music, dance, and scientific lectures for children and adults at the Badisches Staatstheater Karlsruhe from April 22 to 24, 2023. Parts of the program also took place at KIT’s TRIANGEL Transfer | Culture | Space facility.

Transferring knowledge between the sciences, the arts, industry, and civil society is an important task in these challenging times. To bring science and theater closer together, the Badisches Staatstheater Karlsruhe teamed with KIT to present “Nerds retten die Welt” (Nerds Save the World), an artistic interpretation of current research topics at KIT. With six performances at various locations on KIT’s Campus South between June 15 and July 20, 2023, they presented a creative and performative outlook on the future.

After a four-year hiatus caused by the pandemic, KIT again hosted visitors at an open house. On June 17, 2023, KIT’s Campus North turned into a treasure chest of outstanding science to look at and take part in, and offered an opportunity for dialog in a time of technological change. With more than 200 activities on its agenda, the event offered something for the entire family, including music and comedy performances and quizzes on the main stage (see also page 91).

Insights and innovations are based on research data, which thus play an essential role in our society’s progress. The National Research Data Infrastructure (NFDI e.V.) has the mission of putting data resources to better use in the

future. From September 12 to 14, 2023, KIT and the NFDI held the first Conference on Research Data Infrastructure at KIT’s Campus South (see also page 98).

In honor of the International Day of Democracy on September 15, and 175 years after the Frankfurt Parliament, TRIANGEL Transfer | Culture | Space, the Institute for Technology Assessment and Systems Analysis, and the Law Forum Foundation held a series of events for three “Days of Democracy.” TRIANGEL, KIT’s center for innovation, startups, and knowledge transfer at Kronenplatz square in Karlsruhe, was a meeting place where lectures and panel discussions as well as art and music highlighted the present and possible futures of democracy.



Germany’s top five young IT talents. Left to right: Philip Gilde, Raphael Gaedtke, Chuyang Wang, Finn Rudolph, and Selma Hübner, winners in the final round of the nationwide computing contest. [28]

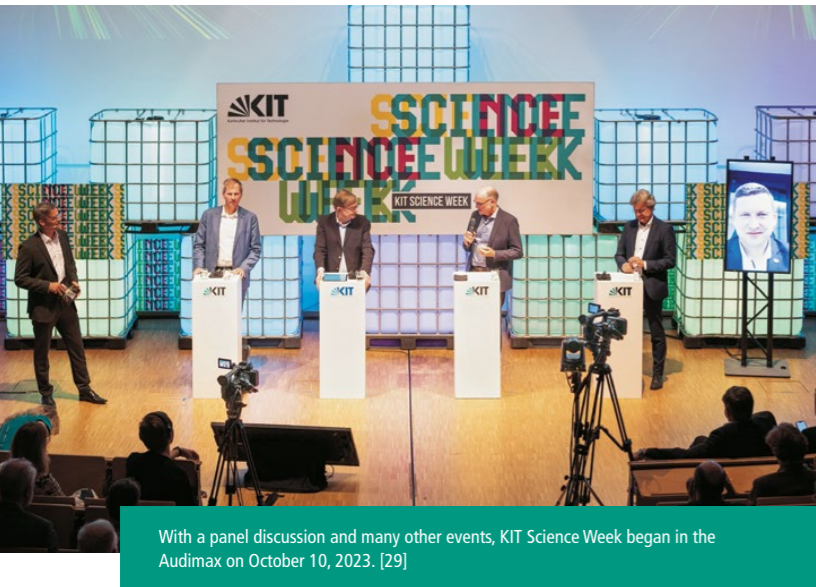
After solving complex problems, convincing experts of their own expertise, and proving themselves as team players, the five winners of Germany’s 41st nationwide computing contest were honored at KIT on September 15, 2023. After two rounds in which more than 1,600 contestants from all over Germany took part, 26 finalists qualified for the final round of the annual contest. Over two days, the top young IT talents were confronted with research-level problems, which they had to work on in groups and alone.

With its theme “Making the Future Sustainable. Together” the second KIT Science Week from October 10 to 15, 2023, addressed climate action, environmental protection, wildlife conservation, sustainable resource management, ecologically compatible growth, green entrepreneurship, and global justice, combining a top-level scientific conference with a wide range of events for all social groups.



Top international researchers met curious citizens to discuss how society can transition to a more sustainable future (see also page 90).

On November 9, 2023, KIT held a farewell symposium for its longtime president, Professor Holger Hanselka. Leading figures from government, industry, and academia honored Hanselka's achievements at the event in the Audimax.



With a panel discussion and many other events, KIT Science Week began in the Audimax on October 10, 2023. [29]

### Changes in the Executive Board

Effective January 1, 2023, the responsibilities of the former Human Resources and Law portfolio were assigned to the Executive Board member responsible for Business Affairs and Finance and consolidated into the new Finance, Human Resources, and Infrastructure portfolio. The new portfolio is headed by Michael Ganß, previously the Vice President for Business Affairs and Finance.

Digitalization and sustainability are inseparable at KIT. They are linked together in many ways and affect our core tasks of research, teaching, and innovation just as they affect our administration and infrastructure. On January 1, 2023, the new Digitalization and Sustainability portfolio was established.

Professor Kora Kristof assumed the position of Vice President for the new portfolio on March 1, 2023. Kristof, an economist, had headed the Sustainability Strategies, Sustainable Resource Use, Instruments department at Germany's Federal Environment Agency since 2011. She is an expert on the digital transformation, the energy

transition, successful societal change processes, sustainability, resource conservation, and climate. In addition to her research, she advises government, business and civil society, and teaches at Witten/Herdecke University.

Our longtime president, Professor Holger Hanselka, left KIT to assume his new role as President of the Fraunhofer-Gesellschaft on August 15, 2023. Hanselka had been President of KIT and Research Field Coordinator Energy at the Helmholtz Association since October 2013.

During his tenure as president, Hanselka's top priority was defining a clear strategy for KIT and forming it into a single entity. The primary aim of the 10-point plan he submitted when he took office was to better exploit potential synergies. The Joint KIT Statutes were adopted in 2014. The KIT 2025 Strategy developed by Hanselka and his Executive Board colleagues was the foundation of major achievements in cutting-edge research. For example, KIT regained its University of Excellence title in 2019, and with its cutting-edge projects it is also very well positioned to benefit from the Helmholtz Association's program oriented funding.

Hanselka's time at KIT also saw the 2nd KIT Further Development Act take effect in January 2023.

Until a new president takes office, Professor Oliver Kraft, Vice President for Research, will be Acting President of KIT. ■



President Holger Hanselka departed from KIT on August 15, 2023. [30]



The KIT Executive Board at the staff meeting on November 30, 2023. Left to right: Thomas Hirth, Kora Kristof, Oliver Kraft, Alexander Wanner, Michael Ganß. [31]





## RESEARCH

Research at KIT can be viewed from various perspectives. Different aspects of KIT's wide-ranging research portfolio come into focus depending on one's standpoint.

Work in the various scientific disciplines is organized in the following five divisions at KIT: Biology, Chemistry, and Process Engineering; Informatics, Economics, and Society; Mechanical and Electrical Engineering; Natural and Built Environment; and Physics and Mathematics. At the heart of the divisions are the institutes where research, teaching, and innovation take place. Program-based research is organized in the Helmholtz programs, and university teaching in the KIT departments.

The Helmholtz programs are embedded in the higher-level program structure of the Helmholtz Association's six research fields. KIT is involved in eleven research programs in four research fields. KIT operates the Grid Computing Centre Karlsruhe as a large-scale research facility.

The KIT Centers focus on interdisciplinary problems of fundamental importance to the existence and continued development of our society and on key issues resulting from the pursuit of knowledge. They are characterized by their unique scientific approaches, their strategic objectives, and their long-term perspective. Nine KIT Centers currently combine interdisciplinary research activities and interact with the outside world on strategic research

fields. As KIT's research themes evolve, new KIT Centers may be established and existing ones may be shut down.

For example, the new KIT Health Technologies Center (KITHealthTech) was founded in 2023 to promote the digital transformation of medical technology, personalized medicine, and healthcare. Its mission is to develop digital and technological solutions for medical products with a focus on benefiting society and meeting its medical needs (see also page 41).





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## ENERGY

## Making the Energy Transition a Success with New and Holistic Technologies

A number of research projects at KIT are related to the energy transition, with some 1,500 researchers working on a reliable, safe, and sustainable energy system for the carbon-neutral society of the future. Their priorities are energy efficiency, renewable energy sources, energy storage systems and networks, and expanding international research cooperation.

### Energy Transition in Municipalities: Linking Electricity, Heat, and Traffic

Even small administrative units like municipalities can make valuable contributions to the energy transition. Towns and cities are playing a key role in bringing about sustainable energy systems, for example by making better use of heat from wastewater or furnishing new buildings with solar panels.

“The challenge for the energy transition is that when we replace fossil fuels with electricity, we can no longer treat individual sectors separately,” said Dr. Dirk Scheer of KIT’s Institute for Technology Assessment and Systems Analysis, who coordinated the now-completed ZuSkE project.

Into the future with solar power: Over half of Europe’s single-family homes could achieve energy self-sufficiency. [45]



ZuSkE is the German abbreviation for “Future Sector Coupling on the Municipal Level.” The project sought ways to design and implement linkages between power, heat, and transport infrastructures so that all sectors can be quickly and efficiently decarbonized.

The researchers worked with the municipalities of Berlin, Freilassing, and Walldorf, compiling a list of 100 measures already implemented and developing tools to assist the municipalities. As energy suppliers, municipal utilities can increasingly use geothermal energy, expand their district heating systems, install power-to-gas systems to use excess power from wind or solar facilities for heating, and connect solar power systems in their buildings to charging stations for their electric vehicle fleets.

### Energy Transition: Self-sufficiency for Single-family Homes

Electricity prices in Europe have been rising for years, and they reached record levels after Russia’s invasion of Ukraine. At the same time, photovoltaic systems and battery storage are making it easier for customers to become more independent of utility companies. Researchers at KIT, Forschungszentrum Jülich, ETH Zurich, and the Paul Scherrer Institute have assessed the potential for complete energy self-sufficiency in residential buildings.

“By investing in local energy production systems, customers can cover most of their own electricity needs and reduce their dependence on expensive externally produced electricity,” said Max Kleinebrahm from the Institute for Industrial Production. With such an approach, more than half of Europe’s single-family homes could already meet all of their energy needs. More than two million buildings could go off-grid by 2050 if their owners were prepared to invest up to 50 percent more than a comparable on-grid energy system would cost.

These figures are based on a database in which high-resolution geographical information about existing buildings and their households was combined with data on local climatic and economic conditions. Using innovative complexity reduction methods on supercomputers, the researchers first configured cost-optimized self-sufficient

supply systems for 4,000 typical single-family homes. In a later step, neural networks were used to extend the results to the 41 million single-family homes covered by the study. The researchers found particular potential for self-sufficient residential buildings in regions with minimal seasonal weather variations, such as Spain, or with high electricity prices, as in Germany.

The actual configuration of such cost-optimized energy systems for buildings in Central Europe could consist of photovoltaics to generate electricity and short-term battery storage combined with a long-term, seasonal hydrogen storage system.

### Energy Transition with Rooftop Hydrogen

With Canadian partners, KIT researchers made important progress in efficiently producing hydrogen or other fuels with low-cost photoreactor modules on rooftops or on solar farms. They optimized artificial photosynthesis, in which sunlight is used to drive chemical reactions, for large-scale use on roofs.

As in the natural analog, photons are absorbed by a photocatalytic material and their energy is used to drive a chemical reaction. There are various photocatalysts that can be used for purposes such as splitting water into hydrogen and oxygen or producing carbon-neutral fuels from water and carbon dioxide. This technology has thus far been used mainly in laboratories because the cost of solar hydrogen production has simply been too high.

Now a major advance toward practical application has been made with a design for high-efficiency photoreactor panels that can be installed in inexpensive modules. The widespread use of such novel photoreactor modules to produce hydrogen or other fuels on roofs or solar farms appears to be one of humanity’s greatest technological opportunities for fighting the climate crisis. “This could make the use of fossil fuels completely superfluous,” said Paul Kant of the Institute for Micro Process Engineering, who headed the research effort.



KIT researchers and their partners developed a high-efficiency photoreactor panel design for installation in low-cost modules. [46]

The photoreactor design consists of microstructured polymer panels coated with aluminum for high reflectivity, providing optimum operating conditions and ensuring efficient transmission of light to the photocatalyst throughout the day. The researchers developed the system with computer-assisted geometry optimization and a photocatalytic model system. Their first laboratory-scale demonstrations were successful. ■

More information:

KIT Energy Center:

<https://www.energy.kit.edu/index.php>

ZuSkE project (in German):

<https://kommunale-sektorkopplung.ffe.de/>

Original publication on energy transition in municipalities:

<https://doi.org/10.1016/j.erss.2023.103210>

Original publication on energy self-sufficiency in single-family homes:

<https://doi.org/10.1016/j.joule.2023.09.012>

Original publication on energy transition with rooftop hydrogen:

<https://doi.org/10.1016/j.joule.2023.05.006>



## BATTERY RESEARCH

## Recycling Lithium-ion Batteries

Lithium-ion batteries are part of everyday life. Not only do they provide wireless power for our notebooks, smart-phones, toys, remote controls, and other small devices, they are also the most important means of energy storage in the rapidly growing electromobility sector. The increasing use of such batteries calls for economically and ecologically sustainable recycling methods.

## Mechanochemical Recycling Process

Nickel, cobalt, copper, aluminum, and steel are the materials most often recovered and recycled from today's battery waste. Recovering lithium is still expensive and unprofitable. Existing recovery methods are mostly metallurgical in nature. They consume a lot of energy and often produce hazardous byproducts. In contrast, mechanochemical approaches (in which mechanical processes induce chemical reactions) promise higher yields and better sustainability at lower cost.

Such a process has now been developed by KIT's Institute for Applied Materials (IAM), the Helmholtz Institute Ulm for Electrochemical Energy Storage (established by KIT and Ulm University), and EnBW Energie Baden-Württemberg AG.

The more batteries need to be recycled, the more important sustainable recycling processes for their reusable materials become. [47]

With the new approach, the researchers reached a lithium recovery rate of up to 70 percent without the need for corrosive chemicals, high temperatures, or prior sorting of materials. "The process can be used to recover lithium from cathode materials of various chemical compositions, so it works for a wide range of commercially available lithium-ion batteries," said Dr. Oleksandr Dolotko of IAM and HIU. "It enables inexpensive, energy-efficient, and environmentally compatible recycling."

The researchers use aluminum as a reducing agent in the mechanochemical reaction. Since the cathode already contains aluminum, no other substances need to be added. In the first step of the process, the battery waste is ground up. Then it is used in a reaction with aluminum to produce metallic composites with water-soluble lithium compounds. The lithium is recovered by dissolving the soluble compounds in water; the water is then heated and removed by evaporation. Since the mechanochemical reaction takes place at ambient temperature and pressure, the method is especially energy-efficient. A further advantage is the process's simplicity, which will make it easier to implement at the industrial scales needed since large volumes of batteries will have to be recycled in the near future.

## DiRecReg

A more advanced approach was taken by DiRecReg (Agile Process Chain for Direct Recycling of Lithium-ion Batteries and Regeneration of Active Materials), a large-scale joint project involving KIT and industry partners. The researchers are developing a complete process chain that recycles spent batteries more efficiently by recovering the active components while retaining their functionality.

In current processes, battery cells are crushed and their active materials are dissolved down to the molecular level as metal salts for later extraction from the solution. Though up to 90



In the DiRecReg project, four KIT institutes and seven companies are developing a complete process chain to improve the recycling of used batteries and production waste. [48]

percent of the key elements such as cobalt, nickel, and manganese can be recovered this way, large amounts of energy and chemicals are needed. Moreover, producing new battery materials from the recovered substances also requires large amounts of energy and raw materials. New and very promising approaches involve directly recycling active materials from spent batteries and production waste. "We no longer completely dissolve the active materials. Instead we break them down into their individual cell parts and separate them mechanically to recover them in maximum purity," said Dr. Marco Gleiß from the Institute for Mechanical Process Engineering and Mechanics. Gleiß coordinates KIT's work in the joint project.

Such a direct recycling process chain has not yet become established in industry due to the unpredictability of the recycled material's behavior. There are also no criteria and rules for assessing the usability of the old material, nor are there practical and economical solutions for breaking down different kinds of battery packs into their individual components. These key aspects are addressed by the DiRecReg project.

The DiRecReg project is set to run for three years and has received EUR 2.95 million in funding from Germany's Federal Ministry of Education and Research. The project consortium, which is directed by Weber Ultrasonics AG, includes ten partners and one associate partner. Four of the partners are KIT institutes. ■

*More information:*

*Original publication on mechanochemical recycling (open access):*

<https://doi.org/10.1038/s42004-023-00844-2>

*KIT Center Materials in Technical and Life Sciences:*

<https://www.materials.kit.edu/index.php>



## MOBILITY SYSTEMS

## Supporting the Mobility Transition with New and Flexible Approaches

In many fields of research at KIT, mobility and mobility-related activities play a key role. In ground-based transport, we are developing multidisciplinary solutions for the mobility of tomorrow. About 800 employees at more than 35 institutes are working on mobility research at KIT.

### Supercomputers to Control the Cars of the Future

Future vehicles will be increasingly automated and networked to enhance their autonomy on the road and, eventually, to relieve their drivers. This will require enormous computing capacity that can only be provided by the most powerful computer systems, whether they are in the vehicles, along the roads, or at central computing facilities.

In the CeCaS (CentralCarServer) research project, which is coordinated by Infineon, 30 industrial and research organizations are working on suitable processors, interfaces, and system architectures for highly automated and networked vehicles. KIT and the Technical University of Munich are responsible for the scientific coordination of the project, for which KIT is developing novel multi-purpose hardware accelerators for highly effective image processing and the integration of reliable AI in cars.

The new accelerators are integrated in high-performance processes via high-speed interfaces. The researchers are especially focused on the AI components between the sensor nodes and the central computer. In addition, KIT is working on new development tools to analyze and ensure compliance with real-time criteria, and on extensive benchmarking software for evaluating the hardware accelerators.

Computer systems in the highly automated and networked cars of the future will need to perform complex calculations, process enormous amounts of data, and achieve extremely high reliability. [49]

“Progress in automotive engineering is directly dependent on progress in computing and information technology, and especially on the automotive industry’s ability to use modern chip technologies effectively,” said Professor Jürgen Becker of KIT’s Institute for Information Processing Technology. “CeCaS aims to help the German automotive industry play a leading role in the global competition of the digital era.” Germany’s Federal Ministry of Education and Research is funding CeCaS with EUR 46 million.

### Autonomous Ridepooling to Support Mobility Transition

Up to 10,000 autonomous shuttles could be on the streets of Hamburg by 2030, with a modern on-demand transportation service set to offer a mobility solution that complements classical bus- and train-based public transport. The system will be easy to book and use, and ideally it will also be scalable to larger regions and even suitable for rural areas.

In their autonomous ridepooling project called ALIKE, researchers from the Institute for Transport Studies (IfV) are developing new mobility services with autonomous shuttle buses that will relieve inner-city congestion, cut emissions, and provide greater flexibility for passengers. Autonomous ridepooling will help to close the gap between the actual mobility needs of many living arrangements and what public transport can actually offer.

Acceptance of the new service by the people of Hamburg will be measured by mobiTopp, a simulation tool developed for the project. “The first large-scale integration of autonomous vehicles into public transport will take place here. We are investigating how people will react to autonomous ridepooling services,” said Dr. Martin Kagerbauer of the IfV. Ridepooling can be operated more economically with autonomous vehicles, and it offers another mobility option besides private cars.

In addition to consortium leader HOCHBAHN, the project consortium includes the on-demand service MOIA, the vehicle manufacturers HOLON and Volkswagen Commercial Vehicles, research partner KIT, and Hamburg’s

transport and mobility transition authority. Germany’s Federal Ministry for Digital and Transport is supporting the project with EUR 26 million.

### Automated Platooning to Boost the Flexibility of Bus Transport

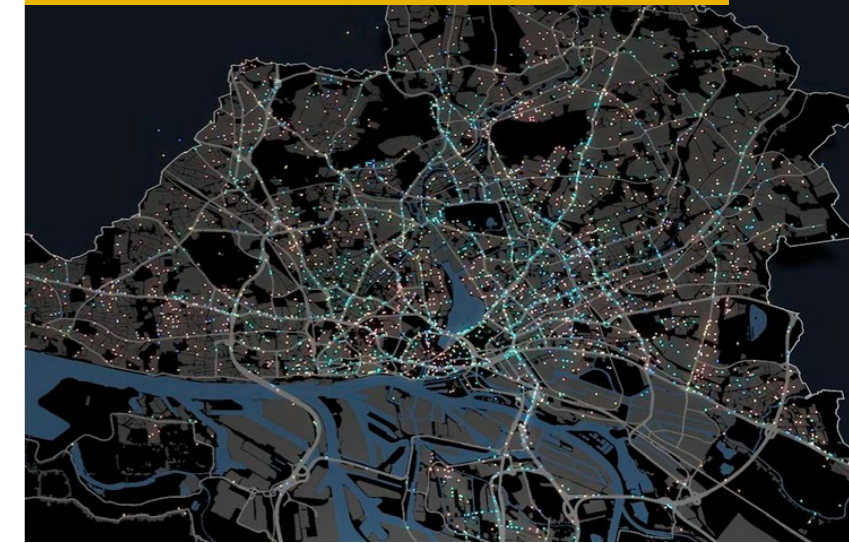
Automated driving in public transport makes sense both ecologically and economically, and the shortage of drivers is a further factor in its favor. In cooperation with Munich’s public utility company and the vehicle manufacturer EBUSCO, researchers at KIT are developing electric buses for regular service in Munich that automatically follow a lead vehicle. The first prototypes based on this idea, known as platooning, are already in operation. In platooning, several vehicles follow each other at short distances; their separation is controlled electronically.

“Conventional articulated buses need too much energy and can’t be used flexibly enough to react to rapid fluctuations in passenger volume,” said Professor Eric Sax from the Institute for Information Processing Technology. With platooning, a driver is only required for the lead vehicle; the others follow automatically. The platoons can be modified as needed to adapt to specific traffic situations.

There is no physical connection between platooned units, which instead are controlled with communications technology. The “electronic tow bar” can be disconnected easily so that the bus platoons can be split and reconnected without further ado.

Lidar, radar, and camera systems monitor vehicle separations. Vehicle data such as position, steering angle, and speed are transmitted by radio to the following vehicles. If the lead bus brakes, the following vehicle receives both a radio signal and a visual signal as the brake lights flash. Technical challenges remain, such as keeping the separation between the buses small enough that other vehicles cannot cut in, detecting pedestrians trying to pass between vehicles, and dealing with ice, snow, and dust.

The mobiTopp tool is used to simulate ridepooling vehicles in research on the effects of autonomous traffic.



The TEMPUS project for pilot tests of urban autonomous road traffic in Munich is funded by Germany’s Federal Ministry for Digital and Transport with EUR 12 million for a period of two and a half years. ■

More information:

Video “Der Stadtbuss der Zukunft fährt in Kolonne” (City buses to drive in platoons in the future – in German)

<https://www.youtube.com/watch?v=VWkSfzPCK-U>

KIT Center Information · Systems · Technologies:

<https://www.kcist.kit.edu/>

KIT Mobility Systems Center:

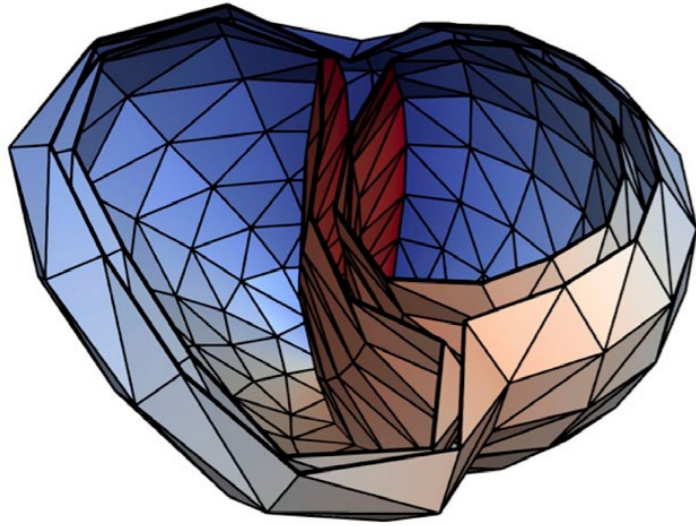
<https://www.mobilitaetssysteme.kit.edu/index.php>

Electronically networked traffic: With so-called platooning, groups of buses can be connected or split up as needed. [50]





## ARTIFICIAL INTELLIGENCE

**AI Applications in Medicine, Building, and Meteorology**

Machine learning methods make it possible to determine where extrasystoles originate – non-invasively and without tomographic imaging. [51]

Artificial intelligence (AI) is used in many ways in the sciences. It helps researchers analyze large amounts of data and detect patterns or correlations that would often be difficult for human experts to recognize. AI is used for a wide range of applications at KIT.

**Artificial Neural Networks Localize Extrasystoles**

Cardiovascular diseases cause more than 17 million deaths per year worldwide. Some 25 percent of those deaths can be attributed to cardiac arrest, which can be related to ventricular tachycardia, i.e. rapid cardiac rhythm irregularities in the ventricles that are often caused by ventricular extrasystoles. These additional heartbeats in the ventricles feel like skipped heartbeats.

Ventricular tachycardia can be treated with catheter ablation, in which the source of the extrasystoles is ablated by high-frequency current from a special catheter. This process requires the source to be precisely localized. "Machine learning methods enable the origin of extrasystoles to be identified in a non-invasive manner and without tomographic imaging," said Dr. Axel Loewe, who heads the interdisciplinary Computational Cardiac Modeling Group at KIT's Institute of Biomedical Engineering.

Researchers from KIT and EPIQure, a Karlsruhe company, used deep learning to localize ventricular extrasystoles from ECG signals without patient-specific geometries. They used convolutional neural networks, a special type of artificial neural network comprising various layers that perform different tasks. Such networks are suitable for high data volumes and can be trained relatively quickly.

**Progress on the Way to Fully Automated Construction**

How can artificial intelligence help people in the construction sector? Which tasks can machines learn? These were some of the questions addressed in the SDaC (Smart Design and Construction) project coordinated by KIT.

"We developed a platform for digitizing and organizing project documents such as delivery notes in PDF format," said SDaC's lead scientist, Professor Shervin Haghsheno from KIT's Institute of Technology and Management in Construction (TMB).

The SDaC project partners also developed nine AI demonstrators to support organizations in the construction sector in the planning and implementation of their projects. "We gave special emphasis to transparency and explainability," Haghsheno added.



With its focus on the lossless transfer of information between organizations and software systems, the SDaC project made an important contribution to research on human-machine collaboration. [52]

Anyone who is interested can view the demonstrators on the platform, and test them to see what value AI can add for the construction sector. Though the project has been completed, TMB will continue to operate the platform and the demonstrators beyond the end of the project in order to support the transfer of knowledge and experience relating to AI in the construction sector.

More than 40 partners from academia and industry were involved in the SDaC project. The project won a Germany-wide AI innovation contest and was funded for a duration of 3.5 years by Germany's Federal Ministry for Economic Affairs and Climate Action with EUR 9 million.

**High-resolution Precipitation Maps with AI**

Many natural disasters such as floods or landslides are the direct result of extreme precipitation. "Precipitation is highly variable over space and time, making it difficult to forecast, especially at the local level," said Dr. Christian Chwala from Atmospheric Environmental Research of KIT's Institute of Meteorology and Climate Research, KIT's Campus Alpine in Garmisch-Partenkirchen. "So we want to increase the resolution of rainfall fields of the kind generated by global climate models and improve our ability to classify them in terms of possible threats such as floods."

The global climate models used thus far are based on a grid that is not fine enough to precisely represent the variability of precipitation. High-resolution rainfall maps can only be produced with models that require extreme computing power and are thus spatially or temporally limited. The researchers developed a generative neural network and trained it with high-resolution data from radar observations of rainfall fields. Not only do the resulting refined radar maps show how rain cells develop and move, they precisely reproduce local rain statistics and the corresponding distribution of extreme values.

The results show that the AI model and methodology

developed by the researchers will enable the future use of neural networks to improve the spatial and temporal resolution of precipitation calculated by climate models. This will allow a more precise description and analysis of precipitation effects and trends in a changing climate. ■

More information:

Original publication on extrasystoles:

<https://doi.org/10.1016/j.artmed.2023.102619>

Computational Cardiac Modeling Group at KIT:

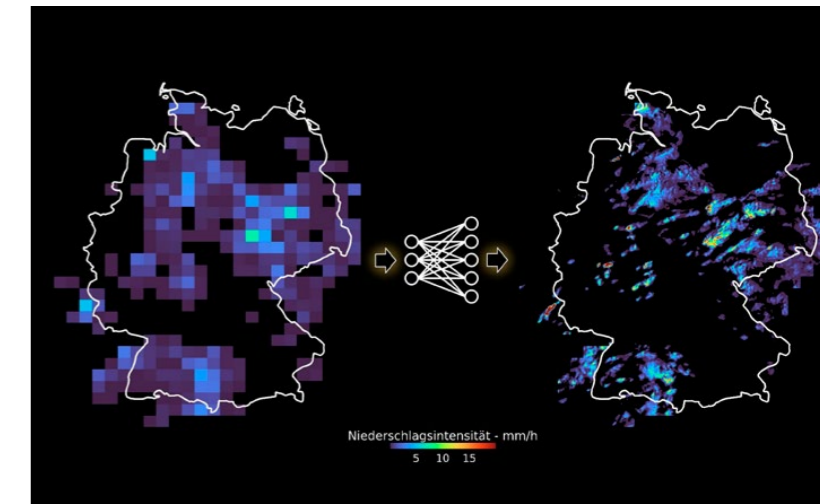
<https://www.ibt.kit.edu/english/camo.php>

SDaC project:

<https://sdac.tech/en/>

Original publication on precipitation maps:

<https://doi.org/10.1029/2023EA002906>



To improve local precipitation forecasts, KIT researchers used AI to make high-resolution radar videos out of coarsely resolved maps. [53]



## CLIMATE AND ENVIRONMENT

## Stopping the Destruction of Natural Habitats



Ecosystems with a variety of species and functions can do much to mitigate the impact of climate change. [54]

The climate crisis caused by humans has consequences for our entire planet. The sea level is rising, extreme weather events occur more often, and the oceans are becoming increasingly acidic.

At the same time, the combination of climate change and the intensive exploitation and destruction of natural ecosystems has triggered a progressive loss of animal and plant species worldwide. But the climate and biodiversity crises are often treated as separate catastrophes.

An international team of researchers, with participation by KIT, has published a review study in the journal *Science* documenting the urgency of making massive reductions in greenhouse gas emissions, staying as close as possible to the 1.5-degree target, and placing at least 30 percent of land, freshwater, and ocean areas under protection. It is imperative that climate action and wildlife conservation be considered together, because measures that focus only on climate protection could well have a negative impact on biodiversity.

For example, human activities have significantly changed about 75 percent of Earth's land surface and 66 percent of its ocean areas. Habitat destruction and overexploita-

tion have put more species at the risk of extinction than at any time in human history, a situation further exacerbated by climate change. Warming and habitat destruction also reduce carbon storage capacity, which in turn intensifies the climate crisis. To counter these developments, a package of measures is needed, including emissions reductions, restoration and conservation measures, smart land management, and government agencies with cross-institutional authority.

Substantially restoring just 15 percent of the areas converted to farmland would be enough to prevent 60 percent of the expected extinctions. In addition, this could result in the long-term removal of up to 300 gigatons of carbon dioxide from the atmosphere, an amount corresponding to 12 percent of the carbon dioxide emitted since the beginning of the industrial era.

The study concludes that to achieve the global biodiversity, climate, and sustainability goals planned for 2030 and 2050, climate protection, the preservation of biodiversity, and social benefits for local populations must be considered together in all measures. The study is the result of a workshop held by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and the Intergovernmental Panel on Climate Change (IPCC). ■

*More information:*

*Original publication:*

<https://doi.org/10.1126/science.abl4881>

*KIT Climate and Environment Center:*

<https://www.klima-umwelt.kit.edu/english/index.php>

*Climate and biodiversity researchers make the case for a holistic view of the climate crisis and extinctions (podcast, in German):*

[https://media.bibliothek.kit.edu/world/2023/DIVA-2023-161\\_mp3.mp3](https://media.bibliothek.kit.edu/world/2023/DIVA-2023-161_mp3.mp3)

## ATMOSPHERIC RESEARCH

## KIT Planning Climate Research from Space

The European Space Agency (ESA) plans to launch the Earth Explorer 11 satellite in the early 2030s. From Earth orbit, it is expected to help address urgent environmental problems by gaining a deeper understanding of the dynamic processes at work on Earth.

In November 2023, the ESA chose CAIRT, a mission proposal coordinated by KIT, as one of the two remaining candidates for the mission. The final decision will be made in 2025.

At the heart of CAIRT (Changing-Atmosphere InfraRed Tomography) is an imaging infrared spectrometer to measure a large number of trace gases, aerosols, and atmospheric waves with unprecedented spatial resolution. CAIRT will regularly measure the atmosphere at altitudes from 5 to 115 kilometers in the infrared with a horizontal resolution of around 50 by 50 kilometers and a vertical resolution of 1 kilometer. This makes CAIRT a kind of space tomograph that measures Earth's atmosphere continuously.

The planned mission builds on many years of experience in atmospheric remote sensing at KIT. KIT researchers have carried out pioneering remote sensing work in recent years, using high-altitude research balloons and airplanes to carry instruments. In cooperation with Forschungszen-

trum Jülich, KIT scientists developed GLORIA, an instrument that can be thought of as a kind of prototype for CAIRT. GLORIA has made a number of scientific observations, including new findings on the transport of aerosols after extensive forest fires in Canada during the PHILEAS measurement campaign with the HALO research aircraft, and also on high-altitude balloons.

KIT coordinated the proposal for the CAIRT mission's satellite concept. The scientific objectives are being defined and elaborated by an international panel of closely cooperating experts from KIT and Forschungszentrum Jülich, the European Centre for Medium-Range Weather Forecasts (UK), the Institute of Applied Physics "Nello Carrara" (Italy), the Institute of Astrophysics of Andalusia (Spain), the National Center for Scientific Research (France), the Royal Belgian Institute of Space Aeronomy, the University of Leeds and the University of Oxford (UK), the University of Oulu and the Finnish Meteorological Institute (Finland), and the University of Toronto (Canada). ■

*More information:*

*ESA press release:*

[https://www.esa.int/Applications/Observing\\_the\\_Earth/FutureEO/Cairt\\_and\\_Wivern\\_Earth\\_Explorer\\_candidates\\_go\\_forward](https://www.esa.int/Applications/Observing_the_Earth/FutureEO/Cairt_and_Wivern_Earth_Explorer_candidates_go_forward)

*CAIRT website:* <https://www.cairt.eu/de>

Earth's atmosphere over Timmins, Canada, in August 2022, photographed by the GLORIA scientific instrument from a high-altitude research balloon. [55]





## CATALYSIS

## New Ammonia Reaction Could Be Sustainable Nitrogen Source

One of the world's most widely produced chemicals, the ammonia molecule ( $\text{NH}_3$ ), is used for the production of many other compounds containing nitrogen. If amines could be easily produced by the addition of ammonia to unsaturated hydrocarbons, it would be a major breakthrough in chemistry. Amines, organic derivatives of ammonia, are in demand for various applications, e.g. as building blocks for agricultural and pharmaceutical chemicals and for detergents, dyes, and coatings. They are also used as catalysts in the production of polyurethanes, and another important application is the gas scrubbers used in refineries and power plants.

If the strong bond between nitrogen and hydrogen is broken (a process called activation), the ammonia molecule can at least theoretically be transferred to other molecules such as alkene ethylene or other unsaturated hydrocarbons, a process chemists call hydroamination. However, ammonia and ethylene do not react with each other easily. A catalyst is needed, but conventional catalysts based on transition metals have the disadvantage that they react with ammonia themselves and become inactive.

The hydroamination of non-activated alkenes with ammonia is thus considered a major challenge. In cooperation with researchers from Paderborn University and Complutense University of Madrid, KIT researchers developed a system for the activation and catalyzed transfer of ammonia that is based not on transition metals but on a compound of main-group elements. The activation and

subsequent transfer of ammonia does not result in any waste, which is of particular interest in terms of sustainability.

A so-called frustrated Lewis pair (FLP) results, consisting of an acid as an electron pair acceptor and a base as an electron pair donor. The two usually react, resulting in an adduct. If adduct formation is prevented or at least limited, a frustrated situation results and the molecule reacts readily with small molecules such as ammonia.

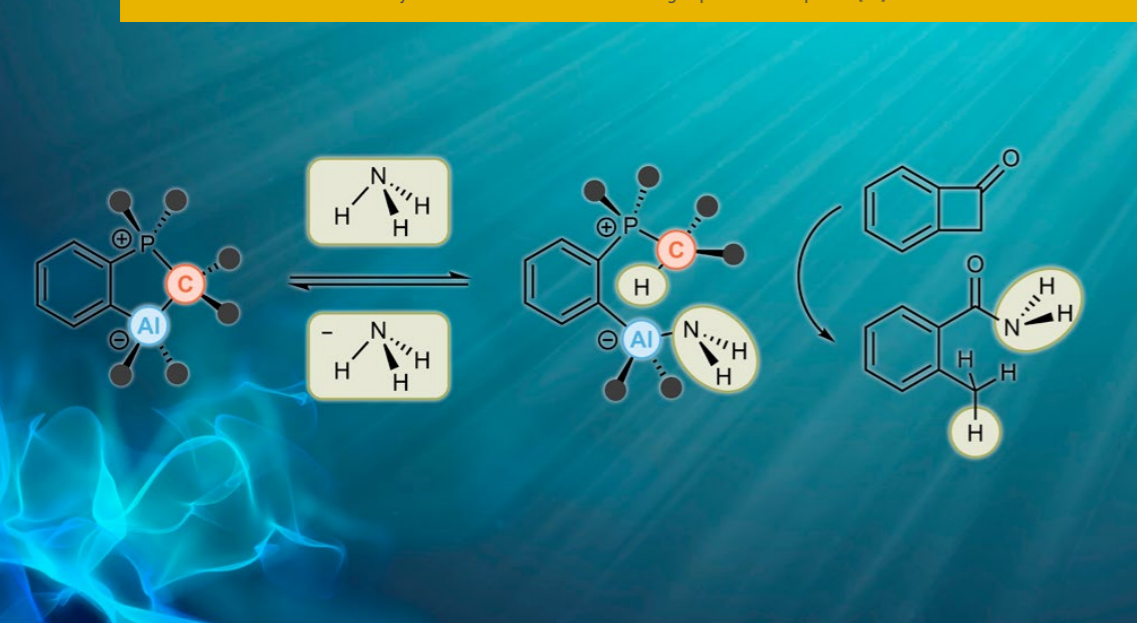
What is crucial here is to suppress the reactivity so that the reaction with small molecules is reversible; only then is it possible to use such an FLP for catalysis. Now this has been achieved for the first time, with ammonia as a substrate. The researchers showed that the FLP reacts easily and thermoneutrally with non-aqueous ammonia and the nitrogen-hydrogen bond of ammonia splits reversibly at room temperature. ■

*More information:*

*Original publication:*

<https://doi.org/10.1038/s41557-023-01340-9>

The reversible activation and catalytic transfer of ammonia with a main-group element compound. [56]



## CLIMATE AND ENVIRONMENT

## Grapevines: From Origin and Spread to Resilience

Grapevines, one of the oldest cultivated plants, and wine, one of the first globally traded goods, are the subject of two genome research projects at KIT. One international genome project is investigating the origin of grapevines and the other concerns how the plants can adapt to increasing soil salinity caused by climate change.

### Genome Research: Origin and Evolution of Grapevines

Where did the grapevine come from, and how did it spread? These questions have long been a matter of dispute. At the end of the Ice Age, the grapevine originated from a wild European variety, of which a relict population can be found on the Ketsch peninsula on the Rhine river between Karlsruhe and Mannheim. In a large-scale genome research project initiated by KIT, researchers from the Chinese Yunnan Agricultural University determined the grapevine's origin and its evolution from the wild vine to today's cultivar by analyzing thousands of grapevine genomes collected along the Silk Road from China to Western Europe. KIT's collection of wild vines, which is unique worldwide, played an important role in the project.

A network of researchers from 16 countries supplied the DNA from more than 3,500 vines, including over 1,000 wild varieties. Now the origin of viticulture can be dated to earlier than 11,000 B.C. in the South Caucasus region. Human migration left traces on vine genomes; medieval vines from southwest Germany, for example, have genes from Azerbaijani and Central Asian vines. In an "Interreg Oberrhein" project called KliWiReSSe, climate resilience genes from wild vines are being crossed into currently cultivated vines to make them more resistant to the effects of climate change.

### Soil Salinity: Wild Grapevines Defend Themselves

The combination of artificial irrigation and sea level rise due to climate change is causing soil salinity to increase. This has a negative impact on viticulture as plants die and yields decline. KIT researchers studied "Tebaba," a salt-tolerant wild grapevine from the Atlas Mountains, to find ways of making cultivated varieties more resilient. Their



Autumn leaves of a grapevine that thrives in salty soil. KIT researchers studied how it is able to do so. [57]

objective was to identify the genetic factors that make grapevines resilient so that they can be introduced into commercial varieties to safeguard cultivation and ensure that the fruit plant with the highest yield per area worldwide can be adapted to the effects of climate change.

To gain insights into processes like photosynthesis in Tebaba, researchers compared it with a rootstock widely used in the Mediterranean. Though it absorbs salt from the soil and the salt reaches its leaves, Tebaba grows without producing harmful substances. It is now assumed that its salt tolerance cannot be attributed to a single genetic factor but results from favorable and mutually supportive metabolic fluxes. The wild grapevine can use more of its resources for photosynthesis and prevent the cell walls from collapsing. ■

*More information:*

*Original publication on the origin and evolution of grapevines:*

<https://doi.org/10.1126/science.add8655>

*Video on the origin and evolution of grapevines:*

*Original publication on wild grapevines defending themselves:*

<https://doi.org/10.1093/plphys/kiad304>



## MATERIALS

## Time Crystals Give Light a Boost

In the broadest sense, time crystals belong to the so-called metamaterials, which are artificially produced and exhibit properties that do not occur in nature. The fascinating concept of time crystals was first introduced in 2012 by Professor Frank Wilczek, a Nobel Prize-winning physicist. Unlike ordinary crystals, time crystals have properties that are uniform in space but vary periodically in time.

Research on photonic time crystals has so far focused on bulk materials, i.e. three-dimensional structures. Implementing photonic time crystals in bulk materials has proven to be enormously challenging; experiments have not yet gone beyond model systems with no practical applications.

Researchers from the Institute of Nanotechnology and the Institute for Theoretical Solid-State Physics at KIT, working with partners from Aalto University in Finland and Stanford University in the United States, developed a new approach. The team created the first two-dimensional photonic time crystal ever, which is actually an extremely thin layer of such a metamaterial with periodically embedded tunable components to dynamically

repeat its electromagnetic properties in time. Using such a structure, they experimentally verified the theoretical predictions about its behavior. This discovery enabled the first strong wave amplification in photonic time crystals.

This breakthrough will enable significant advances in various technologies, such as wireless communication, integrated circuits, and lasers. Amplifying electromagnetic waves will make it possible to build more powerful and efficient wireless transmitters and receivers in the future.

Another important application emerges from the finding that two-dimensional photonic time crystals amplify not only the incident electromagnetic waves in free space but also surface waves, which are used for communication between electronic components in integrated circuits. When surface waves propagate, they suffer absorption losses in the material, resulting in reduced signal strength. ■

*More information:*

*Original publication:*

<https://www.science.org/doi/10.1126/sciadv.adg7541>



## MATERIALS

## Using Enzymes in a New Class of Materials for Biocatalytic Processes

Industrial biocatalysis with enzymes is considered a “game changer” in the development of a sustainable chemical industry. Enzymes can be used to synthesize an impressive range of complex molecules such as pharmaceutical active ingredients and specialty chemicals under environmentally friendly conditions. Researchers are working hard on new process technologies to advance industrial biocatalysis. In biocatalysis, reactions are accelerated with enzymes instead of chemical catalysts, conserving resources and using less energy.

Researchers at KIT have developed a new class of materials by producing enzyme foams with extremely high stability and activity. Their aim now is the continuous production of large quantities of enzyme biocatalysts under conditions that are as gentle as possible. To achieve efficient material conversions, the enzymes are immobilized in microstructured flow reactors. They are spatially fixed and bound to an inert material, limiting their mobility and resulting in a higher concentration of enzymes and higher productivity.

Foaming normally changes the enzyme structure, leading to a loss of biocatalytic activity. In contrast, the new protein foams have tremendous stability and activity. Two dehydrogenase enzymes are mixed to produce the protein foams. In a microfluidic chip, they are then subjected to a stream of gas, resulting in the controlled formation of microscopic gas bubbles of uniform size. The foam with its uniformly sized bubbles is applied directly onto plastic chips and dried, with the proteins polymerizing and forming a stable hexagonal lattice.

The result is monodisperse all-enzyme foams, three-dimensional porous networks exclusively consisting of biocatalytically active proteins. The new foam-based materials have a far larger surface area on which the desired reaction can take place, and they exhibit strikingly high durability, mechanical stability, and

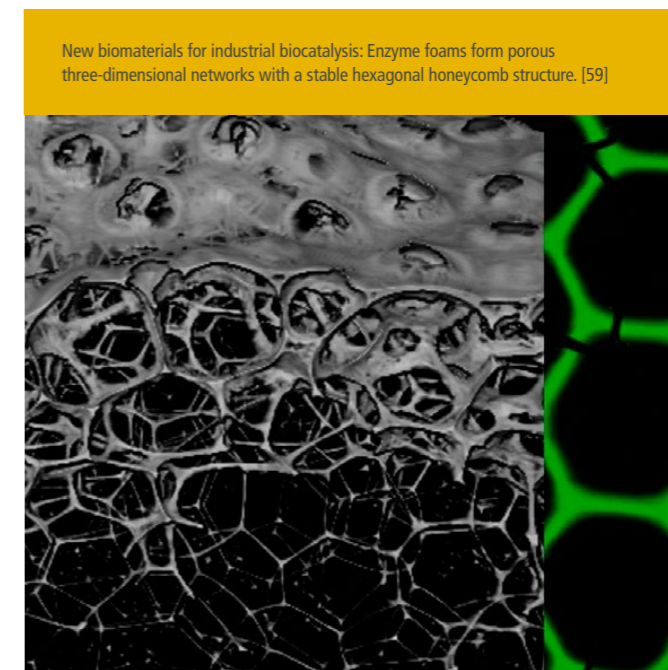
enzyme catalytic activity, characteristics that had not previously been achieved in foaming proteins. The researchers assume that the foam’s stability results from its covalently linked enzymes.

After drying for four weeks, the new enzyme foams are much more stable than the same enzymes without foam, which is of particular interest for the commercialization of the process. The new biomaterials open up many opportunities for innovation in industrial bioengineering, materials sciences, and food technology. The researchers demonstrated that the foams can be used to produce tagatose, an industrially valuable sugar and a promising alternative to refined sugar as a sweetener. A patent application has been submitted for the innovative production method for the enzyme foams. ■

*More information:*

*Original publication:*

<https://doi.org/10.1002/adma.202303952>





## NANOMATERIALS

**3D-printed Glass without Sintering**

The ability to print micro- and nanometer-scale quartz glass structures with pure silicon dioxide will enable many new optics, photonics, and semiconductor applications. To date, such processes have been based on conventional sintering. The temperature required for sintering silicon dioxide nanoparticles is above 1,100 degrees Celsius, far too high for direct deposition onto semiconductor chips. A research team from KIT's Institute of Nanotechnology, working with colleagues from the University of California Irvine and Edwards Lifesciences (a medical technology company based in Irvine, California), developed a new process to produce transparent quartz glass with excellent spatial resolution and outstanding mechanical properties at much lower temperatures.

They developed a hybrid organic-inorganic polymer resin to use as a feedstock material for the process. This liquid resin consists of so-called polyhedral oligomeric silsesquioxane (POSS) molecules, which are small cage-like silicon dioxide molecules featuring organic functional groups. After the material is cross-linked via 3D printing to form a complete nanostructure, it is heated in air to 650 degrees Celsius, driving out the organic components and fusing the inorganic POSS cages to form a continuous quartz glass micro- or nanostructure. The temperature required for this process is only half the temperature needed for processes based on nanoparticle sintering.

The lower temperature enables free-form printing of robust, optical-grade glass structures directly onto semiconductor chips at the resolution needed for visible-light nanophotonics. In addition to its excellent optical quality, the quartz glass produced with this method has excellent mechanical properties and can be worked easily.

The process enables structures that remain stable even under harsh chemical or thermal conditions. The team from Karlsruhe and Irvine used the POSS resin to print many different nanometer-scale structures including photonic crystals of free-standing 97 nm beams, parabolic microlenses, and a multi-lens micro-objective with nanostructured elements. ■

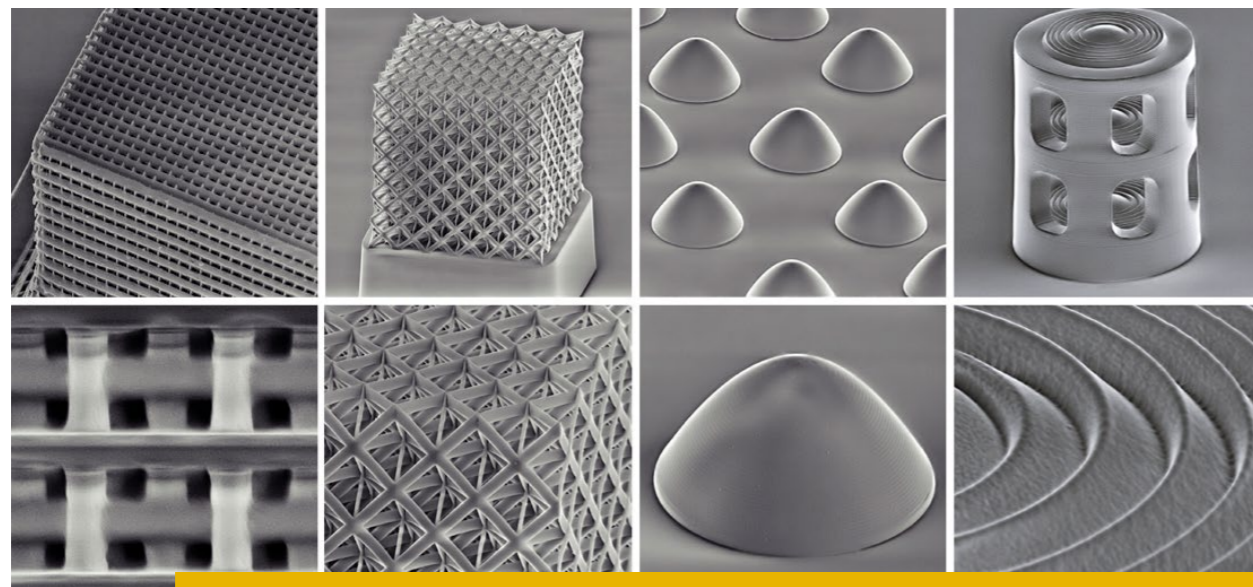
*More information:*

*Original publication:*

<https://www.science.org/doi/10.1126/science.abq3037>

*Information about the 3DMM2O Cluster of Excellence:*

<https://www.3dmm2o.de>



A wide variety of nanometer-scale quartz glass structures can be produced with the new process. [60]

## MATERIALS

**Nanorings: New Building Blocks for Chemistry**

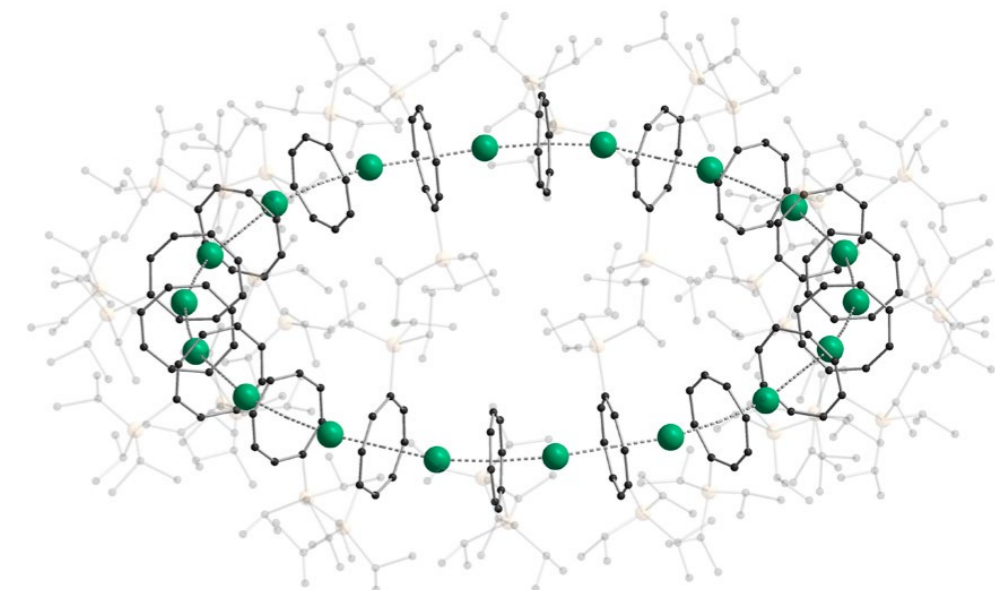
Sandwich complexes are special chemical compounds used as basic building blocks in organometallic chemistry. Sandwich complexes were developed about 70 years ago and, as their name suggests, have a sandwich-like molecular structure in which two flat aromatic organic rings (the "bread") enclose a single central metal atom (the "filling"). And like the slices of bread in a sandwich, the two rings are parallel. Adding further layers of "bread" and "filling" produces triple-decker and multi-decker sandwiches.

One such molecule is ferrocene, a particularly stable molecule whose "fathers" Ernst Otto Fischer and Geoffrey Wilkinson were awarded the Nobel Prize in chemistry in 1973. Ferrocene is comprised of an iron ion and two five-membered aromatic organic rings and is used in synthesis, catalysis, electrochemistry, and polymer chemistry.

These compounds are among the most important complexes used in modern organometallic chemistry; to date their structure had always been linear. Researchers from KIT and the University of Marburg tried for some time to arrange sandwich complexes in a ring. They were able to produce chains, but not rings. Finally, the scientists produced the first stacked sandwich complexes to form a nanometer-scale ring, achieving a world premiere with their choice of the right organic "bread."

Their new nanoring consists of 18 building blocks and has an outer diameter of 3.8 nanometers. Depending on the metal used as the sandwich "filling," an orange-colored photoluminescence results. The new compound has been dubbed "cyclocene" by the researchers.

With elaborate quantum chemical calculations, the researchers were able to find out why the molecules could be arranged in a ring instead of forming a chain of sand-



Cyclocene is the new molecule in which the first nanometer-scale ring was formed from sandwich complexes. [61]

wich complexes. The calculations revealed that the driving force for the ring's formation is the energy gained when the ring closes. The new nanoring adds a new item to the organometallic chemistry toolbox. The physical and other properties of these cyclocene structures will be the subject of further investigations. ■

*More information:*

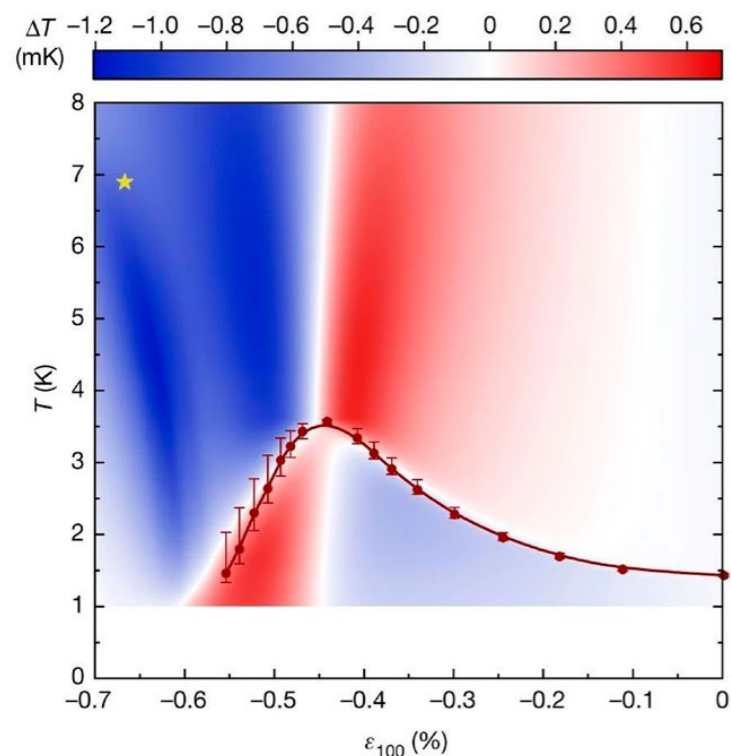
*Original publication:*

<https://doi.org/10.1038/s41586-023-06192-4>



## QUANTUM MATERIALS

## Superconductor Performs Best under Pressure



This diagram shows how the transition temperature (the temperature below which superconductivity sets in) rises in strontium ruthenate. [62]

Superconductors are materials that have no electrical resistance at temperatures below a certain threshold, the so-called transition temperature. This makes them very interesting for various energy conversion and distribution applications. In the case of strontium ruthenate ( $\text{Sr}_2\text{RuO}_4$ ), scientists have not yet understood how it becomes superconductive. Conventional theory does not apply to strontium ruthenate, but researchers from KIT and the Max Planck Institute for Chemical Physics of Solids (MPI CPFS) in Dresden were able to gain new insights by applying quantum mechanics, which can be used not only to describe the properties of single atoms and molecules but also to explain the collective properties of multi-particle systems.

In a 2022 paper in the journal *Nature*, the researchers demonstrated that mechanical pressure in a certain direction increases the transition temperature of strontium ruthenate considerably, and that the excitation behavior of its electrons changes as a result. Working with international partners, the researchers from Karlsruhe and

Dresden have now found that this pressure that strongly increases superconductivity makes the material much softer and facilitates its deformation. The researchers attributed this to a quantum mechanical resonance of electron oscillations.

About 60 years ago, the Soviet physicist Ilya M. Lifshitz predicted this mechanical softening phenomenon, which is now called the Lifshitz transition. However, the effect described here is over a thousand times greater and can be clearly associated with enhanced superconductivity.

The interaction of elastic and electronic properties is also the focus of the ELASTO-Q-MAT project funded by the German Research Foundation, in which MPI CPFS and KIT are playing a major role. For the paper published in *Science*, KIT researchers developed a model of the effect, in which a few current-carrying electrons dominate all the others and can soften the material considerably. The relevant measurements were made at MPI CPFS in Dresden. The paper offers a new perspective and opens up the possibility of manipulating strong quantum fluctuations in the lab and optimizing materials for a given physical effect. ■

*More information:*

*Original publication:*

<https://doi.org/10.1126/science.adf3348>

*ELASTO-Q-MAT Transregio project:*

<https://transregio288.org/>

## HEALTH TECHNOLOGIES

## New KIT Center of Health Technologies Launched

Not only is digitalization affecting life at home and at work, it is also changing the entire healthcare sector. Thanks to e-health, telemedicine, and wearables, the place where medical care is provided will increasingly shift from general practitioners and hospitals to patients in their homes. New and innovative digital technologies and infrastructure will be needed to accommodate this trend.

Making sustainable progress in medical technology to preserve patient health will require closer cooperation among patients, physicians, and researchers in the future. The KIT Center of Health Technologies (KITHealthTech) was established to support this transformation. Its mission is to develop digital and technological solutions for medical products with a focus on benefiting society and meeting its medical needs.

More than 150 KIT scientists from a wide range of disciplines, including medical engineering, additive manufacturing, robotics, life sciences, and data sciences work together at the center to accelerate research in this area. Their work will address the needs of both the public and the healthcare sector.

Constant change, such as developments in digitalization or robotics, offers many new opportunities for researchers at KIT to work across disciplinary boundaries and shape the future of healthcare. The wide range of expertise and activities at KIT provides a foundation for coordinated health technologies research.

In particular, the aim is to combine basic research in various fields with applications in health technologies and address the needs of an aging society while also offering new and modern research-based study programs.

To develop successful digital and technological solutions for future global challenges in the healthcare sector, the researchers are also cooperating closely with hospital networks, health insurance companies, and licensing authorities. They envision patients and the general public in the Karlsruhe region interacting directly with physicians, hospitals, and other healthcare sector stakeholders.



At the new KIT Center of Health Technologies, researchers aim to work with students and the public to further the progress of digitalization in healthcare. [63]

Researchers from nearly all of KIT's centers, divisions, and departments are contributing their interdisciplinary expertise in three main fields: Precision medical technology, holistic and personalized patient care, and digital health. Their work includes humanoid robotics, exoskeletons, accelerator technologies for radiation diagnostic systems, biomaterials, precision medicine for personalized therapy, cybersecurity for the protection of health data, and digital health. ■

*More information:*

<https://www.healthtech.kit.edu/>



## HUMANS AND TECHNOLOGY

## KIT to Advise Bundestag and European Parliament for Five More Years

At its meeting on June 21, 2023, the German Bundestag's Committee for Education, Research, and Technology Assessment unanimously decided to entrust KIT and its Institute for Technology Assessment and Systems Analysis (ITAS) with the continued operation of the Office of Technology Assessment (TAB) at the German Bundestag through 2028.

The TAB is an independent scientific institution that advises the Bundestag (Germany's parliament) and its committees in matters of scientific and technological change. It has been run by KIT's ITAS since 1990. With its analyses of new scientific and technological developments and their impact on society, the environment, and the economy, the TAB contributes to informed decision-making by political leaders and the formation of public opinion outside of parliament.

The current focus of the TAB's studies is on digitalization in society and the economy, critical infrastructures and crisis preparedness, applications of artificial intelligence, innovative energy carriers and environmental technologies, mobility and transport systems, and biological and medical technologies. It also studies focal points of innovation activity, the strengths and weaknesses of Germany as a location for research, and current challenges in research and science policy.

In May 2023, the European Parliament also resolved to continue relying on the expertise of the European Technology Assessment Group (ETAG) for consultation in scientific matters. The ETAG, a group of scientific institutions from Germany, the Netherlands, Austria, the Czech Republic, Denmark, Norway, and Portugal, is coordinated by the ITAS.

It advises the European Parliament's Panel for the Future of Science and Technology (STOA), which consists of 27 Members of the European Parliament. The ETAG has been providing the STOA with regular briefings and detailed analyses about new and emerging technologies since 2005.

In recent years, the ETAG has conducted a large number of analyses of the social, ecological, and economic aspects of new technological and scientific developments. Its studies recommending actions and regulations for dealing with AI-manipulated media content, so-called "deepfakes," and on the implementation of the European hydrogen strategy, have recently attracted particular attention. ■

*More information:*  
Office of Technology Assessment at the German Bundestag:

<https://www.tab-beim-bundestag.de/english/index.php>

European Technology Assessment Group (ETAG):

<https://www.itas.kit.edu/etag.php>

Panel for the Future of Science and Technology (STOA):

<https://www.europarl.europa.eu/stoalen/home/highlights>

The European Parliament will continue to rely on the expertise of the group of European technology assessment institutions headed by KIT. [64]



## ASTROPARTICLE PHYSICS

## Ghost Particles from the Milky Way

At the IceCube Neutrino Observatory in the Antarctic, researchers identified neutrinos from the Milky Way for the first time. KIT and several other German universities are involved in the IceCube Collaboration, which includes some 350 scientists from around the world. Using these neutrinos, they have created a new way of looking at the Milky Way.

IceCube has opened a window to neutrino astronomy. Along with electromagnetic radiation, cosmic rays (particles with mass), and gravitational waves, neutrinos give us an additional way to observe interesting objects in the Milky Way or in distant galaxies.

Neutrinos provide valuable insights into the high-energy particles that comprise cosmic rays. Though neutrinos can pass through matter virtually unhindered, they interact in rare cases with the detector's ice or its surroundings. Such interactions can result in the formation of charged elementary particles that cause flashes of light in the transparent ice. From those flashes, scientists can make inferences about the neutrinos' origins. The discovery of neutrinos from the Milky Way confirms predictions based on observations of cosmic rays and high-energy gamma rays.

The IceCube detector is composed of over 5,000 light-sensitive sensors embedded in a cubic kilometer of ice. The energy of the neutrinos detected by IceCube is up to a billion times greater than that of the neutrinos produced in the nuclear fusion reactions inside the Sun.

The IceCube Neutrino Observatory is at the Amundsen-Scott South Pole Station, a United States research station at an elevation of 2,835 meters. It was funded by the National Science Foundation. Scientific institutions from 14 countries are involved in the observatory,

including 10 universities and the DESY and KIT Helmholtz research centers from Germany. Germany's Federal Ministry of Education and Research and the German Research Foundation are supporting the IceCube detector's further development and the scientific analysis of its data.

The researchers plan to improve IceCube in several stages in the years ahead. First, an upgrade will improve measurements of cosmic rays and make IceCube sensitive to lower-energy neutrinos. IceCube-Gen2, a major expansion planned through 2035, will increase the observatory's volume to eight cubic kilometers. ■

*More information:*  
IceCube observatory:  
<https://licecube.wisc.edu/>  
IceCube group at KIT:  
<https://www.iap.kit.edu/icecube/index.php>



In the IceCube experiment, digital optical modules are lowered deep into the ice, where they measure high-energy neutrinos. [65]





## TEACHING

There were 22,816 students at KIT in the 2023/24 winter semester, about 2 percent more than in the previous year. Foreign students accounted for 21.1 percent of the student body and female students 29.7 percent, both slight increases.

About 6,450 students began their studies at KIT in 2023, a significant recovery from the low enrollment figures for first-semester students seen during the pandemic. Students at KIT can choose from among 44 bachelor's and 59 master's degree programs. New programs include the bachelor's and master's degree programs in digital economics.

The Leadership Talent Lab (LTL) at KIT's House of Competence (HoC) proved itself as a space for experimenting with good leadership at public events on various occasions. At its kickoff on May 9, 2023, there were interesting presentations and discussions for students and KIT employees about the theme of "Good leadership: Does it matter for students?!" Anselm Grün, a well-known Benedictine monk, gave a lecture about the importance of good leadership in the NTI lecture hall in November 2023. The LTL, which is funded by the Karl Schlecht Foundation, offers a wide range of courses every semester on all aspects of good leadership. It has been very popular among students, with 953 registering so far.

A new website, [studium.hoc.kit.edu](https://studium.hoc.kit.edu), has supplemented the existing [hoc.kit.edu](https://hoc.kit.edu) website since May 2023. The new website promotes the acquisition of interdisciplinary skills with its attractive design and GDPR-compliant spaces for KIT students. In the past year, the site reached 50,000 users who not only sought information about the HoC's course offerings, registered for courses or booked counseling sessions, but also looked into its extensive e-learning portfolio. Not only does the new website unite teaching, self-study, and collaboration, it is also the central source of information on live events and news at the HoC.





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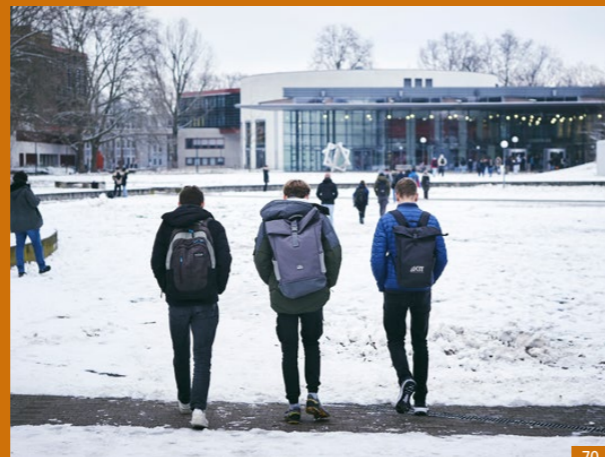
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## BEGINNING STUDIES AT KIT

**Starting a New Stage in Life**

About 6,450 new students, including those starting their master's programs, began their studies at KIT in 2023. This figure marked a significant increase over the previous year, which saw some 5,900 first-year students, and a recovery from the low enrollment figures for first-semester students seen during the pandemic.

KIT's study programs address key issues that are important for transformative and sustained progress in the sciences, industry, and civil society. Working closely with top researchers and innovators is what makes studying at KIT special. Students at KIT can choose from among 44 bachelor's and 59 master's degree programs. New additions for the 2023/24 winter semester are the bachelor's and master's degree programs in digital economics (see also page 49).

A variety of events was held to welcome first-semester students to KIT and help them get off to a successful start. The welcoming ceremony for first-semester students was held in the Audimax at KIT on October 27, 2023, and was also streamed live. After the ceremony, KIT institutions, university organizations and partners presented their offerings and answered questions at booths in the Audimax lobby.

Some 350 first-year students from KIT's Department of Mechanical Engineering were invited to the Europa-Park to start off the semester. [77]



KIT's International Students Office (IStO) greeted the foreign students in the Johann-Gottfried-Tulla lecture hall on October 20, 2023. In addition to presentations held in German and English, the IStO set up information booths and organized a contest in which participants explored the city and the campus.

To keep new students from becoming overwhelmed by questions such as how to organize their studies, where to get counseling, how to get involved in campus life, or what sports and cultural activities are available, a dossier entitled "Starting Your Studies at KIT" provides a clear and compact summary of the most important information.

Another way to ease the start at KIT is the orientation phases (O-phases) organized by student representatives of the departments before the beginning of the semester. KIT's departments also give first-year students an opportunity to familiarize themselves with their studies and get acquainted with their fellow students.

For example, some 350 first-semester students in the Department of Mechanical Engineering had a special day at the Europa-Park on October 23, 2023. For the 11th time, future engineers were invited by its owner, Dr. Roland Mack (a KIT alumnus), to have some fun on the first day of the new phase in their lives while also encountering examples of real-life applications of their future field of study. ■

*More information:*

*Starting Your Studies at KIT:*  
<https://www.sle.kit.edu/english/index.php>

## NEW COURSES OF STUDY

**Bachelor's and Master's Programs in Digital Economics**

KIT's Department of Economics and Management established two groundbreaking new courses of study in the 2023/24 winter semester: The bachelor's and master's programs in digital economics. The digital economics degree programs are among the first in Germany and worldwide to make digitalization their organizing theme and apply a methodologically sound and interdisciplinary approach to presenting it.

The subject matter of digital economics is at the intersection of economics, computer science, and the social sciences. From this interdisciplinary perspective, the new degree program examines the economical and social transformation processes associated with the spread of digitalization and analyzes their effects on competition policy and their macroeconomic and sociopolitical impact.

The bachelor's program in digital economics is taught in German but also includes compulsory and elective courses taught in English. It is a limited-admission program; 40 places were available for the 2023/24 winter semester. The program's length is three years. In addition to its namesake subject of digital economics, the curriculum includes economics, business administration, computer science, mathematics, statistics and econometrics, operations research, social sciences, and machine learning and artificial intelligence (in particular for analyzing large amounts of data).

The interdisciplinary master's program in digital economics builds on the academic qualifications earned in the bachelor's program with elective courses of the student's choice and the compulsory subjects of economics, methods, and society. The language of instruction for the master's program is English, but there are compulsory and elective courses taught in German. However, the Department of Economics and Management has long-term plans to change the master's program to English-only instruction and will be adding to its English-language offerings in the years ahead.

The program is intended to last four semesters. There were 20 places available for the 2023/24 winter semester.



New bachelor's and master's degree programs in digital economics were established at KIT in the 2023/24 winter semester. [78]

The bachelor's and master's programs in digital economics replace the corresponding "Technische Volkswirtschaftslehre" programs, which were discontinued in the 2023/24 winter semester. ■

*More information:*

*KIT Department of Economics and Management:*

<https://www.wiwi.kit.edu/english/index.php>

*Bachelor's program in digital economics:*

<https://www.sle.kit.edu/english/vorstudium/bachelor-digital-economics.php>

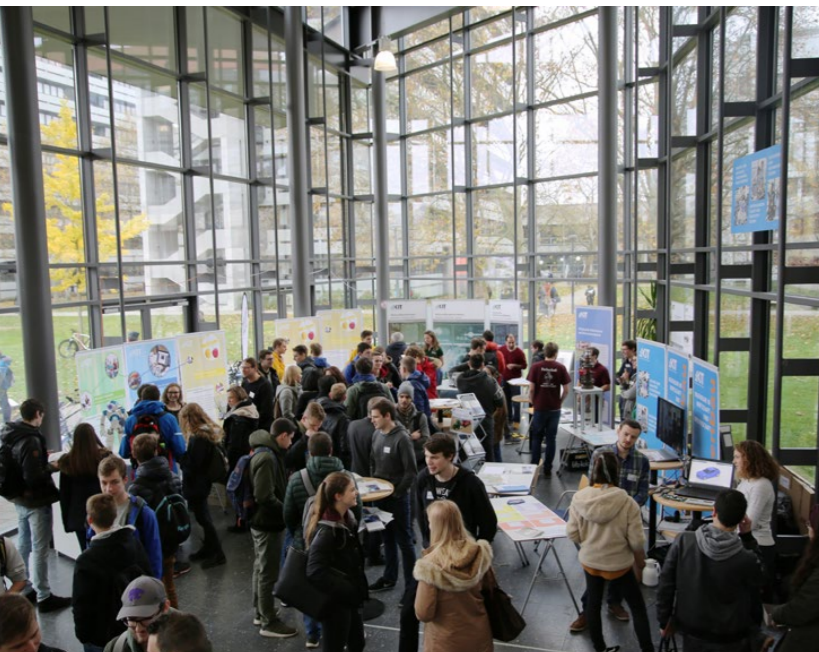
*Master's program in digital economics:*

<https://www.sle.kit.edu/english/vorstudium/master-digital-economics.php>



## ACADEMIC ADVISING

## Student Information Day and Networking



Student Information Day gives school pupils an opportunity to get acquainted with a university. [79]

For prospective students, current students, doctoral students, and teaching staff at KIT, the Studying and Teaching Business Unit is the point of contact for all academic questions. It had two main themes in 2023.

**Hybrid Student Information Day 2023**

On Student Information Day, school pupils in grade J1 (aged from about 16 to 18) from all over Baden-Württemberg have the day off from school to visit universities in person or online for the purpose of career guidance.

Student Information Day, which took place on November 22 in 2023, is a fixture in KIT's calendar of events. More than 170 in-person and hybrid events were held in the morning, followed by another 60 online events in the afternoon. The afternoon events were intended to enable participation by pupils from outside of Baden-Württemberg. This new event format proved a success, with some 3,000 young people taking part.

Throughout the day, students, teaching staff, and advisors answered questions at the events or online. Prospective students were able to get important information and form

impressions about course contents, application processes, study abroad, key skills, and other topics to help them choose a field of study.

**New Network for Academic Advisors**

Established at the initiative of KIT's Student Advisory Services in the spring of 2023, the Student Advisors Network sees itself as an open discussion forum for people involved in advising students on matters relating to the academic curriculum. It includes some 30 people from the KIT departments with their academic advisors and examination boards, the Career Service, the MINT-Kolleg, and International Affairs. In addition to bringing people into contact for networking, the network aims to intensify cooperation and synergy effects. Joint training sessions are another topic of discussion in the network.

Network meetings take place twice yearly, in April and October. In addition to discussions about issues of current interest, which can be raised by any participant, a best-practice example of a special event or collaboration is always presented.

Items on the agenda included a review of the previous year's application process with ideas about improving future communication with prospective students, studying with a family, a presentation on a quality project for improving the initial phase of study and reducing the number of students intending to drop out, and discussing how first-semester students can be better prepared for the first examination phase. ■

*More information:*

*Student Information Day (in German):*  
<https://studieninformationstag.sle.kit.edu/index.php>

## TEACHING TEACHERS

## Studying for Vocational and Secondary School Teaching Degrees

Teachers educate the next generation. Not only do they impart knowledge and skills, they arouse and nurture interests – from the arts, humanities and social sciences to natural sciences and technical fields. For those interested in teaching, several options exist for earning a teaching degree in Karlsruhe. At a joint event on November 9, 2023, KIT, the Karlsruhe University of Education, the Karlsruhe University of Music, and the Staatliche Akademie der Bildenden Künste Karlsruhe (state academy of fine arts) presented information about courses of study at KIT's Campus South.

The four universities offer a wide variety of teaching degrees covering the entire range of German schools, from elementary school to secondary and vocational school. At the event, prospective students had an opportunity to gain insights into the academic and professional aspects of teaching from presentations and personal accounts and to speak with current students, graduates, teaching interns, and professors from all of the participating universities.

KIT offers study programs in secondary school and vocational school teaching. The study program for a secondary school teaching degree is divided into two successive programs, the bachelor of education and the master of education in secondary school teaching. Earning a secondary school teaching degree requires candidates to successfully complete the bachelor's and master's degree programs. Successful completion of the master's program with the first state examination is followed by a teaching internship. This internship is not part of the study program at KIT; it is centrally organized by Baden-Württemberg's education authorities.

The engineering education study program at KIT is also divided into a bachelor's and a master's degree program, followed by an internship on successful completion. This program consists of classes in engineering sciences, pedagogy, and an elective minor field. Graduates then have a sound basis for working as teachers at any kind of vocational school.

The master's degree program in engineering education for engineers is intended for those who have completed



There are many ways to earn a teaching degree in Karlsruhe and in particular at KIT. [80]

a bachelor's program in engineering sciences and wish to pursue a teaching career at a vocational school. Those who successfully complete the program receive the master of education degree, which entitles them to enter an internship for vocational school teaching. ■

*More information:*

*Teaching degree programs at KIT (in German):*  
<https://www.hoc.kit.edu/zlb/1906.php>



## DIGITAL, APPLICATION-ORIENTED, AND INNOVATIVE

## Architecture Professor Moritz Dörstelmann Wins 2023 State Teaching Award



Moritz Dörstelmann won Baden-Württemberg's state teaching award in the innovation/transformation category. [81]

KIT's interdisciplinary and research-oriented teaching not only prepares students to use the tools they will need in their future work, it also fosters open-mindedness and curiosity while providing them with an in-depth scientific and application-oriented education. Their studies equip them to break new ground, develop creative and durable solutions, and actively shape transformation processes later in their careers.

The climate, resource, and energy crises pose major challenges. To meet them, we will need to transform a wide range of sectors, including the construction sector. Innovative ideas and motivated specialists are needed. With the students in his research-oriented courses, tenure-track professor Moritz Dörstelmann designs digital building processes that enable circular and resource-saving construction methods.

For his innovative approach, which combines digital design methods with application-oriented demonstration projects using innovative materials, Baden-Württemberg's

Ministry of Science, Research and the Arts awarded him its 2023 state teaching award worth EUR 50,000 in the innovation/transformation category.

Dörstelmann's practice-based teaching focuses on the question of how to enable circular construction. Working with his students from various disciplines, he creates digital models and then experiments with full-scale test constructions using natural materials like clay and willow to investigate the prefabrication of component prototypes. At this intersection of application-oriented research and industrial practice, Dörstelmann and his students investigate how combining digital design and production processes with natural materials can reduce resource consumption in the construction sector.

In his courses, Dörstelmann and his team teach more than the fundamentals of architectural geometry, spatial thinking, and modern digital tools such as 3D printing, laser cutting, and computer-assisted design; they also encourage self-study and lifelong learning, meaning their students not only master today's tools but are also flexible enough to adapt to and shape the constant progress in tools and technologies.

With the prize money, Dörstelmann plans to procure three small collaborative robots for use in the classroom to show his students the potential of robotic production methods. An innovation contest will also be held for interdisciplinary student teams to implement and present their ideas. ■

Video on 2023 KIT department teaching award (in German):

<https://www.youtube.com/watch?v=u5-55gXFIDk>

## REFRESHINGLY GREEN

## Student Team Wins ECOTROPHELIA Contest with "Weedy" Beverage

Competing against 12 other teams, a team of chemical engineering, bioengineering, and food chemistry students from KIT won the ECOTROPHELIA Europe contest, claiming the EUR 4,000 first prize with a refreshing, green, and fermented beverage called ABNOBA, which is made from stinging nettles and ground elder, two easily cultivated local herbs.

With its unusual mixture of regional plants – often denounced as weeds today – ABNOBA won over the Europe-wide contest's jury with its combination of minimal ecological footprint and "very good taste."

The innovative drink was named after a Black Forest fertility goddess. The forest's closeness to Karlsruhe and KIT makes her an appropriate choice. The five winners are Richy Bergmann, Bianka Bohnacker, Jonathan Noll, Laurids Pernice, and Felix Tham, students in chemical engineering, bioengineering, and food chemistry.

The team's drink can be produced with little effort and is supplied in environmentally friendly reusable bottles. ABNOBA is not yet on sale, but there are plans to offer it in cafés, restaurants, and bars in Karlsruhe and the surrounding area.

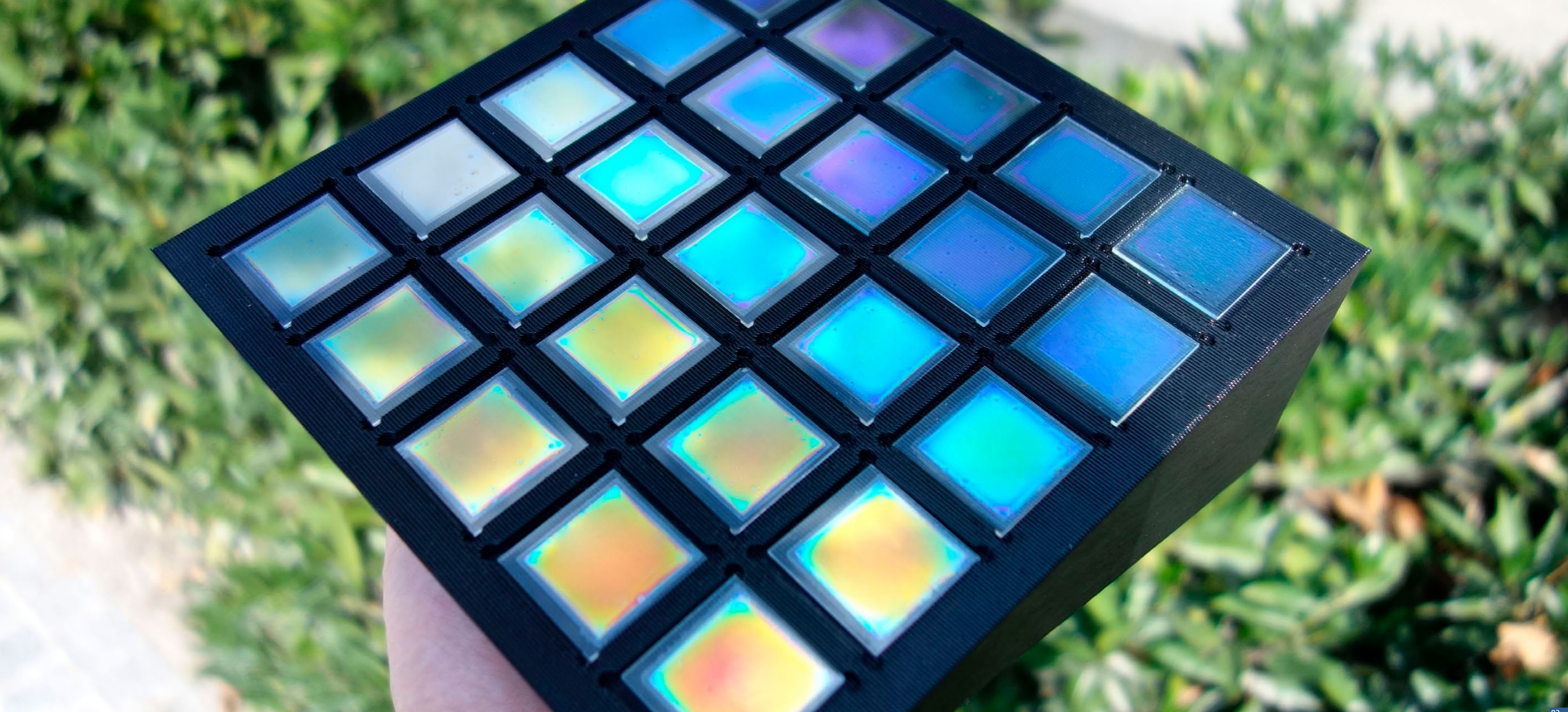
In the ECOTROPHELIA contest, which has taken place annually since 2008 and is organized by the food industry, teams of students from all over Europe compete to develop innovative and ecologically beneficial food products. The contest is intended for food science students and was held for the 14th time by the Forschungskreis der Ernährungsindustrie e.V. (FEI), the German food industry's central research organization.

At ANUGA, the world's largest food and beverage trade fair, 13 teams presented their ideas on October 8 and 9, 2023. The KIT team had previously taken first place at TROPHELIA Deutschland 2023, a preliminary contest for Germany that was also organized by the FEI. ■

ECOTROPHELIA contest winners. Left to right: Sebastian Höhne (supervisor), Jonathan Noll, Laurids Pernice, Felix Tham, Richy Bergmann, and Bianka Bohnacker, Dr. Ulrike van der Schaaf (supervisor). [82]







## INNOVATION

At the Hannover Messe from April 17 to 21, 2023, KIT showed exhibits and presentations at the two main booths in the Future Hub and Energy Solutions areas. KIT presented current mobility research projects at the Baden-Württemberg International stand and focused on AI in production at the Federal Ministry of Education and Research booth. And in the Startup Area, KIT was represented by ten spinoffs.

One of the highlights was optical filters and mirrors produced using inkjet printers. In many devices and systems such as telescopes, light barriers, cameras, laser measurement equipment, and smartphones, optical filters

ensure that light is reflected or transmitted depending on its wavelength.

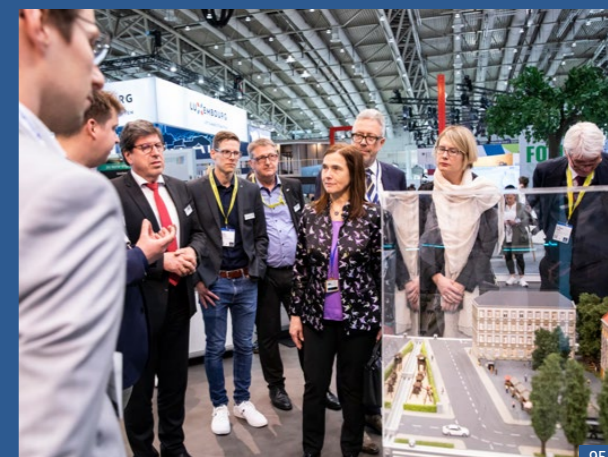
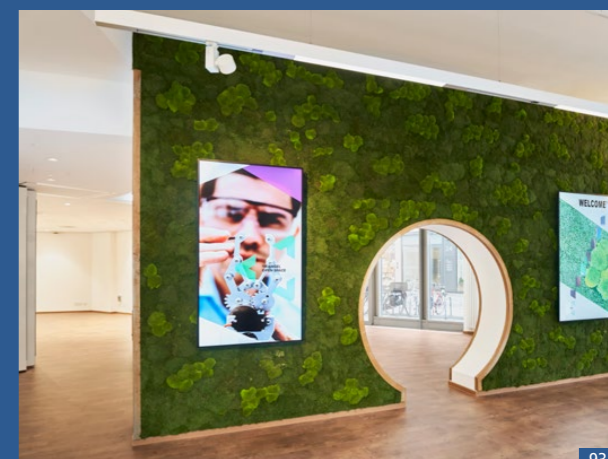
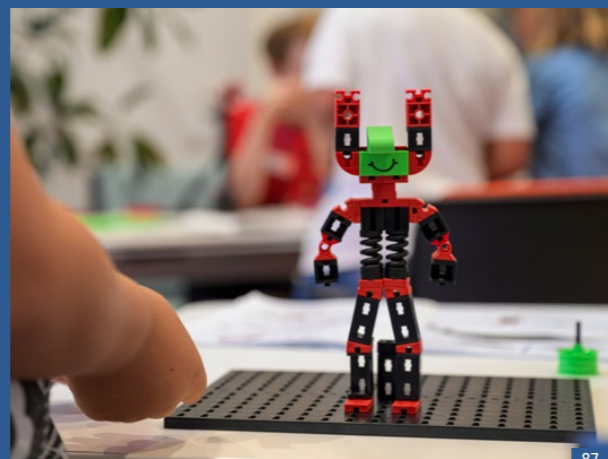
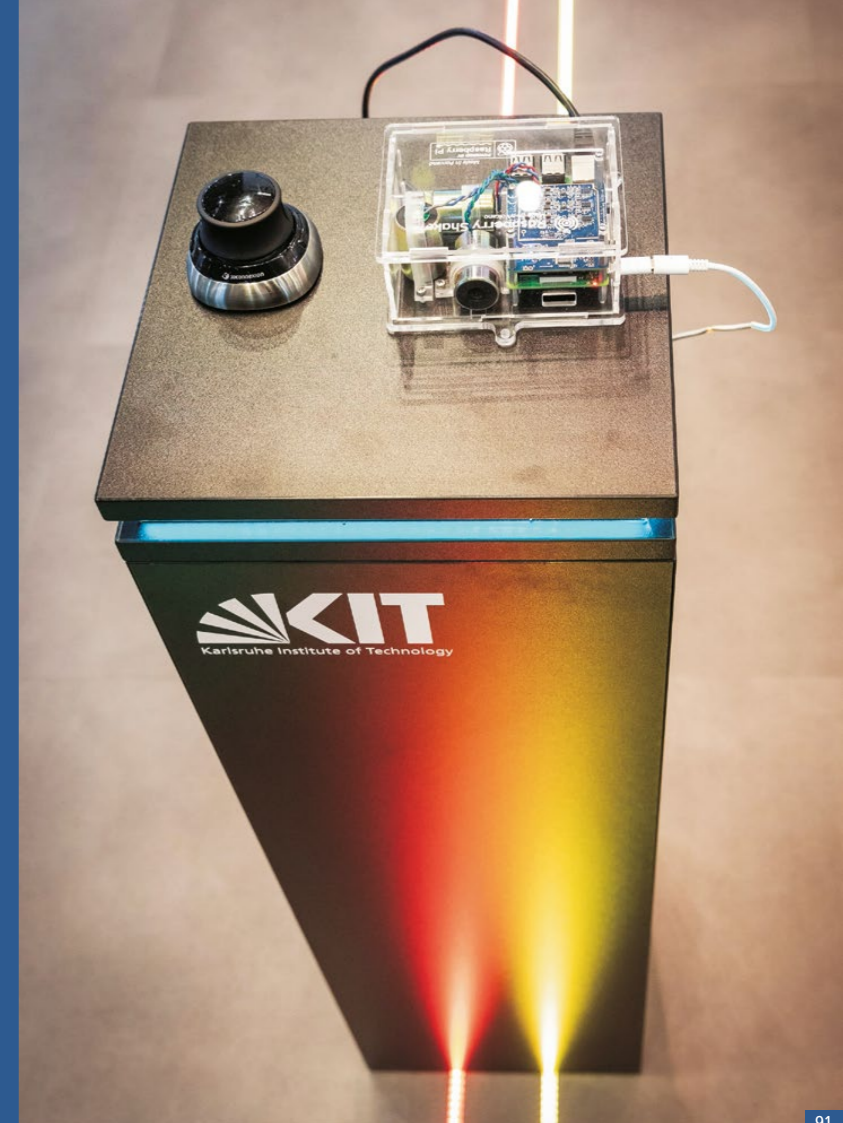
Optical filters consist of many nanometer-thin, superimposed layers made of two materials with different thicknesses and refractive indices. Conventional production methods rely on vapor deposition of the material over large areas at high temperatures in large plants, an energy-intensive process in which a lot of material is lost.

Researchers at KIT have developed new materials and a new process for the inexpensive and energy-efficient production of such filters with inkjet printers using two different inks specifically developed for the new process.

The researchers see high demand for the inkjet-produced filters in telescopes, medical applications, and the chemical industry.

The scientists use the innovative inkjet printing process not only to produce optical filters but also high-tech dielectric mirrors, so-called Bragg mirrors that are used in camera systems, microscopes, or sensor systems.







## KNOWLEDGE TRANSFER AND DIALOG WITH THE PUBLIC

### Knowledge Weeks at TRIANGEL: A New Showcase Format in Karlsruhe

With the TRIANGEL Transfer | Culture | Space venue at Kronenplatz square in Karlsruhe, KIT has opened a forum for promoting dialog with the public, building a bridge to academia, making the results of its research tangible, and facilitating the transfer of knowledge and technology. With the Knowledge Weeks, TRIANGEL has created a new format for presenting selected topics of importance at KIT over a period of several days. Three Knowledge Weeks were held in 2023; a further event was the Days of Democracy.

#### Architecture & Building Technology

Architecture has never been more strongly associated with the consumption of resources than it is today. The shift from an “anything goes” mentality to a much more prudent use of land and building materials is shaping the current discourse in architecture and building technology. The Knowledge Week dedicated to architecture and building technology featured traditional but forgotten construction methods as well as pioneering experimental methods. With lectures, panel discussions, an exhibition, and much more, KIT's Department of Architecture invited visitors to discover sustainable construction and look at it from a variety of perspectives.

#### Environment & Resources

Global warming, resource shortages, and safeguarding the natural basis of life will be the major challenges of the years ahead. The Knowledge Week dedicated to the environment and resources, held in cooperation with the

KIT Climate and Environment Center and featuring many contributions by the city of Karlsruhe, addressed the question of how our environment can be used in a safe, clean, and responsible manner. Topics included the condition of our forests, influences on urban climate, and the importance of the circular economy. Presentations on soil, water, subsoil, and air rounded out the agenda. In addition to lectures and panel discussions, there was a climate change exploration trail and performances by an environmental theater group.

#### Mobility

The Knowledge Week on mobility offered the public an opportunity to explore and discuss current teaching and research projects at KIT, the FZI Research Center for Information Technology, the Karlsruhe University of Applied Sciences, the Fraunhofer-Gesellschaft, and their project partners. In addition to technological developments such as automated and networked driving, the event also focused on future uses of public spaces and new ideas for mutually beneficial urban-rural relationships. Exhibits, prototypes, and short keynote talks provided insights into current questions relating to mobility, and the visitors became part of the research themselves via experiments on foot, by bicycle or using apps.

#### Days of Democracy

Democracy cannot be taken for granted. To keep it alive, we need to uphold democratic values, be involved and take a stand, but also be able to compromise and accept different opinions. In a partnership with KIT's Institute for Technology Assessment and Systems Analysis and the Law Forum Foundation, the Kronenplatz square became a meeting place with art, music, panel discussions, and other activities. An eclectic mix of activities awaited those taking part, including a contest in which participants explored Karlsruhe, a reading interspersed with acting, and discussions about both the pressing and the hopeful questions confronting our democracy. ■

An event in the new Knowledge Week format concerned resources and the environment. [96]



## SHAPING THE FUTURE TOGETHER: FIRST FOUNDATION DAY AT KIT

### KIT Foundation Provides Sustainable Support to Research, Teaching, Innovation, and Academic Life

Foundations provide important support for KIT's efforts to promote outstanding science, practice-based teaching, and effective knowledge transfer to industry and society. In this spirit, private citizens and companies joined together to establish the KIT Foundation. Its members make important contributions, such as procuring scientific and technical infrastructure, facilitating outstanding research projects and innovative teaching methods, supporting excellent young scientists, and awarding scholarships to students.

KIT thanked its partners for their commitment at the first Foundation Day in November 2023. The event was also an opportunity for other foundations to familiarize themselves with KIT. The event was a success from KIT's perspective, with 21 foundations accepting the invitation. In addition to interesting reports on various joint projects, the program included exciting excursions to research sites around the KIT campus and a series of short presentations on a variety of topics.

The KIT Foundation is transparent and efficient and is open to all interested citizens, foundations, and businesses. It provides innovative ways for new and old KIT supporters to express their private commitment to the sciences. The KIT Foundation pursues exclusively non-profit objectives and uses its funds only in accordance with its charter. It provides non-material support for KIT and its staff and students, and it provides funding for lead projects and the implementation of specific projects.

The KIT Foundation aims to enhance KIT's excellence in research, teaching, innovation, and academic life, and to help KIT position itself as one of the world's leading scientific institutions. Its activities include structural assistance such as establishing endowed professorships, and funding facilities, research projects, and innovative teaching projects at KIT. This also includes providing personal support for international guest researchers and students visiting KIT, and for students in special personal circumstances.

Other KIT Foundation activities include recognizing



achievement by awarding prizes, promoting the awareness of personal and entrepreneurial responsibility for research, teaching, and academic life, acquiring trust foundations and endowment funds, and attracting donors. ■



## KARLSRUHE: AN ATTRACTIVE LOCATION FOR STARTUPS

### For Startups, KIT Is One of the Leading Scientific Organizations in Germany

For many years, KIT has been one of Germany's leading scientific institutions for startups, but Karlsruhe is also becoming an attractive place to start a business. In a current study by the German Startup Association ranking cities by the number of startups per 100,000 inhabitants, Karlsruhe rose from 7th place in 2022 to 4th place in 2023 with 10 startups, after Berlin, Munich, and Darmstadt.

The wide range of services offered by the KIT-Gründerschmiede (Founders Forge) strengthens the local startup culture. More than 30 teams decide to start a company every year, and the trend is upward. Founded in 2013, the KIT-Gründerschmiede is now one of the largest university business incubators in Germany. It serves as an initial point of contact for people interested in founding technology-based companies and sees itself as a medium and an accelerator for innovative business ideas relating to key transitional fields like digitalization, artificial intelligence, biotechnology, mobility, and energy.

KIT is a magnet for potential founders, founders, and others from the general startup scene and is especially supportive of startup projects by KIT students, staff, and alumni, providing a wide range of offerings and services,

e.g. organizing public and private financial support or scaling up from an idea to a successful company. Bringing in selected network partners and investors for training, mentoring, and growth financing is another focus of the KIT-Gründerschmiede's work. In some cases, KIT will act as a shareholder in its technology-based spinoffs.

The institutes, professors, mentors, and coaches at KIT work together to promote an entrepreneurial spirit and culture, actively contributing to the success of the startups. Also providing assistance in this regard is PionierGarage e.V., a university organization for student entrepreneurs at KIT in which students from all disciplines can explore and get involved in founding businesses.

The Institute for Entrepreneurship, Technology Management, and Innovation teaches scientifically based knowledge about entrepreneurship at KIT and prepares students to put it to use in practice. In lectures and seminars, students are systematically trained to think and act as entrepreneurs so that they can turn technological and business opportunities into innovations. The lessons form the professional foundation for prospective founders. ■

The KIT-Gründerschmiede is one of the largest university business incubators in Germany. [98]



## KIT CAREER FAIR RELOADED

### Successful Restart for In-person Event with 190 Companies

Though its name was still the same, a completely revamped event awaited visitors to the 2023 KIT Career Fair. From noon into the evening over two days, they had the opportunity for informal, in-person talks with experts from a wide range of companies in a casual open-air atmosphere in front of the Audimax. The guests got first-hand information about career paths, entry-level opportunities, application processes, and available jobs.

Instead of a crowded trade fair hall filled with booths, the visitors could casually mingle and talk over food and drink or fun and games. Numerous companies and institutions from various sectors presented their job offers, internships, trainee positions, and much more. There were also presentations on technical topics, and KIT alumni spoke about their careers.

The unconventional new format with department pavilions, food trucks, game stations, and meeting places such as sofa talks was aimed at allowing more personal interaction and face-to-face contact after three years of virtual events. In spite of cool weather, many students found their way to the venue for many encounters and conversations.

Visitors could start their day at the fair by getting advice from the Career Service on how to polish their résumés and make contact with the companies there. They could listen to interesting lectures on a wide range of topics every hour on the open-air stage or join the sofa talks



The completely revamped KIT Career Fair was an ideal setting for relaxed conversation. [100]

that started every half hour at the pavilion for their discipline, where they could learn about the career paths of former KIT students.

Visitors could interact with the participating companies over tasty food or in human football matches in the sponsor lounges, and they could get an impression of everyday working life and corporate culture at various companies by watching company videos in the Audimax lobby. ■

The KIT Career Fair took place on May 16 and 17, 2023, on Campus South. [99]







## PROMOTING YOUNG TALENT

KIT supports its postdocs in their personal and professional development by providing an outstanding environment, offers tailored to specific target groups, and advice on scientific career paths and career prospects outside of academia.

The Karlsruhe House of Young Scientists (KHYS) promotes and supports young scientists at KIT in their various tasks in research, teaching, and management. The KHYS Postdoc Office is a central point of contact with a wide range of support offerings and numerous services relating to the postdoc phase. It is specifically intended for postdocs, potential postdocs, and their supervisors.

The KHYS Postdoc Office is funded by the Helmholtz Association's Initiative and Networking Fund. It has three main objectives:

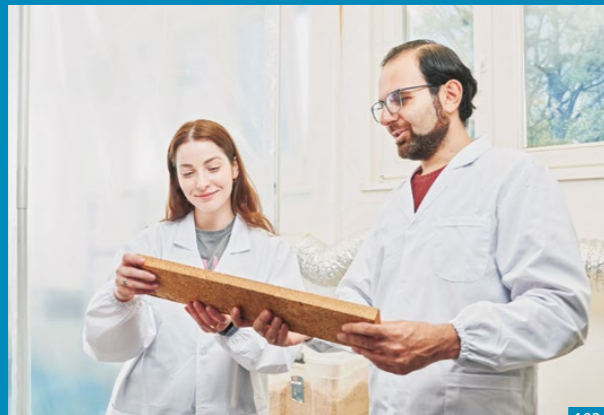
- Providing orientation for career development and career-related decisions
- Offering opportunities for career-related training
- Promoting independence and networking within and outside of academia

The fourth KHYS Postdoc Days took place in September 2023, with a focus on scientific and non-academic careers. For the first time, they were held during Postdoc Appreciation Week Germany. For five days, postdocs could attend

panel discussions, lectures, workshops, counseling sessions, KIT networking events, and the offerings of the other 65 cooperating scientific institutions. With 430 registrations at KIT alone (of which 141 were external), there was considerable interest in the event – also from outside the region.

At that time, the new KIT Postdoc Meeting format was also introduced: A networking event whose content and topics can be set by the KIT postdocs themselves. It will take place three times per year.





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## ENDOWING ROBOTS WITH HUMAN-LIKE CAPABILITIES

### Computer Scientist Noémie Jaquier Is an AI Newcomer of the Year

Dr. Noémie Jaquier's goal is to make robots usable for people outside the laboratory. Jaquier, from the Institute for Anthropomatics and Robotics (IAR), is one of ten newcomers recognized by the Federal Ministry of Education and Research and the Gesellschaft für Informatik e.V. for their research work and their outstanding dedication to the field of artificial intelligence (AI). She received the award as one of the talents in the technology and engineering category.

Jaquier sees robotics as one of the most challenging areas of artificial intelligence and at the same time as the area from which people and society can benefit most in the long term. She is a postdoctoral researcher in the Group for High-performance Humanoid Technologies headed by Professor Tamim Asfour at the IAR. In particular, she focuses on the acquisition of robotic skills through human demonstrations and on adaptation techniques using Riemannian geometry, which underlies Einstein's theory of relativity, as a cornerstone.

With her research, she aims to equip robots with human-like learning and adaptation abilities. To reach that goal, she draws on geometric information that is already present in robotics and uses it to develop data-efficient and theoretically sound learning algorithms. In that way she hopes to make robots usable for humans outside the laboratory.

AI newcomer Noémie Jaquier aims to equip robots with human-like learning and adaptation abilities at the IAR. [112]

Particular reasons why Jaquier received the award were the uniqueness of her field of research and her interdisciplinary methodology. In addition to the honor for her own research work, she also associates the award with a social message. She hopes to encourage other scientists to research topics that – in spite of their great importance – do not follow the major trends.

AI talents and renowned AI experts from all over the world meet at the AI Camp held by the Federal Ministry of Education and Research and the Gesellschaft für Informatik e.V. In panel discussions, lecture sessions, and hands-on formats, the cost-free research convention addresses future transdisciplinary issues relating to society, sustainability, health, art, and niche phenomena of AI research. The AI newcomers were chosen partly by public online voting and partly by a panel of experts. ■

More information:

<https://kicamp.org/en/>

More about KIT Center Information • Systems •

Technologies:

<https://www.kcist.kit.edu/>

## KIT JUNIOR RESEARCH GROUPS

### Launching Scientific Careers

Promoting young scientists is one of KIT's central tasks. Junior research groups have been specifically defined at KIT; their approval can be requested from KIT's Council for Research and Promotion of Young Scientists. Recognition as a KIT junior research group is documented by a certificate from the Executive Board.

The Emmy Noether junior research groups are a funding instrument of the German Research Foundation. Four KIT researchers received funding for their projects from this program:

- Dr. Maryna Meretska, Institute of Nanotechnology, for Real-time Holographic Video Display: Meta-SLM1
- Dr. Elia Fioravanti, Institute for Algebra and Geometry, for Coarse Medians as a Hyperbolicity Surrogate
- Dr. Sören Lehmkühl, Institute of Microstructure Technology, for The PHASER in Focus
- Professor Dr. Marvin Künnemann, Institute of Theoretical Informatics, for Structural Complexity Theory for Big Data: From Classification Theorems to Algorithm Engineering

Two KIT researchers, including a junior research group leader, received an ERC Starting Grant from the European Research Council:

- Tenure-track Professor Dr. Philip Willke, Physikalisches Institut, for the project ATOMQUANT: On-Surface Atomic Spins with Outstanding Quantum Coherence



Nine new junior research groups started at KIT in 2023. [113]

Three junior research groups at KIT are receiving support from the Carl Zeiss Foundation's CZS Nexus program (see page 68):

- Dr. Gözde Kabay, Institute of Functional Interfaces, for Rheology-enhanced Interdigitated Electrode Biosensor Decorated with Artificially Imprinted Polymer Receptors for Rapid Diagnosis of Acute Kidney Injury
- Dr. Jingyuan Xu, Institute of Microstructure Technology, for Toward Zero-electricity, Zero-carbon Refrigeration Using Advanced Elastocaloric Cooling
- Dr. Nadja Henke, Institute of Process Engineering in Life Sciences, for BIOSCALE – Establishing Biological Scale-Up Parameters for Scaling Biotechnological Processes

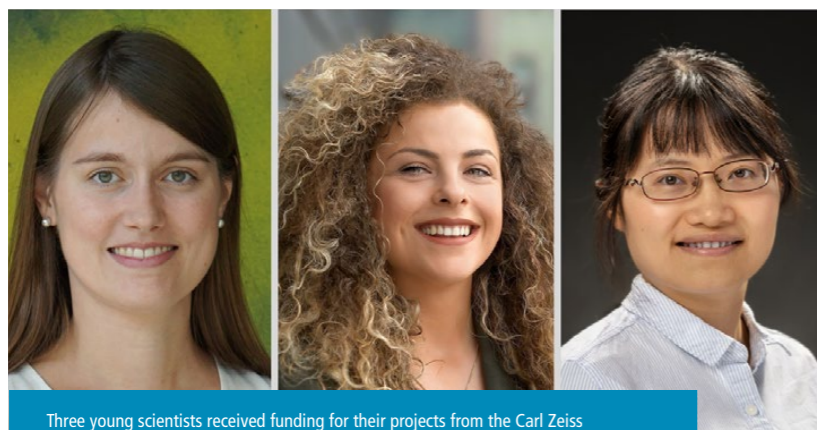
A further KIT junior research group is funded by the German Weather Service:

- Dr. Annika Oertel, Institute of Meteorology and Climate Research, for Increasing the Value of Campaign Observations through Data Assimilation to Improve Convective Forecasting Capability ■



## RESEARCH ON BIOPROCESSES, BIOSENSORS, AND REFRIGERATION

## Nadja Alina Henke, Gözde Kabay, and Jingyuan Xu Receive Funding from Carl Zeiss Foundation



Three young scientists received funding for their projects from the Carl Zeiss Foundation. Left to right: Nadja Alina Henke, Gözde Kabay, Jingyuan Xu. [114]

Three early-stage researchers from KIT, Dr. Nadja Alina Henke, Dr. Gözde Kabay, and Dr. Jingyuan Xu, will each receive EUR 1.5 million for their projects over a period of up to five years from the Carl Zeiss Foundation's CZS Nexus funding program. Their ambitious and interdisciplinary research projects in biotechnology, medical diagnostics, and energy technology have great potential and future relevance.

In her BIOSCALE project, Dr. Nadja Alina Henke of the Institute of Process Engineering in Life Sciences investigates how bioprocesses can be precisely transferred from laboratory scale to industrial scale. Biotechnology-based production processes for proteins or dyes provide crucial insights that can help us deal with major challenges facing society, such as climate change and the energy crisis. Approaches from the chemico-technical industry have mainly been used thus far for the transfer to industrial scale. However, bioprocesses are subject to the complex physiology of cells, which is characterized by gene regulation and biochemical interactions. Through systematic acquisition of transcriptome data, the project aims to better understand and scale bioprocesses.

In her IDEArt project, Dr. Gözde Kabay of the Institute of Functional Interfaces is developing portable, low-cost biosensors for rapid diagnosis of kidney damage. Acute kidney injury (AKI) is one of the most frequent syndromes with high morbidity and mortality. Kabay's design combines artificial receptor synthesis, screening for early-stage AKI-specific biomarkers, and highly sensitive

measurements with user-friendly data display and Wi-Fi data transfer. By enabling sensitive measurements of multiple early-stage AKI biomarkers, the process is cost-effective, precise, and accessible. The project will improve AKI diagnosis and facilitate the development of other biosensor types.

In her ELASTO COOL project, Dr. Jingyuan Xu, who heads a junior research group at KIT's Institute of Microstructure Technology, works

on elastocaloric refrigerators driven by heat. Refrigeration equipment is responsible for about 17 percent of global power consumption. Current units use climate-polluting gaseous coolants with a high global warming potential. Xu's new refrigeration processes are based on thermal changes in shape-memory alloys under mechanical load. Their solid coolant does not harm the climate and they use resources and energy very efficiently. The focus is on small-scale cooling, e.g. temperature control for electronic or bioanalytical chips.

The Carl Zeiss Foundation funds research and teaching in the STEM disciplines of mathematics, computer science, natural sciences, and engineering. Its CZS Nexus funding program aims to support outstanding early-stage researchers working to implement promising ideas at the interfaces of different STEM disciplines. The funding gives them the opportunity to establish their own interdisciplinary research groups and supports them in establishing their scientific careers. ■

## YIG PREP PRO

## Assistance with Junior Research Group Proposals

Attracting excellent young scientists and providing them with postdoctoral support are of great strategic importance to KIT.

The Young Investigator Group Preparation Program (YIG Prep Pro) was launched at KIT in 2019 during implementation of the federal and state Excellence Strategy's plan for the future. Its purpose is to recruit high-caliber postdocs, preferably with an international background, who are interested in establishing themselves at KIT and in setting up junior research groups.

The selection process has two stages.

In the first stage, candidates are selected based on their submitted proposal documents. In the second stage, the candidates present their projects to KIT's Council for Research and Promotion of Young Scientists. The selected postdocs are inducted into the program in a new position at KIT or can stay at their current institution. They receive support in the proposal process for a junior research group.

Personal support and supervision provided by YIG Prep Pro consists of four interlinked elements: Advice about the next career steps from a mentor, assistance (personalized advice and intensive feedback) in applying for a junior research group with third-party funding, a tailored support program including workshops and personal coaching, and the YIG Prep Pro support network.

KIT recruited seven outstanding young scientists in 2023 from Ukraine, Brazil, Bulgaria, the United Kingdom, Austria, and Germany. New positions were established at KIT for five of them; the other two will receive remote assistance with the proposal process at their home institutions.

There have been 338 applicants from 61 countries since the program's inception in 2019, and KIT has gained a total of 60 fellows. The selection rate in the highly com-



KIT attracts high-caliber leaders for junior research groups with its Young Investigator Group Preparation Program. [115]

petitive process is 18 percent, and 28 women (48 percent) were inducted into the program. Its share of foreign researchers is 62 percent. The share of foreign researchers in 2023 was 57 percent (four fellows).

The program celebrated five more successful proposals in 2023: Three CZS Nexus junior research groups from the Carl Zeiss Foundation (all of them headed by women; see page 68) and two Emmy Noether junior research groups from the German Research Foundation. Several proposals to the European Research Council and for further Emmy Noether junior research groups will be submitted soon, and one Emmy Noether proposal is under review. ■

*More information:*

*YIG Prep Pro:*

<https://www.kit.edu/forschen/yig-prep-pro.php>





## INTERNATIONAL AFFAIRS

Enhancing cooperation among universities and cities on the Upper Rhine was the focus of the second Eucor cities meeting held in Karlsruhe in October 2023. KIT and the city of Karlsruhe hosted the gathering of leading representatives of the trinational university association and its host cities.

Eucor is an example of how successful cooperation between universities and cities can connect and strengthen a region across its international borders. Its in-depth contacts benefit the universities and the cities, as exemplified by the close cooperation between Karlsruhe and KIT over many years.

The Eucor member universities see themselves as places of science whose powers of innovation and transformation can only be fully unleashed in cooperation with their host cities.

New ways for universities and cities to cooperate were a focus of the meeting at Karlsruhe's city hall. Three projects were presented: A sustainability association promoting sustainable transformation of the Upper Rhine region, a railway manifesto for the cities on the Upper Rhine, and the large-scale "Biocampus Upper Rhine" project in which the Eucor universities and cities, headed by the University of Basel, aim to enhance cooperation between public and private stakeholders in the healthcare sector.

Eucor – The European Campus is a three-nation association of five universities in the Upper Rhine region. Its members are the universities of Basel, Freiburg, Haute-Alsace, Strasbourg, and KIT. These universities pool the expertise of 15,000 researchers, 13,500 doctoral students, and 117,000 students in a region of vibrant scientific and economic activity across parts of France, Germany, and Switzerland. Eucor's aim is to establish a high-profile region of scientific research with an international reputation and no walls and boundaries.





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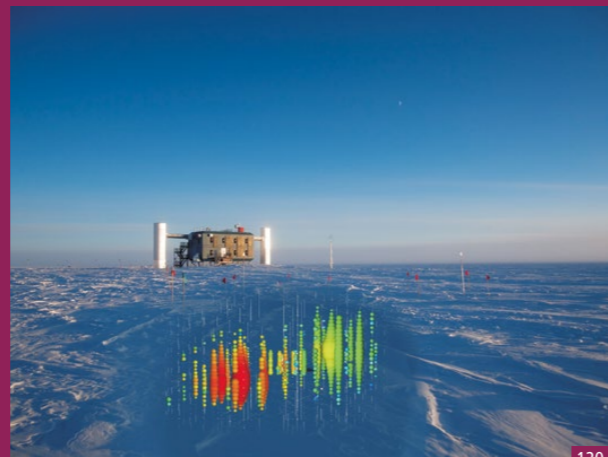
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## EUCOR

**Strengthening Partnerships on the Upper Rhine****European Quantum Center**

Cross-border cooperation between KIT and the University of Strasbourg expanded on October 16, 2023, with the inauguration of the European Quantum Center in Strasbourg as a partner institute to KIT's Institute for Quantum Materials and Technologies. The facility will perform research on artificial quantum systems such as superconducting circuits and electro-optomechanical systems. At the first German-French institute for quantum technologies, scientists will have additional research infrastructure such as laboratories, large-scale equipment, and databases at their disposal.



Representatives from Strasbourg and Karlsruhe at the inauguration of the European Quantum Center in Strasbourg. [129]

Ministry of Science, Research and the Arts. KIT's share of the funding will be EUR 2.8 million.

**Eucor MobiLab Roadshow**

With excellent results from top-level sustainability research on board, KIT's mobile participation laboratory made its way through Germany, France, and Switzerland on a public outreach mission, visiting Freiburg, Basel, Kehl, Strasbourg, Karlsruhe, and Mulhouse. With a wide range of topics and knowledge transfer formats, it offered hands-on activities for young and old.

The Eucor MobiLab Roadshow was carried out under KIT's aegis in cooperation with the Eucor partner universities and the Trinational Upper Rhine Metropolitan Region. The MobiLab roadshow was part of KIT Science Week in Karlsruhe.

The traveling venue was a tiny house on wheels, which was produced with environmentally friendly methods and materials in 2021 in a partnership of the KIT Humans and Technology Center and the Karlsruhe Transformation Center for Sustainability and Cultural Change. ■

**Thomas Hirth Continues As Eucor Vice President**

On December 11, 2023, the assembly of rectors/presidents of the member universities of Eucor – The European Campus reelected Professor Andrea Schenker-Wicki, President of the University of Basel, as President of Eucor. Professor Thomas Hirth, Vice President Transfer and International Affairs at KIT, was also reelected as vice president. Their term of office is three years.

With the new strategic plan for 2024 to 2030, the heads of the five member universities affirmed their intention of maintaining and consolidating their cooperation in research, teaching, and transfer. KIT and the University of Freiburg will receive EUR 5.5 million for the implementation of the new Eucor strategy from Baden-Württemberg's

## INTERNATIONAL STUDY AND INTERNSHIP PROGRAM

**20 Years of GEARE**

The Global Engineering Alliance for Research and Education (GEARE), an international study and internship program formed by KIT and Purdue University in the United States, celebrated its 20th anniversary in 2023. Shanghai Jiao Tong University in China has also joined the network.

The anniversary event was held with the partner universities in Karlsruhe in late May. Some 200 alumni, current program participants, professors, and students from KIT and Purdue were in attendance. Key figures in German-American cooperation also took part.

The three-day event included a ceremonial symposium, workshops, tours of KIT, and excursions to the Black Forest and Karlsruhe. The founders of the GEARE program, Professor Dan Hirlmann, Professor Sigmar Wittig, Professor Eckhard Groll, Professor Albert Albers, and Professor Norbert Burkardt, were honored at the symposium for their dedication and their untiring efforts to gain acceptance for the program and promote its development.

The original student exchange program was founded by Purdue University's School of Mechanical Engineering and KIT's Department of Mechanical Engineering; its aim was to add an international element to traditional study programs and enhance the skills needed for development activities at companies' foreign branches. The partnership was extended to Shanghai Jiao Tong University in 2008.

The program is intended for bachelor's students and begins with mixed teams of KIT and foreign students studying together for a semester at KIT. The KIT students then spend two semesters in the host country, one of them at Purdue University. During their semester of study abroad, they also work on projects related to product development. The second semester of the exchange program includes a three-month internship at an international company in the host country.



Celebrating the anniversary of the international study and internship program GEARE. [130]

Studying in international groups, gaining experience in the development teams at international companies, and recognition by KIT of examinations taken abroad are key features of the GEARE exchange program.

A working group helps students find internships and gives them tips on organizational matters such as booking flights, finding accommodations, opening bank accounts, and getting visas. ■

*More information:*

GEARE:

<https://www.ipek.kit.edu/english/121.php>

GEARE working group (in German):

<https://www.ak-geare.com/ak-geare>



## PRIZE FOR LEADING INTERNATIONAL RESEARCHER

## First KIT International Excellence Award Goes to Chemist Thalappil Pradeep

Professor Dr. Thalappil Pradeep from the Indian Institute of Technology Madras (IIT) in Chennai received the first KIT International Excellence Award and the Fellowship of SCHROFF Foundation at a ceremony in November 2023. With its award, KIT honored the renowned chemist and his basic research in nanoscience and his use of novel nanomaterials for drinking water purification.

Pradeep's research focuses on investigating and unveiling the fundamental properties of metallic nanoparticles and materials derived from them, using various experimental and theoretical methods. Building on the results of that research, he and his team at the IIT recently succeeded in developing novel nanomaterials for drinking water purification.

Access to clean drinking water is still a problem in many parts of the world. Pradeep's group uses nanochemical-based water filters to remove pesticides and other contaminants from drinking water. These filters are a sustainable and cost-effective solution that already benefits several million people in India today.

For his work, Pradeep received the International Excellence Award from KIT and the Fellowship of SCHROFF Foundation with an invitation to stay at KIT for up to six months. In addition to the research stay, the prize includes a scholarship with a duration of up to one year for a junior researcher from Pradeep's working group and

equipment funding of up to EUR 50,000 for a research project to improve the interface between mass spectrometry and nanomaterials at KIT.

With the award, KIT honors an outstanding nanoscientist who performs forward-looking investigations beyond his own field of work. At the same time, the award also boosts international exchange and top-level research at KIT by helping to establish a research environment that appeals to scientists and researchers from all over the world. Only with international scientific collaboration will it be possible to meet the global challenges facing society in the 21st century.

The award is part of the International Excellence Grants initiative in KIT's successful University of Excellence concept. Its aim is to promote international collaboration in top-level research and attract international researchers to KIT. ■

*More information:*

*Professor Dr. Thalappil Pradeep:*

<https://chem.iitm.ac.in/faculty/pradeep/>



Thalappil Pradeep from the Indian Institute of Technology Madras received the first International Excellence Award from KIT and the Fellowship of SCHROFF Foundation. [131]



## INTERNATIONAL RESEARCH FACILITY

## German-French Laboratory for Dark Matter Research Founded

Dark matter is one of the most mysterious phenomena in modern physics. To investigate the nature of dark matter, the French research organization Centre National de la Recherche Scientifique (CNRS) founded the Dark Matter Laboratory (DMLab) with KIT, the Deutsches Elektronen-Synchrotron (DESY), and the Helmholtzzentrum für Schwerionenforschung (GSI).

By itself, the visible matter in galaxies and galaxy clusters cannot account for the total mass required to explain astronomical observations, suggesting the existence of so-called dark matter, which is invisible and barely interacts with normal matter. Though it makes up 26 percent of the universe's total energy, dark matter is still hypothetical and its nature is unknown.

Now leading research institutes from France and Germany have joined forces to establish the DMLab. Its founding marks an important step in the development of cooperation among CNRS, KIT, DESY, and GSI. Together they are working to uncover the secret of dark matter and gain new insights into the fundamental building blocks of the universe.

In addition to the search for dark matter, DMLab's scientific interests include analyzing gravitational waves and astrophysical messenger particles, developing new particle acceleration and detection techniques, processing data gathered in the experiments, and performing theoretical physics research.

A joint project in which DMLab will be involved is the planned DARWIN experiment. Using a 50-ton liquid xenon detector with participation by KIT and CNRS partners, the experiment will search for dark matter particles with unprecedented sensitivity.

An annual meeting gives the DMLab researchers an opportunity to report on their progress and discuss their findings and new approaches. Last year 50 people from various disciplines took part in the meeting. Topics of discussion included current DMLab projects such as the DARWIN and MADMAX experiments as well as new aspects of



Annual meetings of DMLab researchers promote scientific dialog and networking. [132]

theoretical astroparticle physics and new experiments to measure gravitational waves, e.g. science and technology studies for the planned Einstein telescope.

DMLab sets an example for international cooperation and cross-border transfer of knowledge and ideas, and it underscores the role played by German-French cooperation in the pursuit of scientific excellence. ■

*More information:*

*Dark matter group at KIT:*

<https://www.iap.kit.edu/dm/english/index.php>





## KIT AS AN EMPLOYER

With 10,034 employees, KIT is one of the largest employers in the Karlsruhe technology region. Its workforce is composed of 5,823 scientific staff and 4,211 administrative and technical staff. Women make up 39 percent of the workforce. KIT employs 1,934 foreign citizens, mostly scientific staff, and 414 professors, of whom 30 were new appointees in 2023.

Moreover, there are 358 young people receiving vocational training for over 25 professions at KIT; this includes people studying at Baden-Württemberg Cooperative State University, preparing for their future jobs in 12 study programs. Their three-year study program combines scientific theory with on-the-job practice.

KIT received EUR 50,000 from a nationwide program initiated by the German Rectors' Conference and supported by the Federal Ministry of Education and Research to promote diversity at German universities; the funds will be used to implement institutional diversity projects in the winter 2023/24 semester.

KIT's proposed diversity mainstreaming measures and their underlying strategy met with approval and it was one of 33 universities to receive funding. Implementation of the measures at KIT began in October 2023.

In a project (Excellence through diversity – increasing employer attractiveness through diversity-sensitive

employer branding and personnel marketing) funded by the Helmholtz Association, KIT is developing a strategy for establishing a lasting reputation as an employer of choice. Employer branding and personnel marketing communicate KIT's attractiveness as an employer to the outside world. This attractiveness, especially to women and top talent from abroad, will be enhanced and diversity-sensitive personnel recruiting strengthened through careful planning.





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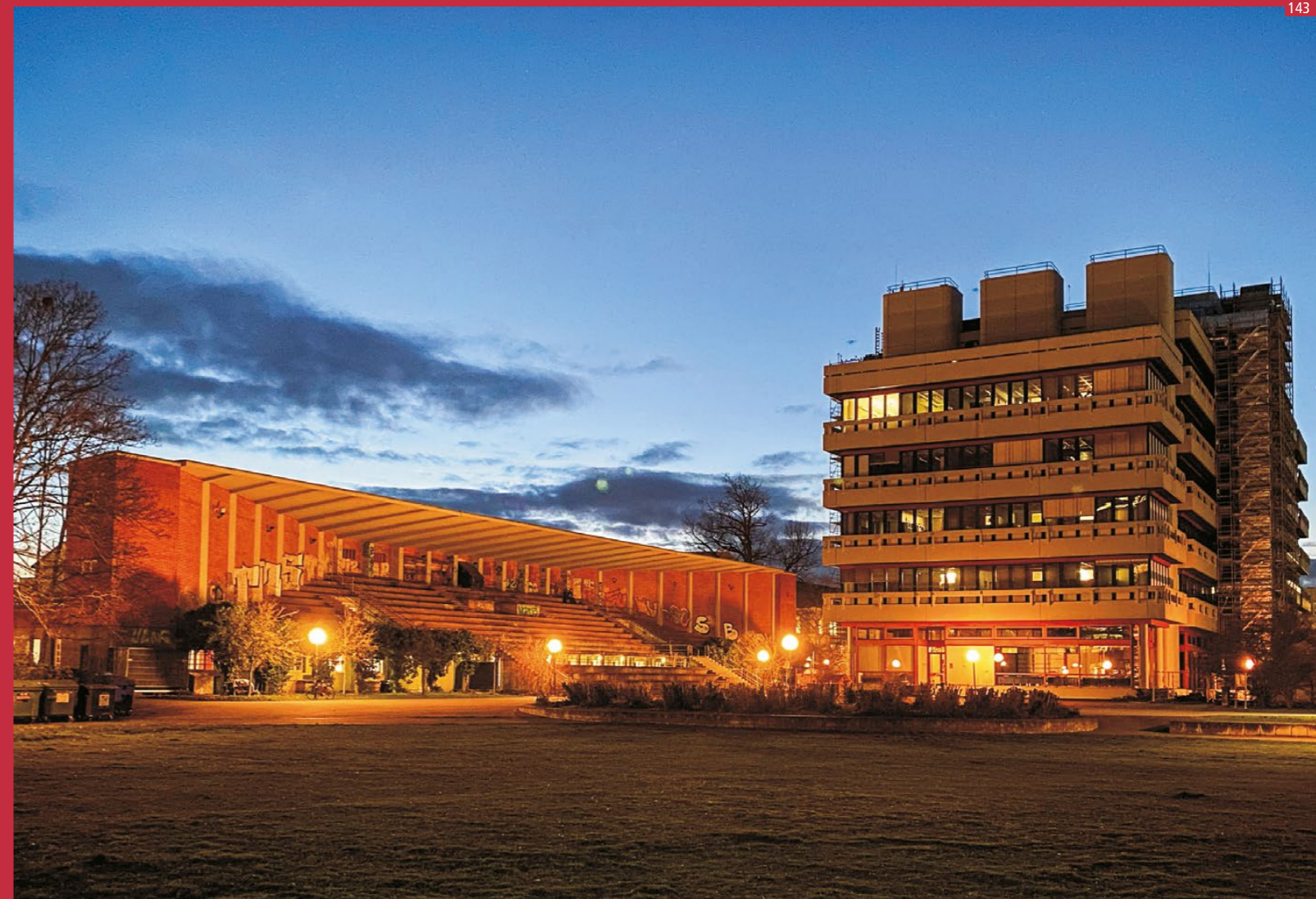
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## NEW WORK FLAGSHIP PROJECT

**New Work Methods Tested for a Year in Five Projects**

The New Work Flagship Project is testing the potential offered by new approaches to work at KIT in the future. The New Work project was launched with the goal of shaping the workplace of tomorrow and making it more versatile and more responsive to employees' needs and to the realities of their lives. Within the scope of the KIT 2025 Strategy's digitalization action area, aspects relating to people, workplaces, technology, and organization have been under consideration since 2021.

Specifically, the project is about hybrid working and leadership, about new ways of using space, platforms, and tools, and also includes the employees' perspective. Participants in five selected pilot projects tested new approaches in everyday situations through March 2023. At the end of the test phase, they presented their findings at a New Work Day event in July 2023.

The Scientific Computing Center developed a system with three workplace models. Employees could choose whether they wanted to maintain a personal workplace, share a workplace in a common office community, or use any workplace that is available (hot desking). Most employees chose a shared workplace in an office community.

Participants from the pilot projects described their results in presentations and workshops at the New Work Day event on July 11, 2023. [144]



The Institute of Product Engineering tested ways to minimize background noise in office work environments. The results indicated that a headset including a boom microphone with a foam cover and connected to the computer with a cable should be used for video conferences. Various pieces of equipment were tested and evaluated.

The Institute of Applied Informatics and Formal Description Methods converted an old computer room into an appealing meeting place with a mobile smart board, beanbag chairs, and computer workplaces. Rules were established to ensure appropriate use: No permanent occupancy by individuals, no regularly recurring meetings, and advance booking is required.

New Work means rethinking work's hierarchies and processes. Existing notions of agility are relevant here, but they call for in-depth engagement with the subject matter by entire teams. For example, in spite of an extensive existing knowledge base, the Optimization and Control working group at the Institute for Automation and Applied Informatics needed several months to adapt and optimize its work processes.

International Affairs is to move to new offices in 2026. Thanks to New Work, all employees will have a workplace (some with desk sharing in an office community) in the new building; this would have been impossible with personal offices. Space can now be used in new ways.

The most important lesson from all the pilot projects is that there are no one-size-fits-all solutions. The ideas and attempted approaches can only serve to suggest a direction. Each team has to decide what works best for it and establish appropriate conditions. ■

## PROFESSORSHIPS

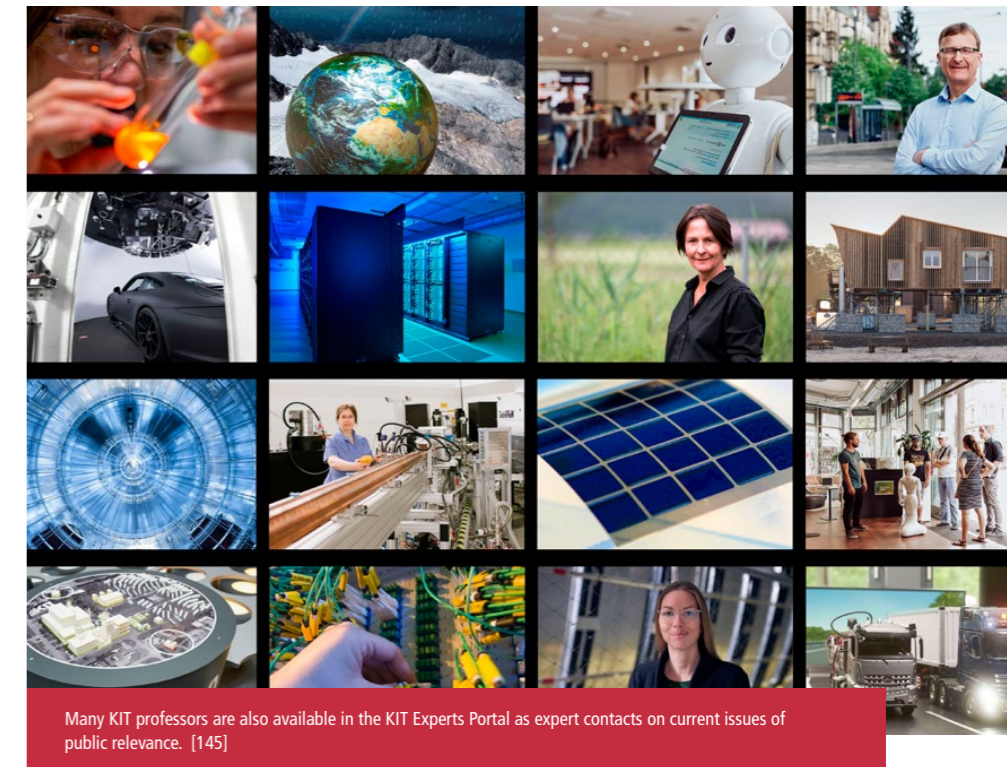
**Over 400 Professors at KIT**

KIT's ambitious 100 Professorships Program is bearing fruit. In 2023 the number of professors at KIT reached and remained above 400 for the first time.

There were 368 professorships at KIT in 2019, considerably fewer in relation to the number of students and the range of disciplines than at competing institutions in Germany. To improve KIT's competitiveness, the 100 Professorships Program was established to create 100 additional professorships within 10 years (2019 to 2029). This total includes 60 junior and tenure-track professorships and 40 W3 professorships. The additional professorships are intended to address new aspects of research, teaching, and innovation and strengthen fields of strategic relevance.

With the 100 Professorships Program, KIT is creating three types of (junior) professorship. The Otto Lehmann Professorships are intended to recruit top-ranked international researchers for KIT. For the second type, KIT is setting up Real-world Lab Professorships, tandem professorships in which one professor deals with a field's technological aspects and the other with the humanities and social science perspective. The third type, KIT Excellent Tenure, combines the pathways to full professorship, namely junior research group leadership and a junior professorship or a tenure-track professorship, in order to make KIT more attractive for young scientists and to create dependable career paths.

The 100 Professorships Program envisions women having a 40 percent share of the new professorship appointments, with the aim of ensuring that at least 20 percent of the professorships at KIT will be held by women by 2030. This goal is set out in KIT's Equal Opportunity Plan. Four professorships have been awarded in the Otto Lehmann program thus far, two of them in 2023, and two tandems have been appointed for KIT Real-world Lab professorships. At the end of 2023, KIT had 24 tenure-track professors (25 percent women and 21 percent from abroad).



Many KIT professors are also available in the KIT Experts Portal as expert contacts on current issues of public relevance. [145]

On December 31, 2023, there was a total of 414 professorships at KIT, including 31 junior and tenure-track professorships. Of that total, 53 professorships were held by individuals from abroad and 81 by women. The fraction of women among the professors rose from 14.7 percent at the end of 2019 to 19.6 percent today. ■

*More information:*

*KIT professorships:*

<https://www.kit.edu/career/26619.php>

*Tenure-track professorships:*

<https://www.kit.edu/research/tenure-track.php>



## SUCCESSFUL INTRANET RELAUNCH

**KIT's Intranet: User-friendlier and More Relevant for Its Target Groups**

KIT's new intranet was launched on the afternoon of November 30, 2023. All employees can now find the information they need for their daily work there. KIT's internal communication and dialog among the staff should improve as a result, and the new intranet has a modern, user-friendly design optimized for mobile devices.

"Digital first" is a central theme of KIT's marketing and communications strategy. For the intranet that means making it easy for employees to find relevant information and services quickly. In these times of New Work, demands on internal communication are increasing and low barriers to interaction are becoming more and more important. A survey of all employees showed that 40 percent use the intranet daily and 30 percent weekly, but only 10 percent were able to find information quickly and easily there.

The internal home page was upgraded with a visual and structural overhaul for the intranet relaunch. News, information, support, and online services are grouped in a central portal to which both staff and students have access. The main intranet pages are available in German and English.

Users can set up a personal dashboard with the services they use most often. The dashboard is an important starting point for everyday tasks.

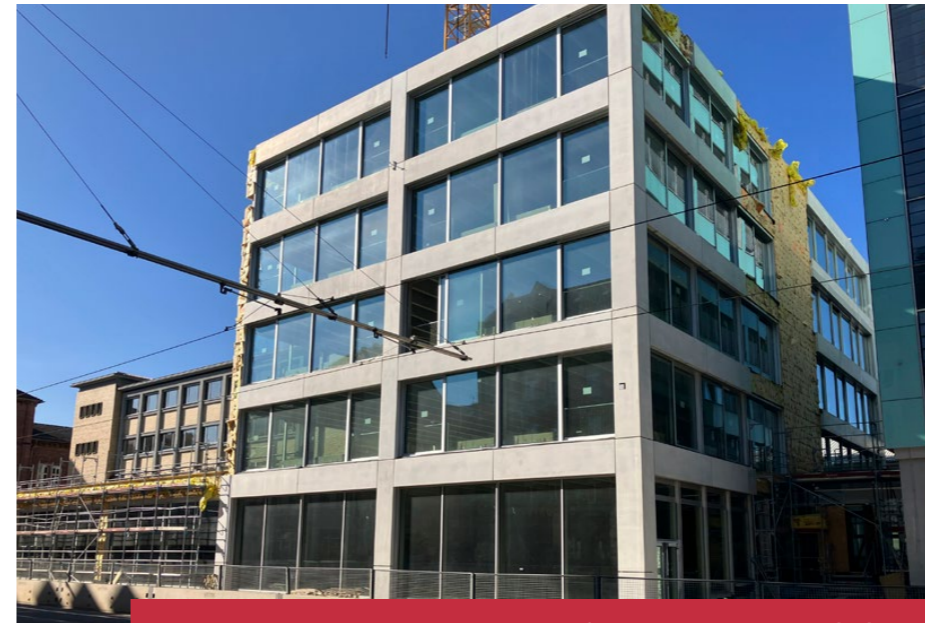
New on the intranet home page is a news feed like those in social networks, a key internal communication feature where users can find all internal news in one place, sorted by target group. Employees will see news about administration, research, teaching, and knowledge transfer, for example; students will mainly see news about studies, research, and startups.

Organizational units can post news in the news feed to provide staff and students with current information about their activities. With the click of a mouse, they can now reach the people at KIT who need to know about their work.

Users can also subscribe to "News" about various topics such as research, health or campus life. ■

Students and employees can use the new KIT intranet and customize it to meet their needs. [146]

## NEW BUILDINGS AND RENOVATIONS

**Major Construction Projects at KIT Sites**

Still a construction site: The Learning and Application Center for Mechatronics on Campus South. [147]

historic buildings. With the users of the Karlsruhe Research Factory for AI-integrated Production, the building now has new tenants.

Renovation of the southwest wing of the institute building on Campus Alpine is in planning. The former Fraunhofer Institute for Atmospheric Environmental Research in Garmisch-Partenkirchen has been part of KIT's Institute of Meteorology and Climate Research since 2002. Germany's oldest environmental research facility consists of two groups of buildings. The southeast, northeast, and northwest wings were put into service in 1991. The southwest wing has been in use

since 1973. The decrepit wing is set to undergo renovation costing EUR 9 million starting in the spring of 2025.

The Learning and Application Center for Mechatronics (LAZ) is under construction on Campus South. With its innovative teaching methods, modern learning and teaching environment, functionally optimized spaces for students to learn and work, and project-oriented infrastructure, the LAZ is unique throughout Germany. The new building with some 3,000 square meters of floor space will consist of a low workshop building and a five-story main building. The workshop will face the street with a large glassed-over area allowing the public to view the students' work over two floors. The new building is under construction at the former site of the Nusselt lecture hall, which was demolished in 2020. ■

KIT assumed responsibility for construction work on most of the buildings on Campus South and Campus West on January 1, 2024. In general, the state of Baden-Württemberg had previously been responsible for all construction activity there. This change, resulting from the 2nd KIT Further Development Act, gives KIT considerable freedom of action but also confronts it with numerous challenges. KIT had already been responsible for construction on Campus North and Campus East for some time.

Several major construction projects are in progress at various KIT sites, including the new InformatiKOM on Campus South (see page 92) and the new Karlsruhe Center for Optics and Photonics on Campus North (see page 11). Many other projects are also in full swing.

Building 70.16 on Campus East has undergone renovation. The former Mackensen barracks has had many different uses since its construction in 1935, and the renovation work that began in 2019 was complicated by the building's protected status. Within three years, the dilapidated and contaminated building was converted to an attractive and functional office building with 2,700 square meters of floor space. It was approved by the local authorities responsible for the preservation of





## LIFE AT KIT

KIT will celebrate its 200th anniversary in 2025. On October 7, 1825, one of KIT's forerunner institutions was founded: The Polytechnische Schule. In the second half of the 19th century, this little school grew to become the Technical University of Karlsruhe. After the founding of the Karlsruhe Nuclear Research Center in 1956, the two institutions quickly began to cooperate at all levels. Finally, in 2009 the University of Karlsruhe and the Karlsruhe Research Center merged to become the Karlsruhe Institute of Technology.

KIT will celebrate this history throughout 2025. The anniversary year will feature many events, activities, concerts,

a commemorative book, and an exhibition with 100 objects contributed by KIT's employees to illustrate its history.

An ambitious program is being developed by a dedicated project team with members from various KIT organizational units: The Executive Office and Strategy business unit with its Knowledge Transfer and Corporate Communications departments, the Innovation and Relations Management business unit, the Archives of the KIT Library, the Campus Services event management unit, and others. For the Executive Board, Professor Thomas Hirth, Vice President Transfer and International Affairs, is assuming responsibility for the anniversary planning.

Since KIT is an integral part of the community, the project team plans to send scientific experts into the city of Karlsruhe to promote dialog between researchers and the public about the challenges facing society, for example environmentally friendly mobility or the future of the energy supply. The dialog activities will be organized and carried out in cooperation with Karlsruhe's citizens' associations.





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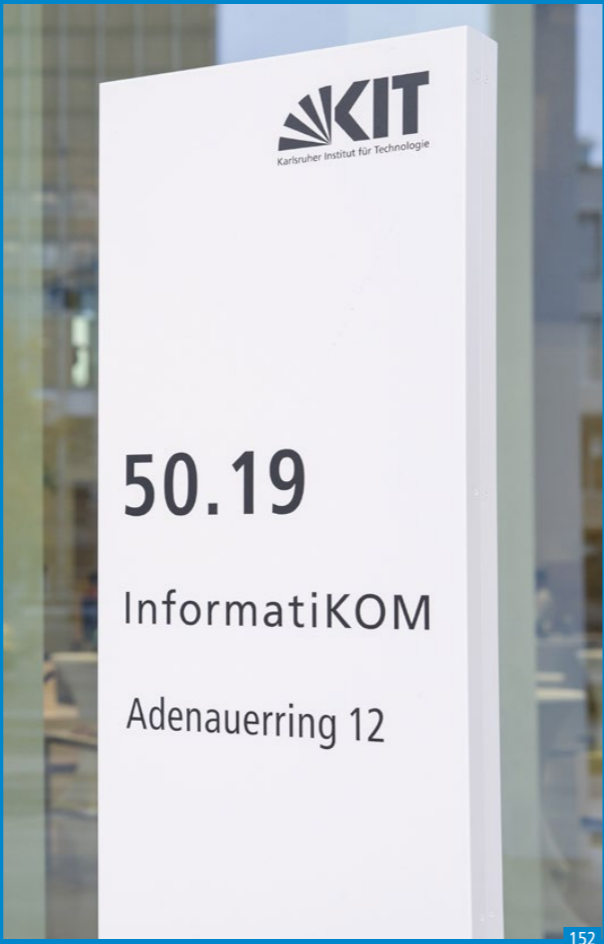
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## DISCUSSING, DOING RESEARCH, DESIGNING

**Second KIT Science Week with Wide Range of Public Events**

With the theme “Making the Future Sustainable. Together,” the second KIT Science Week took place from October 10 to 15, 2023. Topics addressed there included climate action, environmental protection, wildlife conservation, sustainable resource management, ecologically compatible growth, green entrepreneurship, and global justice. It combined a high-caliber scientific conference with a wide range of events for all social groups.

Top international researchers met curious citizens to discuss how society can transition to a more sustainable future.

The event highlighted all aspects of sustainability and climate action, also taking the perspectives of affected people into account. For an entire week, international researchers met ordinary citizens, families, schoolchildren, trainees and apprentices, students and prospective students, decision-makers from government and industry, and people involved in culture and the arts. The researchers reported on their work, put facts and figures in perspective, offered guidance, and got new ideas for their research.

KIT Science Week featured expert forums and events of all sizes, live and online for all social groups. The program included escape rooms, open labs, concerts, discussions, excursions, hands-on exercises, and serious games. One of the highlights was the opening event featuring a keynote speech by marine biologist and polar researcher Antje Boetius followed by a panel of prominent figures discussing science’s contribution to a sustainable society.

At a three-nation congress, international researchers shared their scientific findings and discussed how sustainability could be implemented in practice. Dr. Insa Thiele-Eich, climate researcher and future astronaut,



The second KIT Science Week brought experts and the public together for discussions about sustainability and climate action. [158]

spoke about equitable climate policy with experts from academia, industry, and government in a panel discussion entitled “Global Rethinking: Innovations for more Climate Justice.” In a “climate slam,” researchers from all over Germany presented their science in an entertaining and understandable way. In a citizens’ dialog, scientists and the public discussed how climate action could be rewarded in everyday life.

Another event at the 2023 KIT Science Week was the Helmholtz Sustainability Summit in Karlsruhe. At KIT, sustainability is anchored in both the transfer and innovation strategy and in research and teaching. All nine of the KIT Centers, where KIT’s research activities are concentrated, are working to implement the United Nations Sustainable Development Goals. ■

*More information:*

*KIT Science Week:*

<https://www.scienceweek.kit.edu/english/index.php>

## EFFECTIVE EVENT AT KIT

**Open Day on Campus North**

After a four-year hiatus caused by the pandemic, KIT again hosted visitors at an open day. On June 17, 2023, some 25,000 visitors, among them many families, made use of the opportunity to explore the two square kilometers covered by Campus North in bright sunshine. From A (astroparticles) to Z (zebrafish in biology research), a wide range of research topics was on display in a wide range of sizes – from 3D printers to a particle accelerator.

Over 200 exhibits presented detailed information on a wide range of topics in a variety of formats that made findings from energy, climate, and sustainability research just as exciting as projects involving disruptive technologies like artificial intelligence and robotics. The chance to learn from informal chats with researchers was very well received at exhibits like the drilling site for the DeepStor geothermal energy project. The “Wissen macht Spaß” (knowledge is fun) area around the canteen also attracted many visitors with exhibits by institutes and facilities from other KIT campuses.

The acts on the central stage also created a good atmosphere. They included science comedian Konrad Stöckel, a quiz show for children, and the Falling Walls Lab where young scientists presented their research. The area in front of the stage was the place to take a break with food and drink, and the Campus North fire department had exciting demonstrations for young and old.



Holger Hanselka, then President of KIT, and Frank Mentrup, Lord Mayor of Karlsruhe, opened the EFFEKTE science festival during KIT’s open day [160]

In 2023, KIT’s open day once again served to launch Karlsruhe’s EFFEKTE science festival. Dr. Frank Mentrup, Lord Mayor of Karlsruhe, and Professor Holger Hanselka, President of KIT at the time, kicked off the week-long event, which took place at various venues in Karlsruhe. ■

Open day on Campus North: Fun and knowledge for the entire family. [159]





## 10,000 SQUARE METERS FOR MEETINGS AND DISCUSSIONS

## New InformatiKOM Buildings: Informatics and Science Communication under One Roof

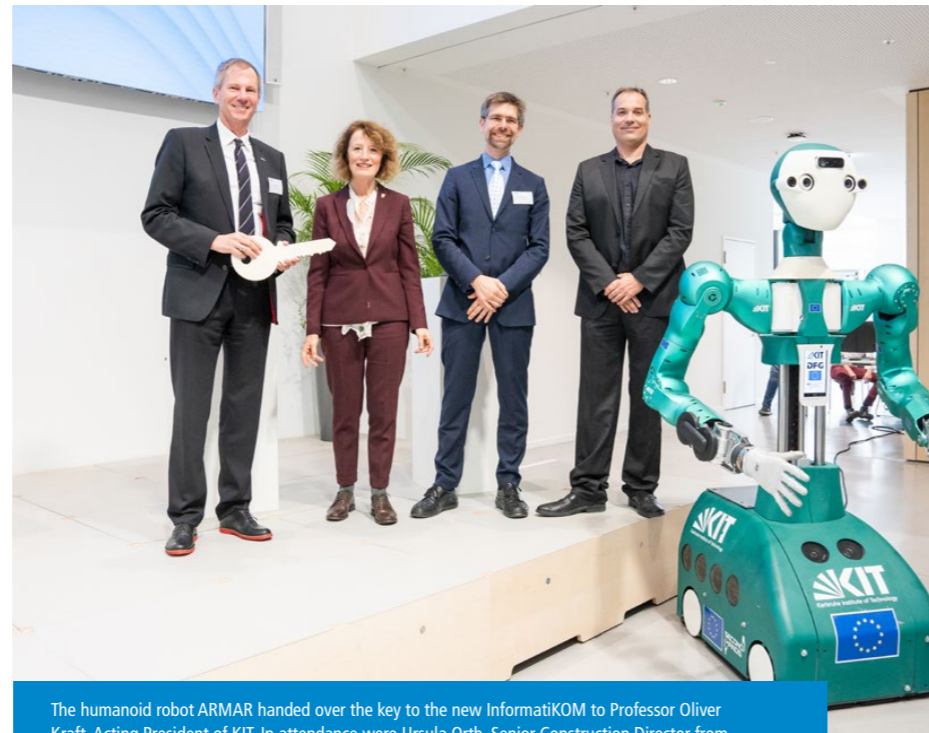
After three years of construction, the Klaus Tschira Foundation completed the InformatiKOM, two new buildings for KIT. The opening ceremony was held on November 9, 2023. The buildings will house computer science institutes and facilities for science communication and cultural studies, with a focus on promoting dialog and interaction between the scientific community and the public.

The InformatiKOM forms the main entrance to the extension of KIT's Campus South and is very close to the main entrance of Campus South, the KIT Library, and the Audimax. With the two buildings, the Klaus Tschira Foundation has provided KIT with total floor space of approximately 10,000 square meters for institutes and classrooms.

InformatiKOM 1, the larger of the two buildings, will house computer science institutes, the Robot Design Atelier, the Science-Media-Communication study program, and the Center for Cultural and General Studies (ZAK). The smaller InformatiKOM 2 building is home to the Center for Digital Accessibility and Assistive Technologies (ACCESS@KIT).

The Darmstadt-based architects Bernhardt + Partner designed the two buildings to facilitate dialog with the public and contact between computer science and science communication staff. The centrally located two-story laboratory for measurement and control systems is designed so that visitors can watch through windows as scientists work on robots.

Three broad foyer staircases connect the open spaces on the ground floor to the third floor and also provide seating. In addition, the lower foyer staircase serves as a location for public lectures and other events. The open atrium, with a translucent air-cushion roof, which joins all floors and study areas, provides further meeting space.



The humanoid robot ARMAR handed over the key to the new InformatiKOM to Professor Oliver Kraft, Acting President of KIT. In attendance were Ursula Orth, Senior Construction Director from the Karlsruhe Office of Vermögen und Bau Baden-Württemberg (VBA); Professor Rafael Lang, Head of Research at the Klaus Tschira Foundation; and architect Sven Bachmann. [161]

The two InformatiKOM buildings are a gift from the Klaus Tschira Foundation to the State of Baden-Württemberg, which is making them available to KIT.

With the InformatiKOM, KIT has reached a further milestone not only for interdisciplinary teaching and research at KIT but especially for the dialog with the public that is so important to KIT. The facilities and open spaces brought together under one roof here will give the public more opportunities to participate in and contribute to science. ■

## SCIENCE PERFORMANCE

## Theater Meets Science: Nerds Save the World

Transferring knowledge between the sciences, the arts, industry, and civil society is an important task in these challenging times. To bring science and theater closer together, the Badisches Staatstheater Karlsruhe teamed with KIT to present "Nerds retten die Welt" (Nerds Save the World), an artistic interpretation of current research topics at KIT. The production offered a creative outlook on the future at several Campus South locations with its performance, which was based on current KIT research on mobility, artificial intelligence, energy, climate, and the environment. A mix of video installation and performance resulted from discussions between scientists from KIT and artists from the Badisches Staatstheater.

For example, the Innovation Campus Future Mobility (ICM) played a role, at least in providing content. The producers presented four ICM projects dedicated to the use of hydrogen in mobility technologies. From the four projects, they developed characters who vied for the favor of a questioner by packaging all their scientific and technical qualities into their answers.



The Badisches Staatstheater joined with KIT to interpret current research topics. [163]

"Nerds retten die Welt" brought science and the public together in a new way and delivered new ideas for dialog, connecting important questions about the future with artistic expression and theatrical language. The performance linked architecture with conflict studies, science communication with theater, and especially science and art enthusiasts.

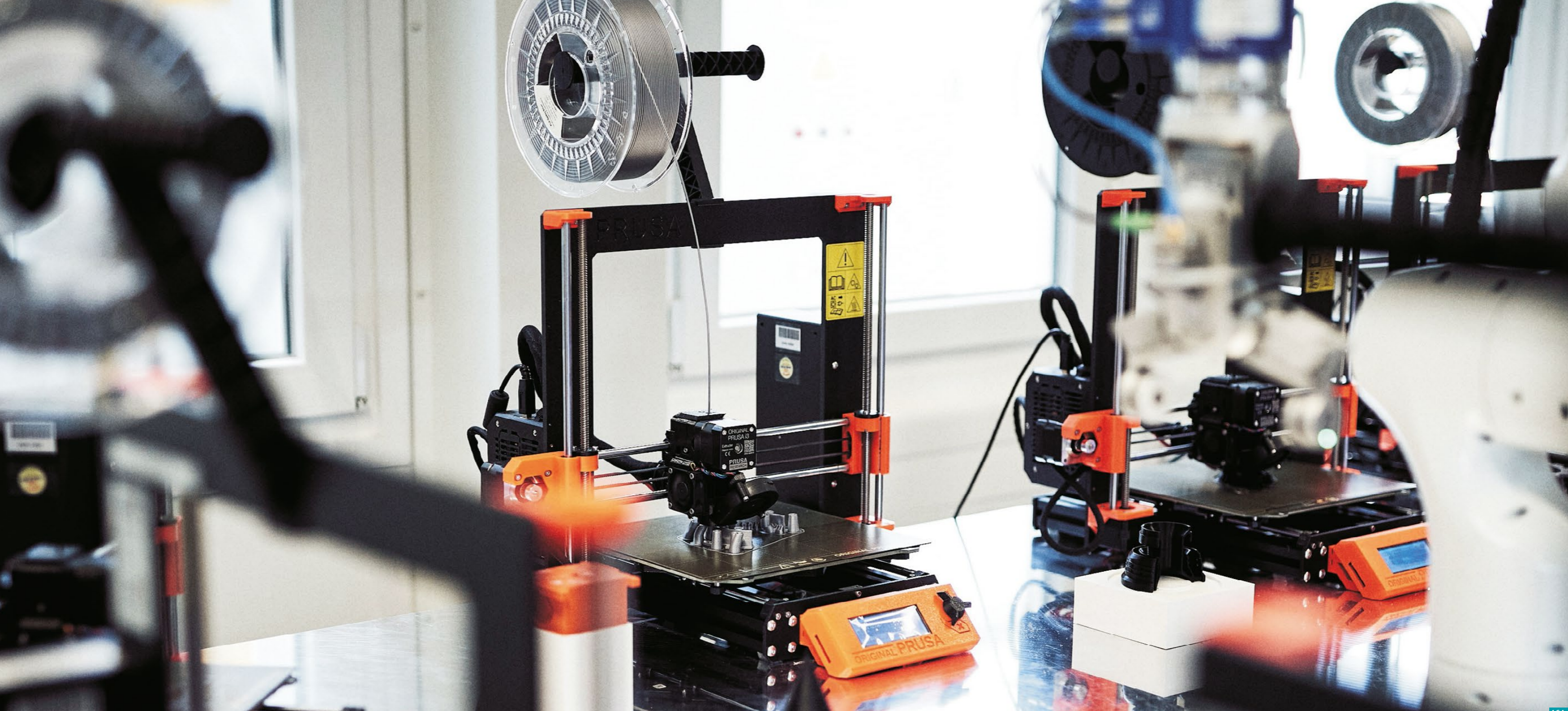
Hope and knowledge, atomic physics and pop culture, algorithms and theater all went hand in hand. Nerds saved the world in the summer of 2023 as Karlsruhe scientists invited theater producers and city residents on a hope-filled walk through the garden of ideas and the hall of visions into unexpected theatrical spaces right in the middle of KIT's Campus South.

The premiere of "Nerds retten die Welt" took place on June 15, 2023. Six further performances attracted audiences through July 20. Karlsruhe's Science Office and the EFFEKTE science festival were partners in the production. ■



"Nerds retten die Welt" brought science and the public together in a new way and delivered new ideas for dialog. [162]





## DIGITALIZATION

Mathematical escape games, teaching-learning videos on biomechanics, or 360° sports videos: In the digiMINT project, teaching degree students at KIT worked on digitalizing the education of future teachers in STEM subjects, testing a wide range of possible approaches. Thanks to the new Digital Learning Lab (DLL) and improved collaboration with external partners, future teaching degree students at KIT will be able to test and integrate digital tools in their studies.

The digiMINT project was funded from 2020 to 2023 by the Federal Ministry of Education and Research under a federal and state campaign for teacher education quality.

It focused on mathematics, computer science, and education sciences.

The digiLAB project funded by Baden-Württemberg's Ministry of Science, Research and the Arts extended digiMINT to include sports and engineering, sports and health, and natural sciences and engineering. KIT collaborated on the project with numerous partners in Baden-Württemberg.

A closing ceremony for the digiMINT project was held at TRIANGEL Transfer | Culture | Space on Kronenplatz square in Karlsruhe on November 9, 2023; the project's achievements and successes were presented there.

This interdisciplinary project at KIT demonstrated how networking and innovative teaching units help to promote digital skills in teacher training.

KIT's Center for Technology-Enhanced Learning developed the DLL during the digiMINT project. The DLL is intended for teaching degree students, providing them with mobile stations with sophisticated equipment for producing various kinds of digital teaching content. Students can use the DLL to acquire action-oriented media skills and improve them in a realistic teaching environment. After moving to the InformatiKOM, the DLL will be available to students and teaching staff beginning April 2024.

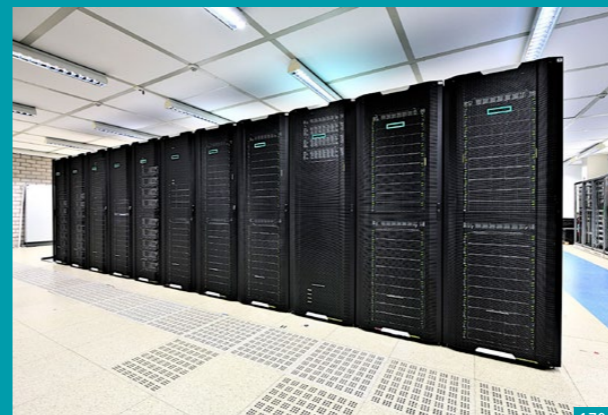




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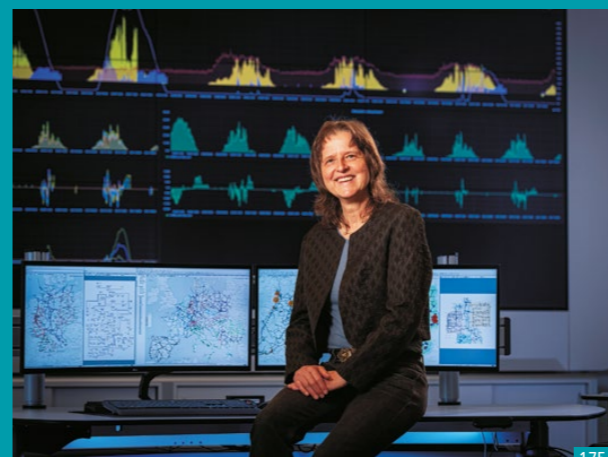
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## BETTER USE OF RESEARCH DATA

## First Conference on Research Data Infrastructure at KIT



NFDI4Energy is one of the 11 consortia in which KIT is involved. [177]

One thing pandemics, climate change, and road traffic have in common is that we can understand them better and make informed decisions about the actions we take if we have high-quality data in good networks.

Since its founding in 2020, the Karlsruhe-based National Research Data Infrastructure (NFDI) has been committed to future-proof management of research data. Now its members include over 250 scientific organizations, universities, non-HEI research institutions, professional societies, and other associations – a strong network that can shape the future of data-driven research.

In cooperation with KIT, the NFDI held the first Conference on Research Data Infrastructure (CoRDI) from September 12 to 14, 2023. Research fields ranged from the humanities to life sciences. With its theme of “connecting communities,” CoRDI gave its 700 participants from all fields of research and from industry and the infrastructure sector their first chance to meet in person at a major event. Over the three days of the event, there were scientific lectures, discussions, poster sessions, and a public evening lecture.

Individual disciplines are represented in the NFDI in 26 consortia. Up to 80 institutions are involved in each of these consortia, working together on issues within and

across their disciplines. Their work has already resulted in several services, such as a platform for searching human molecular biology data (so-called omics data, e.g. the GHGA Metadata Catalog with genome data), an electronic lab notebook (Chemotion), and an interactive virtual assistant for clarifying legal questions relating to data use.

Some topics, such as data protection, overarching standards, shared infrastructure, training, and collaboration with industry are of relevance to several or even all consortia. Such topics are dealt with by the organization’s sections. The NFDI also develops basic services that benefit all consortia, for example better data access management or improved semantic linking based on a terminology service.

KIT is involved in 11 of the 26 NFDI consortia. Three new consortia with KIT participation began to receive state and federal funding in 2022. York Sure-Vetter, a professor at KIT’s Institute of Applied Informatics and Formal Description Methods, has been Director of the NFDI since March 2020. ■

*More information:*

*NFDI website:*

<https://www.nfdi.de/?lang=en>

*Information on CoRDI:*

<https://www.nfdi.de/cordi-2023/?lang=en>

*KIT in the NFDI:*

[https://www.rdm.kit.edu/english/projects\\_nfdi.php](https://www.rdm.kit.edu/english/projects_nfdi.php)

## UNIVERSITY MANAGEMENT

## KIT Committed to Digitalization at German Universities

KIT is involved in various university digitalization projects at federal and state levels.

bwUni.digital is a framework for the digital transformation of administrative processes at Baden-Württemberg’s universities. KIT participated in three so-called think tanks in 2023; these think tanks addressed the use of Microsoft 365 (Think-Tank 05), a resource management process map (Think-Tank 08), and cultural change (Think-Tank 09). An entire page of this report is dedicated to Think-Tank 05 (see page 100); the other two are treated on this page.

The aim of Think-Tank 08 was to create a map providing an overview of the support processes in resource management. The resulting process map serves as a reference for digitalization projects (and for the optimization of individual digitalization processes) at universities. The results were published in 2023 in a white paper, which was well received throughout Baden-Württemberg and beyond.

Triggers for cultural change include current social issues such as digitalization, demography, the skilled labor shortage, and geopolitical developments. Think-Tank 09 focuses on the profound changes that are arising in the context of New Work and affecting cooperation, leadership, and communication. In 2023, the think tank dealt with framing, clarifying, and classifying various concepts, from which it developed methods and ideas for action. The results will be published in a guideline in 2024.

The ZKI (Zentren für Kommunikation und Informationsverarbeitung in Lehre und Forschung) is an association of IT service centers for Germany’s universities and research institutions. KIT is involved in the ZKI’s commission on cloud computing. The commission was established in 2020 with the aim of drawing up guidelines for rolling out and using cloud products at universities. The guidelines were published in 2021. The commission also drew up and published a recommendation on conditions for the use of cloud-based services in the education sector. Given the positive reactions and the ongoing importance of the matter for universities, the commission will continue its work in 2024 with a new mandate, focusing



Experts discuss the digital transformation of administrative processes in various “think tanks” organized by the state of Baden-Württemberg. [178]

on processes in the procurement and rollout of cloud products, and the peculiarities of such products. ■

*More information (in German):*

*Think-Tank 09:*

<https://www.bwuni.digital/kultureller-wandel/>

*Think-Tank 08:*

<https://www.bwuni.digital/think-tank-08/>

*Think-Tank 08 white paper:*

[https://elib.uni-stuttgart.de/bitstream/11682/13783/3/Prozesslandkarte\\_TT08\\_Whitepaper.pdf](https://elib.uni-stuttgart.de/bitstream/11682/13783/3/Prozesslandkarte_TT08_Whitepaper.pdf)

*Report on findings of ZKI cloud computing commission:*

[https://www.zki.de/fileadmin/user\\_upload/Downloads/Ergebnisbericht-ZKIKommission\\_final.pdf](https://www.zki.de/fileadmin/user_upload/Downloads/Ergebnisbericht-ZKIKommission_final.pdf)



## BWUNI.DIGITAL THINK-TANK 05 AND M365 IMPLEMENTATION PROJECT

### GDPR-compliant Use of Microsoft 365 at Universities in Baden-Württemberg

For many years, most universities in Baden-Württemberg and throughout Germany have been using Microsoft products to organize their everyday work. In addition to the ubiquitous Windows operating system, these products include the classic office applications (Outlook, Word, Excel, and PowerPoint) and, increasingly since spring of 2020, the Microsoft Teams videoconferencing software for communication and collaboration.

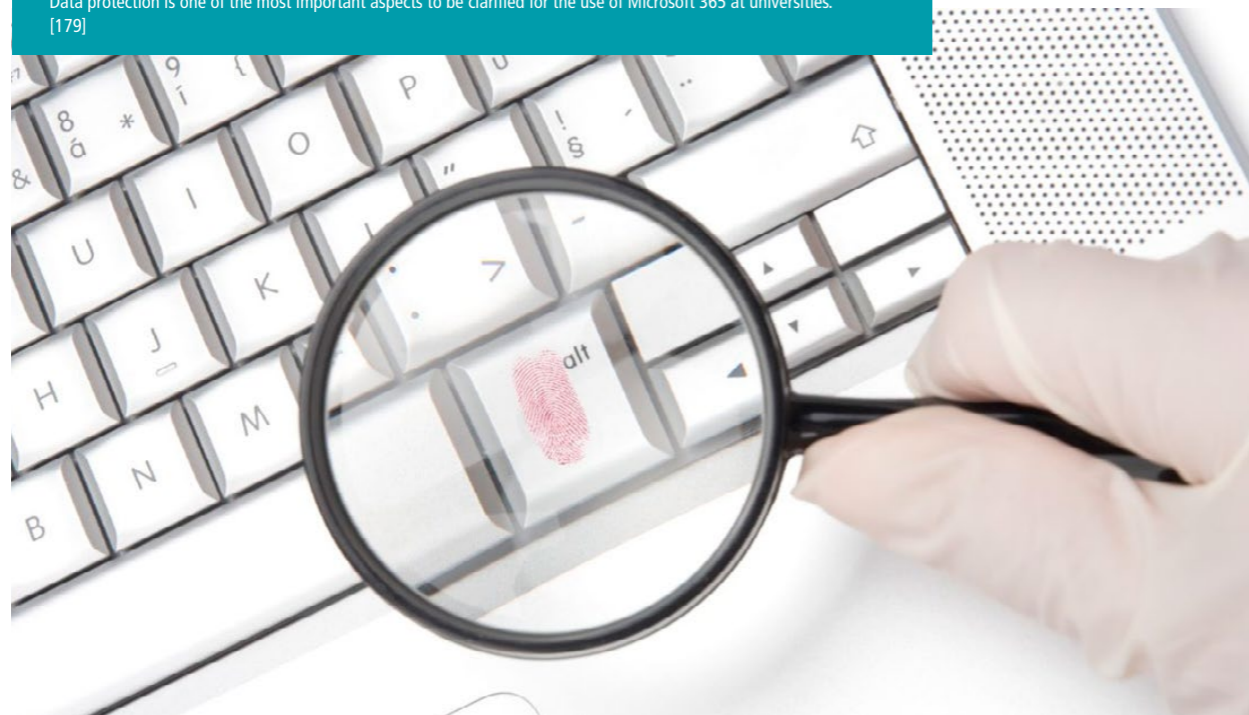
In the configuration used to date, most Microsoft applications are used in an “on-premises” version with which no data are edited or stored on cloud-based storage media. However, the on-premises versions are no longer regarded as technologically future-proof since they do not support many modern capabilities that are now in demand and seen as standard functionality, and it is also possible that the producers will not support them in the future.

Microsoft offers the current versions of its software products to all institutions that have licensed the corresponding products. For the cloud-based Microsoft 365 (M365), however, an automated rollout at universities has been impossible for technical and especially data protection reasons.

bwUni.digital set up a Think-Tank to clarify the issue of whether Microsoft 365 can be used at universities in Baden-Württemberg in accordance with the General Data Protection Regulation (GDPR). Universities that wanted to use M365 (including KIT, acting in a coordinating role) launched the implementation project UP M365 in the spring of 2022. Working with an external service provider, the project drew up a data protection impact assessment and came to the conclusion that it is possible to use M365 if certain technical and organizational aspects are taken into account and the associated risks are acceptable. Assessments of an M365 rollout by other universities in Germany and elsewhere in Europe came to the same conclusion. Since M365 is a platform that is subject to continuous development and technical modifications, the conditions of use must be subjected to continuous monitoring for GDPR compliance. KIT is in constant contact with other universities that share the same objectives.

KIT decided in favor of implementing M365 and has taken the first steps to enable a rollout. ■

Data protection is one of the most important aspects to be clarified for the use of Microsoft 365 at universities. [179]



## SCIENCE CAMPUS

### FIZ Karlsruhe and KIT Investigating Digital Transformation in the Sciences

Research findings are increasingly shaped by digitalization processes. This applies to both the methods used to conduct research and the way the findings are communicated to scientists and the public. In four research clusters, FIZ Karlsruhe – Leibniz Institute for Information Infrastructure and KIT will conduct interdisciplinary investigations of the impact of the increasing digitalization of scientific work and develop solutions. The Senate of the Leibniz Association considers DiTraRe (Digital Transformation in Research) a “project of high relevance and transdisciplinary innovative strength” and agreed in March 2023 to fund the ScienceCampus for an initial period of four years.

In the sciences, the digital transformation affects all disciplines. Changes in scientific methods, e.g. resulting from data-based analyses, are leading to changes in the established methodologies of individual disciplines. It will be important to make both scientists and data users aware of these changes and to study the effects of the transformation on the perceptions of scientists and the public. Transparent and reproducible research processes are of fundamental importance to the scientific system itself and thus to public trust in science.

The interdisciplinary approach taken by KIT and FIZ Karlsruhe is essential for a holistic treatment of this issue. KIT researchers are concerned, for example, with raising scientists' awareness of information security issues in the collection, analysis, and storage of sensitive information and informing them about practicable security solutions. They also conduct research on transparent and understandable communication of scientific results to the public, emphasizing the use of technology assessment methods.



The digital transformation is having an impact on all scientific disciplines. [180]

The DiTraRe project is organized in four research clusters, each of which is based on a specific scientific use case. For example, the protected data spaces research cluster is dedicated to the “sensitive data in sports science” use case. The other research clusters deal with intelligent data acquisition (use case: Smart labs in chemistry), AI-based knowledge spaces (use case: Artificial intelligence in biomedical engineering), and publication cultures (use case: Publishing large amounts of data). ■

*More information:*

*FIZ Karlsruhe:*

<https://www.fiz-karlsruhe.de/en>





## SUSTAINABILITY

With its new Digitalization and Sustainability Executive Board portfolio headed by Vice President Professor Kora Kristof, KIT improved its sustainability governance and implemented a variety of activities in 2023. In a broad-based process involving staff and students, the KIT Sustainability Project aims over the next two years to identify and prioritize promising sustainability-related ideas in research, teaching, transfer, and everyday operations at KIT and to work out ideas and measures for their implementation.

In the project, the multidisciplinary issue of sustainability (along with its connections to digitalization) is to be systematically integrated in KIT's core tasks of research, teaching, and innovation as well as in its operations and infrastructure.

Also important is regular dialog with the new Sustainability Council of students, employee initiatives, and the Round Table on Sustainability. For example, planning for the expansion of photovoltaic systems, the current status of the KIT Construction Plan, and the research partnership with Karlsruhe's municipal utility company were all presented here.

At the 2023 KIT Science Week, KIT played host to the Helmholtz Sustainability Summit with its theme of "shaping sustainability through dialog." This was the first summit with broad public participation, featuring workshops with best practices, lectures, guided tours, and a panel discussion. Moderated by Yvonne Zwick, the panel included Professor Kora Kristof, Professor Otmar Wiestler (President of the

Helmholtz Association), and Professor Daniela Jacob (head of the Climate Service Center Germany), who discussed how scientific activity can become more sustainable. Examples of this could also be seen at the KIT Science Week's "Markt der Möglichkeiten," a kind of exposition at which various local organizations presented their activities and services.

As part of the "Karlsruher Klimapakt" (Karlsruhe climate pact), KIT hosted a workshop on cooperation for a sustainable future between Karlsruhe's universities and the city of Karlsruhe. Baden-Württemberg's Minister of the Environment Thekla Walker learned about KIT's research projects and findings during the "Energiewende- und Nachhaltigkeitstage" (energy transition and sustainability days) in Stuttgart.





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## SUSTAINABILITY IN RESEARCH

## Research Projects on Lithium Extraction and Land Use



Optimizing agriculture for climatic conditions could significantly increase yields while limiting land use. [192]

### Boosting Synergies: Extracting Lithium from Local Geothermal Systems

The sustainability transformation requires us to rethink our use of both finite and renewable resources. As an important raw material for batteries, lithium is essential for electric mobility. Europe's current share of global lithium production is only 1 percent. This could be increased by extracting dissolved lithium from geothermal sources.

Using a computer model based on the geothermal conditions in the Upper Rhine Graben, researchers from the Institute of Applied Geosciences simulated lithium extraction over a 30-year period. In their model, heat production remains constant even when lithium is extracted, while the lithium reserves decrease by 40 percent during the period simulated.

Thus an additional component of the business model for existing geothermal power plants in the Upper Rhine Graben and the North German Basin could be the long-term sustainable extraction of lithium meeting 2 to 12 percent of Germany's annual lithium needs. The findings can also be applied to fracture networks other than that of the Upper Rhine Graben. For practical use, the technology will now need to be brought up to an industrial scale.

### Thinking about Both: Food Production and Carbon Storage

Ensuring the global food supply is one of the greatest challenges of our time. Climate change and unsustainable agricultural practices will cause additional problems in many regions. For example, irrigation and deforestation have a negative impact on water availability and carbon storage. Current global land use patterns reflect historical developments, local traditions, and production costs. The efficient use of land, water, and energy has seldom been a main focus.

Researchers from KIT's Institute of Meteorology and Climate Research Atmospheric Environmental Research, KIT's Campus Alpine in Garmisch-Partenkirchen and Heidelberg University's Heidelberg Institute for Geoinformation Technology investigated how effective land use under changed climatic conditions might look for the periods from 2033 to 2042 and 2090 to 2099. With a radical reorganization of land use, tropical and boreal forests would be preserved, temperate regions would serve as cropland, and semiarid savannas and grasslands would be used as pastureland. Such optimization could double worldwide food production while reducing water consumption and increasing carbon storage. The resulting changes in agriculture would also make an important contribution to climate change mitigation. ■

*More information:*

*Lithium:*

[https://www.kit.edu/kit/english/pi\\_2023\\_066\\_pi\\_sustainable-lithium-for-many-decades.php](https://www.kit.edu/kit/english/pi_2023_066_pi_sustainable-lithium-for-many-decades.php)

*Land use:*

[https://www.kit.edu/kit/english/pi\\_2023\\_080\\_land-use-producing-more-food-and-storing-more-carbon.php](https://www.kit.edu/kit/english/pi_2023_080_land-use-producing-more-food-and-storing-more-carbon.php)

## SUSTAINABILITY IN TEACHING

## Education for Sustainable Development

Teaching is one of KIT's core tasks. A particular focus at KIT is training and educating the experts of tomorrow to meet social and transformational challenges. With its "Leitbild für Lehre" (guiding principles for teaching), KIT's goal is to prepare students for the responsibilities associated with these challenges, and Education for Sustainable Development (ESD) is a key component. As a university, KIT has a high degree of autonomy in implementing ESD – and considerable responsibility.

As an overall educational concept, ESD aims not only to impart knowledge and expertise (e.g. a discipline's potential contributions to sustainable development) and to develop the relevant interdisciplinary skills needed for shaping a more sustainable future, but also to focus on the learning environment itself. Course development can be centralized or decentralized. With regard to undergraduate courses, the existing ESD course offerings are undergoing a structural review for the purposes of raising ESD's visibility and systematically improving the curriculum.

Students are actively involved in the KIT Sustainability Project to work out future choices and ideas for the implementation of ESD, and criteria for prioritizing them. This includes aspects of course planning, curriculum development, professorship and staff planning, and train-the-trainer programs for teaching staff. KIT's wide range of existing activities, courses, and concepts for learning about ESD serves as a starting point.

At the 2023 annual Spring Sustainability Academy held by the ZAK | Center for Cultural and General Studies, the focus was on sustainable agriculture. Food and consumerism, land use and bioeconomy were explored and discussed for students and the general public in workshops, excursions, a public keynote speech, and a panel discussion.

KIT is working with the Eucor universities in Basel and Freiburg to enhance ESD collaboration with a new joint sustainability certification. KIT's "Zentrum für Lehrerbildung" (center for teacher education) offers a "BNE für



Trade-offs and conflicts involving productivity and sustainability in agriculture were discussed at the Spring Sustainability Academy. [193]

Lehramtsstudierende" (ESD for teaching degree students) course in partnership with KLIMA ARENA Sinsheim as an extracurricular learning venue.

Students at the Institute for School Pedagogy and Didactics designed interdisciplinary ESD learning stations with the "MINT Bewegt Nachhaltig" (STEM keeps moving) school laboratory in the Interdisciplinary Didactics of STEM Subjects and Sports department. In the District Future – Urban Lab, a real-world laboratory in the Oststadt district of Karlsruhe, the lab is available to school classes in 6th to 9th grades. ■

*More information:*

*KIT "Leitbild für Lehre" (in German):*

<https://www.sts.kit.edu/452.php>

*Education for Sustainable Development:*

<https://www.unesco.de/en/education/education-sustainable-development>

*KIT as a place of learning for ESD (in German):*

<https://www.so.kit.edu/75.php>



## SUSTAINABILITY IN INNOVATION AND TRANSFER

## From Climate Crisis to Sustainability Innovation Campus

## Costs of the Climate Crisis

The impact of the climate crisis is often felt more strongly in developing countries than in industrialized nations. Many countries in the Global South, especially island and coastal regions, will increasingly face climate-related hazards from flooding, drought, rising sea level, fires, and storms in the future. In addition to their direct impact, such natural disasters also have immense financial costs that the countries are unable to bear on their own. In some years, such countries could suffer losses equivalent to 50 to 100 percent of their gross domestic product due to extreme weather events.

In the run-up to the UN's COP28 climate conference, researchers from KIT's Center for Disaster Management and Risk Reduction Technology, Risklayer GmbH (a KIT spinoff), and the University of Cambridge examined the potential role of public-private partnerships. In combination with technical and local measures, an insurance fund with a so-called umbrella stop-loss mechanism could mitigate the financial consequences of events caused by climate change and limit the economic losses.

The researchers showed how affected developing countries could remain insured through public-private partnerships and recover from damages in spite of

Researchers from KIT and the University of Freiburg plan to work with government, industry, and civil society on sustainability issues at the Sustainability Innovation Campus. [194]

the increasing risks due to climate change. Wealthy individuals and companies with annual profits of more than ten million euros could play a key role in financing the insurance fund.

## Development Phase for Sustainability Innovation Campus Begins

With the Sustainability Innovation Campus, Baden-Württemberg's Ministry of Science, Research and the Arts is funding a joint initiative of KIT and the University of Freiburg. It will fund climate action, well-being, and resource conservation projects with partners from civil society, industry, academia, and government to promote leaps of innovation toward a sustainable future.

Nearly all scientific disciplines will join in interdisciplinary efforts to find solutions that safeguard the natural basis for life. With relevant initiatives, the program will promote knowledge, awareness, and environmentally friendly actions among students and other target groups.

For the development phase, which began in 2023, Baden-Württemberg provided funding to establish networks, start preparatory projects, and set up dialog channels. The aim is to develop a plan for transforming the urban regions of the future and making the Upper Rhine region an international beacon for sustainability research and implementation, according to Baden-Württemberg's science minister, Petra Olschowski. ■

More information:

Climate crisis:

[https://www.kit.edu/kit/english/pi\\_2023\\_100\\_costs-of-the-climate-crisis-an-insurance-umbrella-for-nations-at-risk.php](https://www.kit.edu/kit/english/pi_2023_100_costs-of-the-climate-crisis-an-insurance-umbrella-for-nations-at-risk.php)

Sustainability Innovation Campus:

<https://www.kit.edu/b4/24590.php>

<https://mwk.baden-wuerttemberg.de/delforschung/forschungslandschaft/innovationscampus-nachhaltigkeit>

## SUSTAINABILITY IN INFRASTRUCTURE

## Climate-neutral Buildings and Infrastructure at KIT

From everyday work to infrastructure, KIT's sustainability strategy stresses ecological sustainability in the coming years. The KIT Sustainability Project includes a work package for this purpose; it involves identifying required actions in a number of topic clusters and developing plans for implementing them: Sustainability as a basic mindset, personal actions in the workplace, mobility, events, procurement, green spaces and climate change adaptation, supply and disposal infrastructures, building infrastructure (life cycle) and sustainability management. Reaching carbon neutrality at KIT is to be achieved mainly by using resources more efficiently and shifting away from fossil energy sources while adapting to the effects of climate change and promoting nature conservation.

An important aspect of sustainability in operations and infrastructure at KIT is the Construction Plan for developing the built infrastructure for research, teaching, and innovation in accordance with urban development planning while also developing open spaces according to aesthetic and ecological criteria. Construction activity receives sustainability certification according to the Assessment System for Sustainable Building.

The two InformatiKOM buildings, which were built to the BNB silver standard by the Klaus Tschira Foundation, were put to use in 2023. The green space maintenance program for Campus North was revised with an emphasis on resource efficiency and biodiversity and contracted out. Its implementation will be supervised by KIT's Institute of Geography and Geoecology.

In building operations and supply infrastructure, funding from the Helmholtz Association was used to install LED lighting in eight buildings and plan another 1,700 kW of photovoltaic peak capacity. A groundwater monitoring plan for Campus North was developed to tap the potential of near-surface geothermal energy for heating. Ten new charging stations for electric vehicles were installed to boost the electrification of KIT's vehicle fleet. The charging stations are also available to employees and visitors, making electric mobility more attractive for everyday use. Following the successful organic certification of the KIT canteen and the introduction of reusable dishes for takeout, KIT's major events are also becoming



At the Karlsruhe Center for Optics and Photonics (currently under construction), KIT is implementing an especially sustainability-focused building design. [195]

more environmentally friendly. Vegetarian, vegan, and regional cuisine are always on offer. KIT Science Week, KIT's annual celebration, and the open day all earned the Green Event BW seal. ■

More information:

Sustainability at KIT:

<https://www.kit.edu/kit/english/sustainability.php>

InformatiKOM opening:

[https://www.kit.edu/kit/english/pi\\_2023\\_090\\_opening-ceremony-for-informatikom-informatics-and-science-communication-brought-together-in-new-buildings.php](https://www.kit.edu/kit/english/pi_2023_090_opening-ceremony-for-informatikom-informatics-and-science-communication-brought-together-in-new-buildings.php)

KIT Sustainability Project ("Basisprojekt Nachhaltigkeit", in German):

<https://www.so.kit.edu/basisprojekt.php>

Tables with sustainability information start on page 167.





## PRIZES, HONORS, AWARDS, AND APPOINTMENTS

The KIT Executive Board and the KIT Senate passed resolutions in 2023 awarding honorary titles in accordance with the university's standards.

KIT honored two outstanding figures with a Needle of Merit: Professor Dr. Johannes Blümer and Professor Dr. Norbert Henze. Blümer played a central role in establishing KIT and advancing its development, especially in the fields of elementary particle and astroparticle physics, and he was committed to promoting international cooperation between KIT and the Universidad Nacional de San Martín in Buenos Aires and between Germany and Argentina in general. With Henze, KIT honored a dedicated professor who was a pioneer in the use of innovative teaching and

learning formats at the university and serves as chairperson of Karlsruher Studentendienst e.V., a student services organization.

KIT also awarded four Medals of Merit. Professor Dr. Michel Deneken, President of the University of Strasbourg, was honored for his services to cross-border German-French cooperation in research and teaching between KIT and the University of Strasbourg and for establishing the European university alliance EPICUR. Wolfgang Globke was recognized for his extraordinary efforts on behalf of KIT in supporting young scientists with the Deutschlandstipendium. Susanne Schroff received a Medal of Merit for her extraordinary efforts on behalf of KIT in sponsoring

outstanding scientists and students through the Schroff Foundations. Renate Sick-Glaser was awarded the Medal of Merit for her outstanding service to KIT in supporting young scientists in the STEM disciplines through the Gisela and Erwin Sick Foundation via the KIT Foundation.

Dr. Elfi Schmitt was named an honorary citizen of KIT, honoring her outstanding efforts benefiting KIT through the establishment of the Hajo Schmitt endowment (under the umbrella of the KIT Foundation) in memory of her deceased husband.





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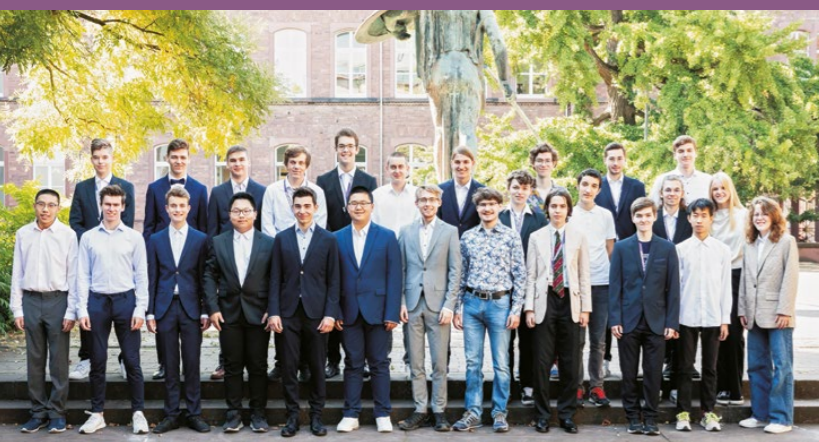
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## GREEN GENETIC ENGINEERING

## Holger Puchta Receives Funding for Reinhart Koselleck Project on Targeted Restructuring of Plant Genomes

Certain plant traits are passed on together because the genes for those traits are on the same chromosome. But with the modern CRISPR/Cas molecular scissors, genetic information in plants can now be modified in a targeted manner. The group headed by Dr. Holger Puchta, a professor of molecular biology at KIT's Joseph Gottlieb Kölreuter Institute for Plant Sciences (JKIP), demonstrated recently for the first time that not only individual genes but entire chromosomes can be modified in this way. To establish techniques for targeted restructuring of plant genomes, Puchta received funding for a Reinhart Koselleck project from the German Research Foundation (DFG). The project's aim is to combine genes freely in cultivated plants.

Holger Puchta received funding from the German Research Foundation for a Reinhart Koselleck project. [206]



In the face of global warming, existing crops need more land, more water, and more fertilizer. With genetic scissors, plants can be modified to cope better with heat. Moreover, the CRISPR/Cas method can make plants more resistant to diseases and pests, reducing the need for pesticides. CRISPR/Cas designates a genetic engineering technique based on a certain DNA sequence (CRISPR, Clustered Regularly Interspaced Short Palindromic Repeats) and an enzyme (Cas) that detects the DNA sequence and cuts the DNA molecule at exactly the right location. Certain individual plant traits have already been improved using this method.

Puchta's Reinhart Koselleck project aims to exploit the method's full potential by the targeted reorganization of plant genomes at various levels. Since they can be used to modify the sequence of genes on chromosomes, genetic scissors enable plant traits to be combined as needed. Desirable crop traits such as heat resistance and salt tolerance can then be passed on together. In the long term, it will become easier for plant breeders to use the entire gene pool of a species and systematically optimize crops.

The project is scheduled to last five years and is funded with EUR 1.22 million. Reinhart Koselleck projects are the highest-endowed grants to excellent scientists by the DFG. The grants enable outstanding researchers with a proven scientific track record to pursue exceptionally innovative or high-risk, high-benefit projects. ■

*More information:*

*JKIP department of molecular biology (in German):*

<https://www.jkip.kit.edu/molbio/index.php>

*Video featuring Professor Dr. Holger Puchta (in German):*

<https://www.youtube.com/watch?v=BmcpwHmux3k>

## ULF GRENANDER PRIZE

## Foundations of Scientific Weather Forecasting

"What will the weather be tomorrow?" This has always been a challenging question since we know that weather is a complex and chaotic system. Intensive cooperation between meteorologists and mathematicians has led to major improvements in the methods used in weather forecasting.

One of the most influential researchers in this field, Professor Dr. Tilmann Gneiting, won the American Mathematical Society's (AMS) 2024 Ulf Grenander Prize in Stochastic Theory and Modeling. Gneiting is Scientific Director of the Heidelberg Institute for Theoretical Studies (HITS) and heads the Computational Statistics group there. He is also a professor of computational statistics in KIT's Department of Mathematics.

"Gneiting's foundational work on statistical post-processing for numerical weather forecasts provides the basis for current practice worldwide," noted the AMS in its official announcement. "Gneiting is most widely known for foundational work on probabilistic forecasting. His two very highly cited 2007 papers have attracted considerable attention in the real-world weather forecasting community, including the European Centre for Medium-Range Weather Forecasts, with which Gneiting has conducted extensive research." The prize was awarded at the Joint Mathematics Meetings in San Francisco in January 2024.

A common thread of Gneiting's research is a thorough theoretical treatment deeply rooted in analysis, probability theory, and mathematical statistics, yet driven by applications, particularly in the atmospheric, environmental, and earth sciences.

With the Ulf Grenander Prize, which is awarded every three years, the AMS recognizes exceptional theoretical and applied contributions in stochastic theory and modeling. The prize is awarded for seminal work in the fields of probabilistic modeling, statistical inference, or related computational algorithms, in particular for the analysis of complex or high-dimensional systems.

HITS was established in 2010 by physicist and SAP co-founder Klaus Tschira (1940–2015) and the Klaus Tschira Foundation as a private, non-profit research institute.



Tilmann Gneiting, Scientific Director of HITS and Professor at the KIT Department of Mathematics, won the 2024 Ulf Grenander Prize in Stochastic Theory and Modeling. [207]

It conducts basic research in the natural, mathematical, and computer sciences. Klaus Tschira studied physics at the University of Karlsruhe, a KIT predecessor institution. ■

*More information:*

*Computational Statistics group at HITS:*

<https://www.h-its.org/research/cst/>

*KIT Department of Mathematics:*

<https://www.math.kit.edu>



## MOBILECITY APP WINS GERMAN MOBILITY PRIZE

## Simulating an Ecologically and Economically Sustainable Urban Mobility System

The transport sector accounts for about a fifth of Germany's greenhouse gas emissions. Measures taken thus far to reduce its share have not been enough. But how can municipalities change their local mobility systems?

With the MobileCity app in its MobileCityGame project, a consortium of three Karlsruhe institutions (the Fraunhofer Institute for Systems and Innovation Research, the Fraunhofer Institute of Optronics, System Technologies and Image Exploitation, and KIT) and Düsseldorf-based takomat GmbH developed a powerful simulator for planning sustainable and financially viable mobility systems. Their research project won the 2023 German Mobility Prize in the Digital Transformation & Data Driven Mobility category.

The MobileCity app is a game that provides an intuitive understanding of the core functionality of complex transport systems. Using Karlsruhe as an example, the players experience the various effects and dependencies that different changes in urban transport can have on climate, quality of life, and finances through 2050. Its realistic future scenarios are intended to promote clearer and better-informed discussions, facilitate participation, and support teaching at universities. The app is based on scientific simulation and analysis models, expert knowledge, and data from the city of Karlsruhe. It is the only

app worldwide on which a complete transport model runs locally on a smartphone or tablet.

The goal in the game is to enable a successful urban mobility transition that achieves climate targets. Researchers from KIT's Institute of Vehicle Systems Technology modeled the project's technical transport solutions with regard to availability, emissions, and costs.

Other KIT institutions involved in the project were the Institute for Transport Studies, the Institute of Economics, and the Institute of Product Engineering. The app's first use case is the city of Karlsruhe. In a follow-up project, CarGoNE-City, the scientists will upgrade the app for use with other cities.

The German Mobility Award is the innovation prize for companies, startups, networks, initiatives from the mobility and digital sectors, and municipalities and public authorities. The prize is one of the most important awards in the digital mobility sector in Germany and is awarded annually by the Federal Ministry for Digital and Transport. ■

*More information:*

*German Mobility Prize:*

<https://mobilitaetspreis.de/en/>

From left: At an event in Berlin, German Transport Minister Volker Wissing presented the German Mobility Prize to Dr. Claus Doll (Fraunhofer-Gesellschaft), Nina Rösner (takomat GmbH), and Michael König (KIT). [208]



## Other Prizes, Honors, Awards, and Appointments

### People

■ **Professor Dr. Tabea Arndt**, Institute of Technical Physics, received the Award for Continuing and Significant Contributions in the Field of Applied Superconductivity from the IEEE Council on Superconductivity.

■ **Professor Dr. Almut Arneth**, Institute of Meteorology and Climate Research Atmospheric Environmental Research, was elected a member of the European Academy of Sciences (EURASC). EURASC's mission is to promote basic research and excellence in science and technology with a vision for Europe as a whole, transcending national borders.



■ In addition, **Almut Arneth** and five other KIT researchers were among the most frequently cited scientists worldwide in 2023.

■ Tenure-track Professor Dr. Ulrich W. Paetzold, Institute of Microstructure Technology, and Emmy Noether junior research group leader **Dr. Frank Biedermann**, Institute of Nanotechnology, each received an ERC Consolidator Grant from the European Research Council.



■ **Professor Dr. Georg Bretthauer**, former head of the Institute for Automation and Applied Informatics, was awarded the Grashof commemorative medal by the Association of German Engineers (VDI) in honor of his lifetime achievements. The medal is the highest honor conferred by the VDI.

■ **Dr. Erik Bründermann**, Institute for Beam Physics and Technology, was elected chair of the Committee for Accelerator Physics and deputy chair of the Overview Board of the Digital Transformation in the Research of Universe and Matter network.

■ **Alice Carré**, a graduate of the binational mechanical engineering degree program at KIT and Institut National des Sciences Appliquées de Lyon, was awarded the Franco-German University's excellence prize.

■ **Dr. Christian Chwala**, Institute of Meteorology and Climate Research Atmospheric Environmental Research, won the Advances in Atmospheric Sciences 2023 Editor's Award.

■ **Professor Dr. Stefanie Dehnen**, Institute of Nanotechnology, was awarded the RSC/GDCh Alexander Todd-Hans Krebs Lectureship in Chemical Sciences by the Royal Society of Chemistry.



■ In addition, the German Chemical Society (GDCh) unanimously elected **Stefanie Dehnen** president at the inaugural meeting of its new board of directors. Her two-year term of office began on January 1, 2024.

■ **Professor Dr. Barbara Deml**, Institute for Human and Industrial Engineering, was reappointed to the Scientific Advisory Board of Germany's Federal Institute for Occupational Safety and Health for four more years.

■ The team headed by **Dr. Benjamin Dietrich**, Institute of Thermal Process Engineering, received the prestigious Gips-Schüle research prize for its NECOC process.



■ The 2023 Baden-Württemberg state teaching award in the innovation/transformation category went to **Tenure-track Professor Moritz Dörstelmann**, Institute for Building Design and Technology.

■ **Professor Dr. Maximilian Fichtner**, Helmholtz Institute Ulm, was awarded the “Ulmer Köpfchen” for his research on lithium-free batteries for environmentally friendly energy storage.



■ **Katharina Flügel**, Helmholtz AI Local Unit Energy, won the Erna Scheffler prize for the best master's thesis from the Soroptimist International Club Karlsruhe.

■ **Dr. Martha Maria Frysztacki**, Institute for Automation and Applied Informatics, won the Erna Scheffler prize for the best doctoral thesis from the Soroptimist International Club Karlsruhe.

■ **Dr. Richard Gebauer**, Institute for Data Processing and Electronics, was awarded a 2022 Helmholtz doctoral thesis award in the information research field in July 2023.

■ **Professor Dr. Kathrin Gerling**, Institute for Anthropomatics and Robotics, and Tenure-track Professor Dr. Philip Willke, Physikalisches Institut, each received an ERC Starting Grant from the European Research Council.



■ The American Mathematical Society's 2024 Ulf Grenander Prize in Stochastic Theory and Modeling was awarded to **Professor Dr. Tilmann Gneiting**, Scientific Director of the Heidelberg Institute for Theoretical Studies and Professor of Computational Statistics at KIT's Institute of Stochastics.

■ **Professor Dr. Alexander Grünberger**, Institute of Process Engineering in Life Sciences, received the Wiley Online Library's B&B Daniel I.C. Wang Award.

■ The Eberhard Schöck Foundation recognized two former KIT students, **Peter Haase**, Research Center for Steel, Timber and Masonry, and Johanna Stähle, Institute of Concrete Structures and Building Materials, for their master's theses with the Schöck Award for Innovation in Civil Engineering.

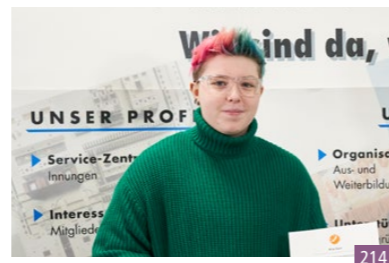
■ **Dr. Amir-Abbas Haghighirad**, Institute for Quantum Materials and Technologies, and five other KIT researchers were among the most frequently cited scientists worldwide in 2023.

■ **Professor Dr. Holger Hanselka**, former President of KIT, received the “Kulturpreis für Völkerverständigung” from the organizers of Karlsruhe's annual “Fest der Völkerverständigung.”

■ **Dr. Bastian Härer**, Institute for Beam Physics and Technology, was elected to the Committee for Accelerator Physics as a representative of the universities.

■ **Dr. Andreas Haungs**, Institute for Astroparticle Physics, was elected spokesperson of the PUNCH4NFDI NFDI consortium.

■ **Kira Heid**, former trainee photographer in General Services, was one of the winners in Baden-Württemberg's state craft skills contest.



■ **Dr. Nadja Alina Henke**, Institute of Process Engineering in Life Sciences, received support from the Carl Zeiss Foundation's CZS Nexus program along with two other young scientists from KIT.



■ **Professor Dr. Jörg Henkel**, Institute of Computer Engineering, was appointed a fellow of the Association for Computing Machinery.

■ **Professor Dr. Thomas Hirth**, Vice President Transfer and International Affairs, was confirmed as Vice President of Eucor – The European Campus by the assembly of the rectors/presidents of its member universities.

■ **Professor Dr. Marlis Hochbruck**, Institute for Applied and Numerical Mathematics, was appointed to a four-year term on the Scientific Advisory Board of the Oberwolfach Research Institute for Mathematics from January 1, 2023.



■ In addition, **Marlis Hochbruck** took on the role of section editor for the Survey and Review section of the prominent research journal SIAM effective January 1, 2023.

■ **Michaela Hofbauer**, graduate of the Upper Austrian University of Applied Sciences and the University of Applied Sciences for Health Professions Upper Austria, was awarded the “Würdigungspreis” for her master's thesis at KIT's Institute for Data Processing and Electronics by the Austrian Ministry for Education, Science and Research.

■ **Professor Dr. Michael J. Hoffmann**, Institute for Applied Materials, was awarded the Seger Plaque by the Deutsche Keramische Gesellschaft.

■ **Dr. Gan Huang** and Professor Dr. Bryce Richards, Institute of Microstructure Technology, took first place in the Public Choice Award in the Best Scientific Image Contest by Helmholtz Imaging.

■ In addition, **Gan Huang** was designated one of 35 Innovators Under 35 Europe 2023 at the MIT Technology Review's EmTech Europe conference.

■ **Felix Huber**, in his third year of technical product design training at KIT, took part in the EuroSkills contest in Gdansk, Poland, in September 2023. He won a Medal of Excellence for his outstanding performance in Mechanical Engineering CAD.

■ **Dr. Alik Ismail-Zadeh**, Institute of Applied Geosciences, was reelected as chairperson of the mathematical geophysics commission in the International Union of Geodesy and Geophysics for a term from 2023 to 2027.



■ **Professor Dr. Jürgen Janek**, Institute of Nanotechnology, Scientific Director of BELLA (laboratory jointly operated by KIT and BASF SE) and research group leader at the University of Gießen, and five other KIT researchers were among the most frequently cited scientists worldwide in 2023.

■ **Dr. Noémie Jaquier**, Institute for Anthropomatics and Robotics, was one of ten newcomers recognized by the Federal Ministry of Education and Research and the Gesellschaft für Informatik e.V. for their research work and their outstanding dedication to the field of artificial intelligence.



■ During the HALO (High Altitude and Long Range Research Aircraft) Symposium on November 9, 2023, **Dr. Sören Johansson**, Institute of Meteorology and Climate Research Atmospheric Trace Gases and Remote Sensing, received the prize for the best HALO publication in 2023.

■ **Dr. Gözde Kabay**, Institute of Functional Interfaces, received support from the Carl Zeiss Foundation's CZS Nexus program along with two other young scientists from KIT.



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■ **Dr. Martin Kagerbauer**, Institute for Transport Studies, was appointed to the advisory committee on climate change mitigation and mobility in the Federal Ministry for Digital and Transport.

■ **Dr. Marek Kaluba** and Junior Professor Dr. Manuel Krannich, both at the Institute for Algebra and Geometry, each received a Frontiers of Science Award for one of their publications at the first International Congress of Basic Science.

■ **Dr. Nick Karcher**, Institute for Data Processing and Electronics, was awarded a 2022 Helmholtz doctoral thesis award in the matter research field in July 2023.

■ **Silvi Kociu** won the Schelling Architecture Foundation's Student Award for her master's thesis at the KIT Department of Architecture.

■ **Professor Dr. Christian Koos**, Institute of Photonics and Quantum Electronics, received an ERC Proof of Concept grant.

■ **Professor Dr. Anne Koziol**, KASTEL – Institute of Information Security and Dependability, and Steffen Becker, University of Stuttgart, were selected for funding in Baden-Württemberg's fellowship program for digital university teaching.

■ **Dr. Emil Kraft**, Institute for Industrial Production, received the EEX Group Excellence Award for his paper entitled "Stochastic optimization of trading strategies in sequential electricity markets."

■ Dr. Marek Kaluba and **Junior Professor Dr. Manuel Krannich**, both at the Institute for Algebra and Geometry, each received a Frontiers of Science Award for one of their publications at the first International Congress of Basic Science.

■ The German Physical Society awarded the Hertha Sponer Prize to **Professor Dr. Belina von Krosigk**, Institute for Astroparticle Physics.



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■ **Professor Dr. Uli Lemmer**, Light Technology Institute, received an ERC Advanced Grant from the European Research Council.

■ Furthermore, **Uli Lemmer** was appointed scientific director of InnovationLab GmbH, a joint innovation platform of KIT, Heidelberg University, BASF, SAP, and Heidelberger Druckmaschinen.

■ **Emeritus Professor Dr. Hans Lenk**, Institute of Philosophy, was awarded an honorary doctorate by the University of Patras, Greece.

■ **Dr. Sebastian Lins**, Institute of Applied Informatics and Formal Description Methods, won the ACM SIGMIS Doctoral Dissertation Award from the Association for Information Systems in the United States for his dissertation. He is the first doctoral researcher from Germany to receive this award.

■ **Dr. Maryna Meretska**, Institute of Nanotechnology, was admitted to the Emmy Noether Program by the German Research Foundation.

■ **Sophia Merkel**, Institute of Technology Futures, won the "Zukunftspreis Kommunikationsgeschichte" from the German Communication Association.

■ **Allen Mohammadi**, Institute for Entrepreneurship, Technology Management and Innovation, won the INFINITY Award at the Singapore Management University's Lee Kuan Yew Global Business Plan Competition for his startup, PlasticFri@.

■ **Luis Mugele**, Institute of Soil Mechanics and Rock Mechanics, won the Young Engineers Award from the Baden-Württemberg Chamber of Engineers for his master's thesis.



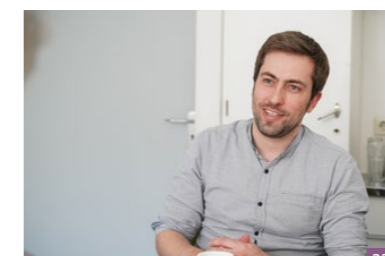
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■ **Professor Dr. Anke-Susanne Müller**, Institute for Beam Physics and Technology, became a member of the CERN Machine Advisory Committee.

■ In addition, **Anke-Susanne Müller** was appointed to the Accelerator Science working group of the International Union of Pure and Applied Physics.

■ **Dr. Boris Narozhny**, Institute for Theoretical Condensed Matter Physics, and Professor Dr. Wulf Wulfhchel, Institute of Nanotechnology, were honored as Outstanding Referees by the American Physical Society – a lifetime distinction.

■ Emmy Noether junior research group leader Dr. Frank Biedermann, Institute of Nanotechnology, and **Tenure-track Professor Dr. Ulrich W. Paetzold**, Institute of Microstructure Technology, received an ERC Consolidator Grant from the European Research Council.



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■ **Professor Dr. Stefano Passerini**, Helmholtz Institute Ulm, and five other KIT researchers were among the most frequently cited scientists worldwide in 2023.

■ **Professor Dr. Clifford Patten**, formerly at the Institute of Applied Geosciences, received the 2023 SGA-Young Scientist Award from the Society for Geology Applied to Mineral Deposits.

■ **Dr. Eva Pauli**, Institute of Meteorology and Climate Research Atmospheric Trace Gases and Remote Sensing and Institute of Photogrammetry and Remote Sensing, received the Wilhelm Lauer Prize from the Academy of Sciences and Literature in Mainz for her dissertation.

■ **Quoc Hung Pham**, Institute of Technical Physics, received the Young Researcher Prize for PhD candidates under the age of 30 during the 2023 EUCAS conference.

■ **Professor Dr. André Platzer**, KASTEL – Institute of Information Security and Dependability, was awarded an Alexander von Humboldt Professorship, Germany's best-funded research prize, for his work on secure computer assistance systems.

■ For his work on plant genomes, **Professor Dr. Holger Puchta**, Joseph Gottlieb Kölreuter Institute for Plant Sciences, received funding for a Reinhart Koselleck project from the German Research Foundation.



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■ In addition, **Holger Puchta** and five other KIT researchers were among the most frequently cited scientists worldwide in 2023.

■ **Dr. Hannes Radinger**, Institute for Applied Materials, was awarded a 2022 Helmholtz doctoral thesis award in the energy research field in July 2023.

■ Dr. Gan Huang and **Professor Dr. Bryce Richards**, Institute of Microstructure Technology, took first place in the Public Choice Award in the Best Scientific Image Contest by Helmholtz Imaging.

■ **Professor Dr. Andrea Robitzki**, head of Division I – Biology, Chemistry, and Process Engineering, was appointed to a further two-year term in Baden-Württemberg’s government council on sustainable bioeconomy.

■ **Dr. Markus Roth**, Institute for Astroparticle Physics, was elected co-spokesperson of the international Pierre Auger Collaboration.

■ **Dr. Christian Scharun**, Institute of Meteorology and Climate Research Atmospheric Trace Gases and Remote Sensing, won science slams in Heidelberg and Munich in 2023.



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■ **Jan Schaßberger**, Institute for Automation and Applied Informatics, received the Best Paper by Young Author Award at the 24th International Conference on Process Control.

■ **Professor Dr. Laurent Schmalen**, Communications Engineering Lab, was named a fellow of the Institute of Electrical and Electronics Engineers.

■ The Max Planck Institute for the Physics of Complex Systems and the Faculty of Physics at the Dresden University of Technology awarded the “Physik-Preis Dresden” to **Professor Dr. Jörg Schmalian**, Institute for Theoretical Condensed Matter Physics.

■ **Professor Dr. Wilhelm Schabel**, Institute of Thermal Process Engineering and POLiS Cluster of Excellence, was elected president of the European Coating Society.

■ **Professor Dr. Hans Peter Schmid**, Institute of Meteorology and Climate Research Atmospheric Environmental Research, received the Award for Outstanding Achievements in Biometeorology from the American Meteorological Society.

■ **Dr. Benedikt Schulz**, Institute of Stochastics, received the Outstanding Student and PhD candidate Presentation Award at the 2022 General Assembly of the European Geosciences Union in Munich.

■ **Professor Dr. Frank Simon**, Institute for Data Processing and Electronics, was appointed to the review panel for particle and nuclear physics grants in the Federal Ministry of Education and Research.



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■ **Professor Dr. Uwe Spetzger**, Institute for Anthropomatics and Robotics and director of the neurosurgery department at Klinikum Karlsruhe, received Baden-Württemberg’s Order of Merit from Minister-President Winfried Kretschmann.

■ **Professor Dr. Alexandros Stamatakis**, KIT Institute of Theoretical Informatics and Heidelberg Institute for Theoretical Studies, and five other KIT researchers were among the most frequently cited scientists worldwide in 2023.

■ The Eberhard Schöck Foundation recognized two former KIT students, Peter Haase, Research Center for Steel, Timber and Masonry, and **Johanna Stähle**, Institute of Concrete Structures and Building Materials, for their master’s theses with the Schöck Award for Innovation in Civil Engineering.

■ UNIPRENEURS, an initiative aimed at promoting German university spinoffs, honored **Professor Dr. Wilhelm Stork**, Institute for Information Processing Technology, as a UNIPRENEUR.



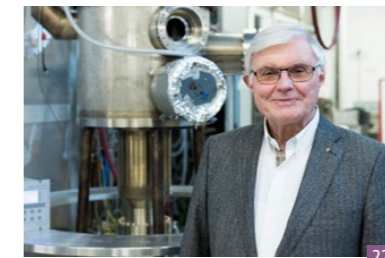
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■ **Dr. Xiaofei Sun**, Institute for Inorganic Chemistry, received the “Südwestmetall-Förderpreis” for young scientists for her dissertation.

■ On the occasion of the 50th anniversary of the International Symposium on Computer Architecture, an expert committee selected and presented the most influential and enduring papers in the field of computer architecture in the last 50 years. Among the selected papers is Printed Microprocessors by **Professor Dr. Mehdi Tahoori**, Institute of Computer Engineering.

■ The Gesellschaft für Datenschutz und Datensicherheit honored **Dr. Scott Thiebes**, Institute of Applied Informatics and Formal Description Methods, for his outstanding dissertation with its 2023 dissertation prize for IT security.

■ The Scientific Council of Karazin Kharkiv National University in Kharkiv, Ukraine, awarded an honorary doctorate to **Professor Dr. Manfred Thumm**, former head of the Institute for Pulsed Power and Microwave Technology, for his many years of fruitful collaboration in the field of plasma physics.



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■ **Jonas Ullmann**, Engler-Bunte Institute, received the DVGW “Studienpreis Wasser” from the German Technical and Scientific Association for Gas and Water (DVGW).

■ **Dr. Bernhard Vogel**, Institute of Meteorology and Climate Research Troposphere Research, received the 2023 European Aerosol Assembly Award.

■ **Junior Professor Dr. Ingo Wagner**, Institute for School Pedagogy and Didactics, and his team won second place in the 2023 “Lernort-Labor-Preis” in the STEM education for teachers category with their “MINT in Bewegung” school laboratory.



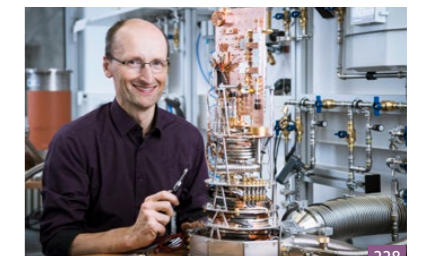
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■ **Professor Dr. Alexander Waibel**, Institute for Anthropomatics and Robotics, was named a Fellow of the Explorers Club.

■ The Microoptics Conference (MOC) hosted by the Japan Society of Applied Physics honored **Professor Dr. Martin Wegener**, Institute of Applied Physics, with an MOC Award.

■ **Professor Dr. Christof Weinhardt**, Institute of Information Systems and Marketing, was appointed by the Senate of the University of Kaiserslautern-Landau to another three-year term on the university’s External Research Advisory Board.

■ The European Research Council (ERC) selected the international project Quantum Technologies for Axion Dark Matter Search (DarkQuantum) for funding with an ERC Synergy Grant. **Professor Dr. Wolfgang Wernsdorfer**, Physikalisches Institut, is one of the project’s head researchers.



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■ Professor Dr. Kathrin Gerling, Institute for Anthropomatics and Robotics, and **Tenure-track Professor Dr. Philip Willke**, Physikalisches Institut, each received an ERC Starting Grant from the European Research Council.

■ In addition, **Philip Willke** received the Hector Research Career Development Award from the Hector Fellow Academy.

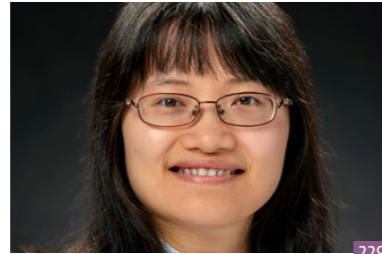
■ **Jessica Wolf**, business informatics student, was runner-up in the German taekwondo championships.

■ **Dr. Joachim Wolf**, Institute of Experimental Particle Physics, was elected vice president of the Deutsche Vakuum Gesellschaft.

■ The German Society for Sustainable Energy Carriers, Mobility and Carbon Cycles awarded the Carl Zerbe Prize for young scientists to **Tenure-track Professor Dr. Moritz Wolf**, Institute of Catalysis Research and Technology.

■ Dr. Boris Narozhny, Institute for Theoretical Condensed Matter Physics, and **Professor Dr. Wulf Wulfhekel**, Institute of Nanotechnology, were honored as Outstanding Referees by the American Physical Society – a lifetime distinction.

■ **Dr. Jingyuan Xu**, Institute of Microstructure Technology, received support from the Carl Zeiss Foundation's CZS Nexus program along with two other young scientists from KIT.



■ In addition, **Jingyuan Xu** received the Sadi Carnot Award, a Young Researchers' Award from the International Institute of Refrigeration.

■ **Dr. Karl-Friedrich Ziegahn**, former head of Division IV – Natural and Built Environment and KIT Distinguished Senior Fellow, was elected chairperson of the university board at the University of Augsburg.

■ As one of Germany's top athletes in jujutsu, **Daniel Zmeev**, business informatics student, was awarded the Silbernes Lorbeerblatt by the German President.

#### Groups and Institutions

■ In November, four **bachelor's degree students** from KIT took second place in COSIMA (Competition of Students in Microsystems Applications) with their flexible PCR diagnostic unit.

■ The KIT spinoff **nanoshape GmbH** won the Karlsruhe Technology Region's NEO2023 Jury Prize worth EUR 20,000 for its surface technology for anti-inflammatory medical implants.

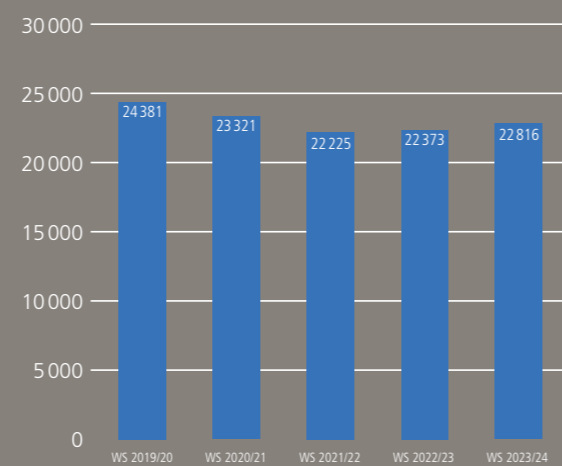
■ A **team of chemical engineering, bioengineering, and food chemistry students** won the ECOTROPHILIA Europe contest by developing a beverage made from stinging nettles and ground elder.

■ **Valoon**, a KIT startup, won the founder's prize in the startup contest for digital innovations sponsored by the Federal Ministry for Economic Affairs and Climate Action.

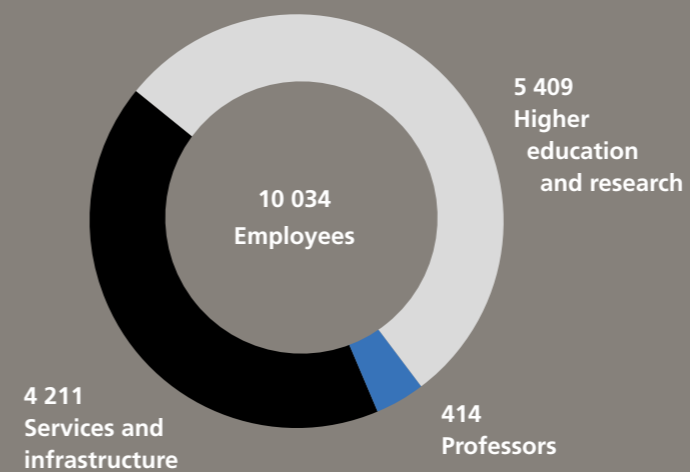


# FACTS AND FIGURES

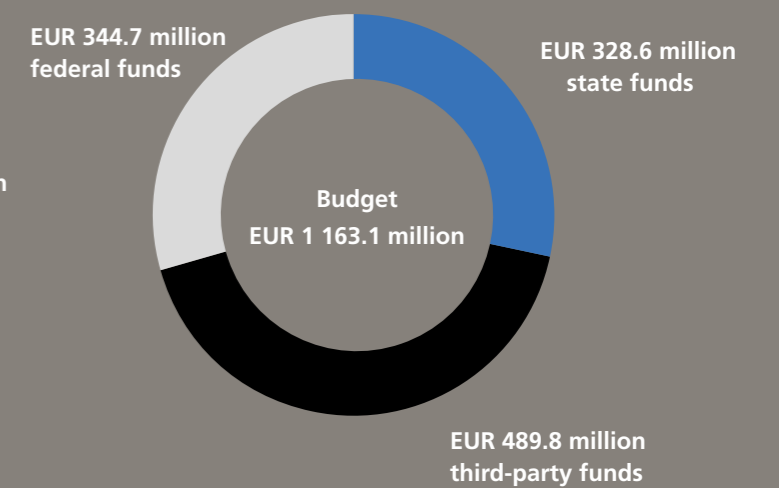
Number of students



Employees 2023



Total budget 2023





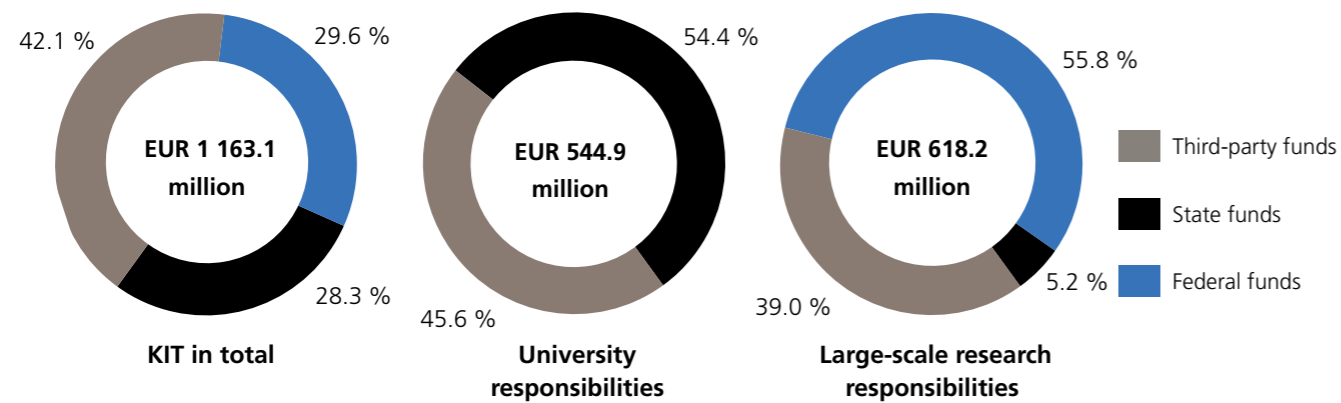
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## Funding

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



### Sources of Funding

#### KIT in Total

In million euros	2019	2020	2021	2022	2023
Income in total	951.3	955.8	1 071.4	1 101.1	1 163.1
Third-party funds	369.7	388.4	432.7	457.0	489.8
State funds	271.4	278.5	305.0	312.4	328.6
Federal funds	310.2	288.9	333.7	331.7	344.7

#### University Responsibilities

In million euros	2019	2020	2021	2022	2023
Income in total	466.7	480.4	510.1	531.4	544.9
Third-party funds	224.4	230.9	237.0	250.4	248.5
State funds	242.3	249.5	273.1	281.0	296.4
Federal funds*	0.0	0.0	0.0	0.0	0.0

\* Federal funds for university responsibilities are included in the third-party funds, as they are granted for special projects rather than for basic funding.

#### Large-scale Research Responsibilities

In million euros	2019	2020	2021	2022	2023
Income in total	484.6	475.4	561.3	569.7	618.2
Third-party funds	145.3	157.5	195.7	206.0	241.3
State funds	29.1	29.0	31.9	31.4	32.2
Federal funds	310.2	288.9	333.7	331.7	344.7

Federal and state funds for large-scale research responsibilities also include the revenues/outstanding sums from the previous year.

### Sources of Third-party Funding

#### KIT in Total

In million euros	2019	2020	2021	2022	2023
Third-party funding in total	369.7	388.4	432.8	457.0	489.8
Third-party funding by DFG, incl. CRC	59.9	53.6	63.9	70.6	62.5
Third-party funding by EU	28.5	30.9	26.4	43.3	37.2
Third-party funding by Fed. and State	142.6	169.1	195.0	205.0	264.4
Other income	138.7	134.8	147.5	138.1	125.7

#### University Responsibilities\*

In million euros	2019	2020	2021	2022	2023
Third-party funding in total	224.4	230.9	237.0	250.4	248.5
Third-party funding by DFG, incl. CRC	45.1	41.3	47.1	47.5	41.5
Third-party funding by EU	11.0	11.9	8.6	13.2	13.5
Third-party funding by Fed. and State	91.2	105.9	108.2	114.8	141.8
Other income	77.1	71.8	73.1	74.9	51.7

\* Third-party funds shall be all income and allowances granted for university responsibilities under the University Funding Agreement I in addition to basic funding.

#### Large-scale Research Responsibilities

In million euros	2019	2020	2021	2022	2023
Third-party funding in total	145.3	157.5	195.8	206.6	241.3
Third-party funding by DFG, incl. CRC	14.8	12.3	16.8	23.1	21.0
Third-party funding by EU	17.5	19.0	17.8	30.1	23.7
Third-party funding by Fed. and State	51.4	63.2	86.8	90.2	122.6
Other income	61.6	63.0	74.4	63.2	74.0

### Use of Funds

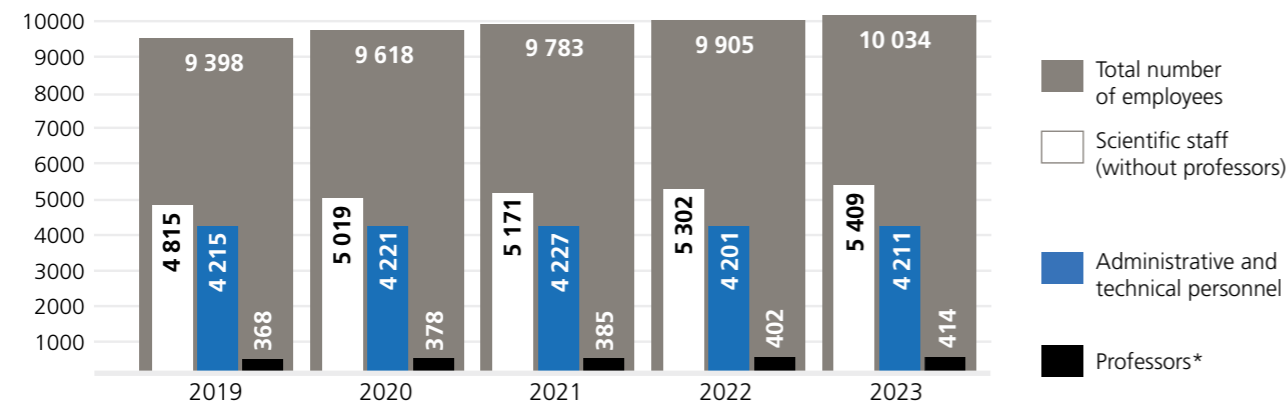
In million euros	KIT in Total	University Responsibilities	Large-scale Research Responsibilities
Expenses in total	1 163.1	544.9	618.2
Investments in total	95.5	20.3	75.2
of these, major investments	17.7	0	17.7
of these, ongoing investments	77.8	20.3	57.5
Personnel expenses	711.6	388.9	322.7
Material expenses	356.0	135.7	220.3



## Personnel Information

### KIT Staff in Total

Staff (headcount)	2019	2020	2021	2022	2023
Total number of employees	9 398	9 618	9 783	9 905	10 034
of these, female employees	3 553	3 636	3 754	3 857	3 961
Professors*	368	378	385	402	414
of these, female professors	54	59	63	72	81
of these, junior professors	11	17	24	31	31
of these, female junior professors	3	5	8	9	8
of these, international professors	43	44	46	50	53
of these, endowed professors	6	10	9	8	8
Scientific staff (without professors)	4 815	5 019	5 171	5 302	5 409
of these, female scientists	1 317	1 385	1 478	1 570	1 637
of these, staff financed from third-party funds	2 446	2 543	2 614	2 652	2 604
of these, international employees	1 135	1 240	1 359	1 481	1 633
of these, employment contracts of limited duration	3 737	3 925	4 049	4 141	4 225
of these, part-time employees	1 605	1 634	1 638	1 670	1 757
Administrative and technical personnel	4 215	4 221	4 227	4 201	4 211
of these, female staff	2 182	2 192	2 213	2 215	2 243
of these, staff financed from third-party funds	751	679	713	759	730
of these, international employees	223	237	246	255	267
of these, employment contracts of limited duration	845	859	876	870	883
of these, part-time employees	1 149	1 172	1 169	1 204	1 229
of these, trainees and students of Baden-Württemberg Cooperative State University	371	370	367	368	358
of these, female trainees and students	140	140	136	135	139
Trainees' share in the total number of employees [%]	4	4	4	4	4



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

### Habilitations

	2019	2020	2021	2022	2023
Total	12	9	13	12	17
Men	10	7	11	9	11
Women	2	2	2	3	6

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

Name, division	Professorship	Previous employer institution
Prof. Dr. Daniel Banuti, Division III	Wasserstoff basierte Energiesysteme	The University of New Mexico
Prof. Dr. Sebastian Bauer, Division V	Didaktik der Mathematik	Georg-August-Universität Göttingen
Prof. Dr. Martin Cichon, Division III	Mobilitäts- und Fahrzeugsysteme für hohe Transportkapazität	TH Nürnberg
Prof. Dr. Matthias Fuchs, Division V	Laserbasierte Teilchenbeschleuniger	University of Nebraska-Lincoln
Prof. Dr. Gerardo Hernandez-Sosa, Division III	Printed Electronic Materials and Systems	KIT
Prof. Dr. Dirk Holtmann, Division I	Elektrobiotechnologie	Technische Hochschule Mittelhessen
Prof. Andrea Klinge, Division IV	Konstruieren und Entwerfen	ZRS Architekten Ingenieure
Prof. Dr. Britta Klopsch, Division II	Schulpädagogik – Lehramt an Gymnasien	KIT
Prof. Dr. Tobias Kohn, Division II	Informatik und ihre Didaktik	University of Cambridge
Prof. Dr. Moritz Kreysing, Division I	Experimentelle Biophotonik in den Lebenswissenschaften	Max-Planck-Institut für molekulare Zellbiologie und Genetik
Prof. Dr. Marvin Künnemann, Division II	Theoretische Informatik	RPTU Kaiserslautern-Landau
Prof. Dr. Anna-Maria Meister, Division IV	Architekturtheorie	TU Darmstadt
Prof. Dr. Thomas Meurer, Division I	Digital Process Engineering for Sustainable Materials and Energy	Christian-Albrechts-Universität zu Kiel
Prof. Dr. Anne Meyer, Division III	Data Science im Maschinenbau	TU Dortmund
Prof. Dr. Raffaella Mirandola, Division II	Software Engineering for Self-adaptive Systems	Politecnico di Milano
Prof. Dr. Katja Mombaur, Division II	Optimization and Biomechanics for Human-Centred Robotics	University of Waterloo





## Personnel Information

### → Appointments\* to W-3 University Professor at KIT

Name, division	Professorship	Previous employer institution
Prof. Dr. Ioan Pop, Division V	Quantentechnologie	KIT
Prof. Dr. Katharina Scherf, Division I	Bioaktive und funktionelle Lebensmittelinhaltsstoffe	KIT
Prof. Dr. Maria Francesca Spadea, Division III	Modellierung und Simulation für die Medizintechnik	University of Magna Graecia
Prof. Dr. Rudolph Triebel, Division II	Intelligent Robot Perception	DLR Oberpfaffenhofen
Prof. Dr. Marcel Utz, Division III	Mikrosystemtechnik	University of Southampton
Prof. Dr. Sander Wahls, Division III	Industrielle Informationstechnik	TU Delft
Prof. Dr. Gregor Wehinger, Division I	Chemische Verfahrenstechnik	TU Clausthal
Prof. Dr. Frederik Zanger, Division III	Digitalisierung der Prozessentwicklung für die Additive Fertigung	KIT

\* Appointment or entry into service

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

Name, division	Professorship	Previous employer institution
Jun.-Prof. Dr. Jens Bauer, Division III	Metamaterialien	KIT
Tenure-Track-Prof. Dr. Barbara Bruno, Division II	Künstliche Intelligenz für Autonome Systeme	EPFL Lausanne
Tenure-Track-Prof. Dr. Roland Maier, Division V	Numerik partieller Differentialgleichungen	Friedrich-Schiller-Universität Jena
Tenure-Track-Prof. Dr. Peer Nowack, Division II	KI in den Klima- und Umweltwissenschaften	University of East Anglia
Tenure-Track-Prof. Dr. Benjamin Schäfer, Division III	Künstliche Intelligenz für das Energiesystem	KIT
Tenure-Track-Prof. Dr. Frederike Zufall, Division II	Öffentliches Recht und Informatik	Max-Planck-Institut zur Erforschung von Gemeinschaftsgütern

\* Appointment or entry into service

### Appointments\* to Apl. Professor and Honorarprofessor

Name	Type	KIT department	Division
Prof. Dr. Ulrich Gengenbach	APL-Professor	MACH	Division III
Prof. Dr. Patrick Jochem	APL-Professor	WIWI	Division II
Prof. Dr. Markus Klaiber	Honorarprofessor	MACH	Division III
Prof. Dr. Gerhard Müller	APL-Professor	GEISTSOZ	Division II
Prof. Dr. Alexander Pischon	Honorarprofessor	BGU	Division IV
Prof. Dr. Hagen Wäsche	APL-Professor	GEISTSOZ	Division II

\* Appointment or entry into service

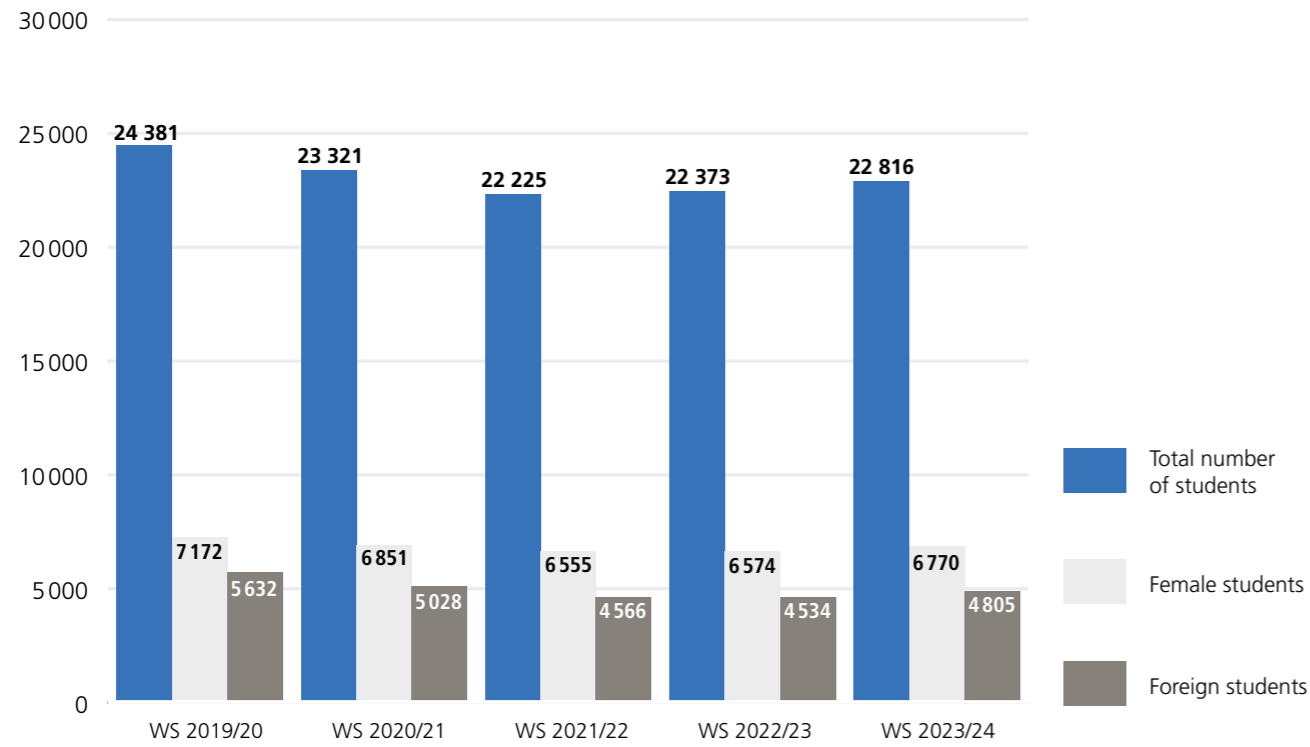
### Emeriti/Retirements

Name	Institute	Division
Prof. Henri Bava	IESL Institute for Urban and Landscape Design	Division IV
Prof. Dr. Thomas Dreier	KASTEL Institute of Information Security and Dependability	Division II
Prof. Dr. Maria Hennes	GIK Geodetic Institute	Division IV
Prof. Dr. Michael Hoffmann	IAM Institute for Applied Materials	Division III
Prof. Dr. Heinz Kalt	APH Institute of Applied Physics	Division V
Prof. Dr. Bettina Kraushaar-Czarnetzki	CVT Institute of Chemical Process Engineering	Division I
Prof. Dr. Enrico Leuzinger	IAG Institute of Algebra and Geometry	Division V
Prof. Dr. Thomas Lützkendorf	IIP Institute for Industrial Production	Division II
Prof. Dr. Jivka Ovtcharova	IMI Institute for Information Management in Engineering	Division III
Prof. Dr. Michael Plum	IANA Institute for Analysis	Division V
Prof. Dr. Ralf Roos	ISE Institute of Highway and Railroad Engineering	Division IV
Prof. Dr. Christoph Syldatk	BLT Institute of Process Engineering in Life Sciences	Division I
Prof. Renzo Vallebuona	IEB Institute for Building Design and Technology	Division IV



## Students

Students in Total



Students and Desired Degrees

Desired degree	WS 2019/20	WS 2020/21	WS 2021/22	WS 2022/23	WS 2023/24
Bachelor	13 495	13 086	12 454	12 329	12 434
Master	8 955	8 548	8 089	7 928	8 042
Teacher (secondary and vocational schools)	952	964	960	959	973
Doctorate	441	355	325	720	950
State examination	0	0	0	0	0
Diploma	32	22	4	0	0
Studienkolleg	185	148	114	168	173
No degree*	321	198	279	269	244
<b>Total</b>	<b>24 381</b>	<b>23 321</b>	<b>22 225</b>	<b>22 373</b>	<b>22 816</b>

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

Allocation of Students to Subject Groups

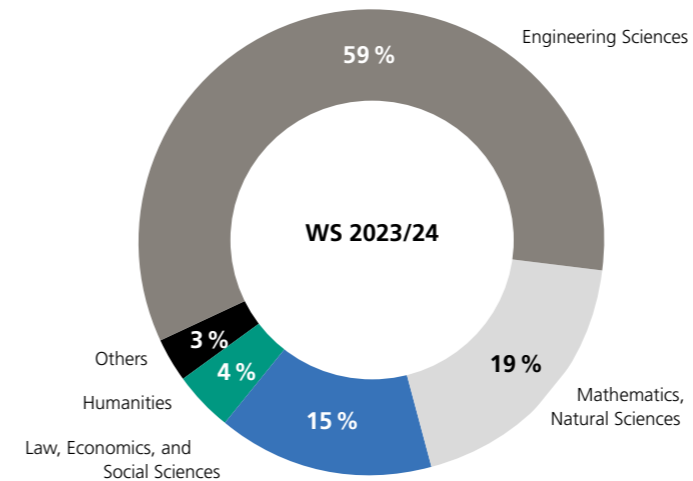
Subject group	WS 2019/20	WS 2020/21	WS 2021/22	WS 2022/23	WS 2023/24
Engineering Sciences	14 729	14 025	13 170	13 170	13 448
Mathematics, Natural Sciences	4 042	3 933	3 841	4 098	4 236
Law, Economics, and Social Sciences	3 833	3 678	3 571	3 467	3 429
Humanities	877	830	818	866	953
Others	900	855	825	772	750
<b>Total</b>	<b>24 381</b>	<b>23 321</b>	<b>22 225</b>	<b>22 373</b>	<b>22 816</b>

Allocation of Foreign Students\* to Subject Groups

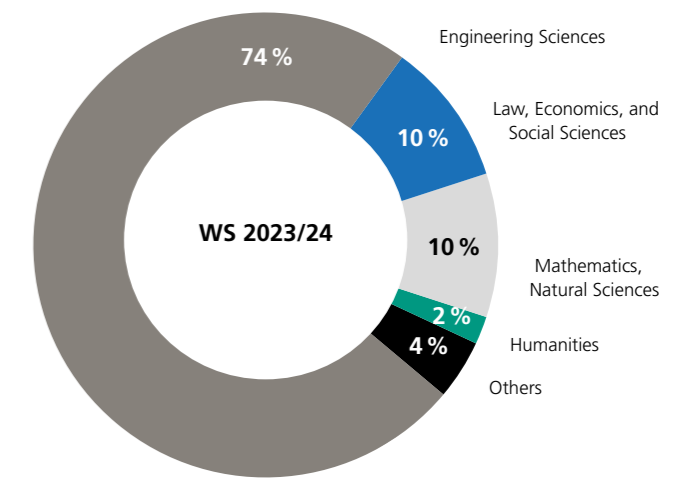
Subject group	WS 2019/20	WS 2020/21	WS 2021/22	WS 2022/23	WS 2023/24
Engineering Sciences	4 267	3 819	3 400	3 337	3 546
Mathematics, Natural Sciences	507	472	445	476	504
Law, Economics, and Social Sciences	529	487	486	446	478
Humanities	78	61	57	64	73
Others	251	189	178	211	204
<b>Total</b>	<b>5 632</b>	<b>5 028</b>	<b>4 566</b>	<b>4 534</b>	<b>4 805</b>

\*Foreign students: Not of German nationality

Allocation of Students to Subject Groups



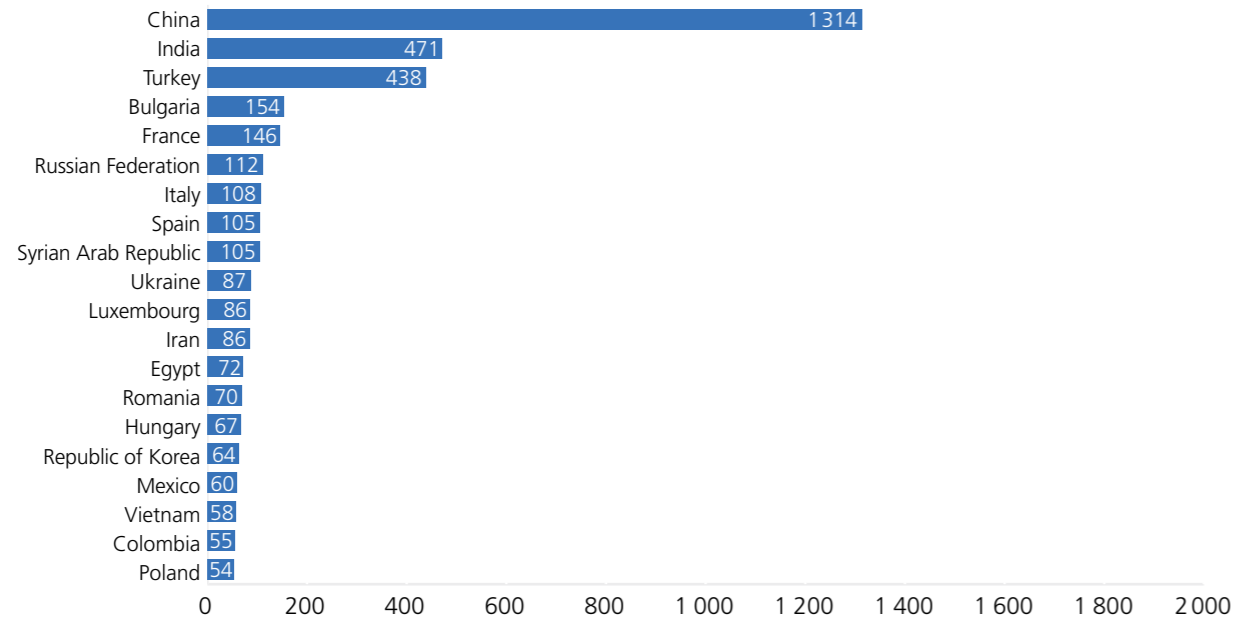
Allocation of Foreign Students to Subject Groups



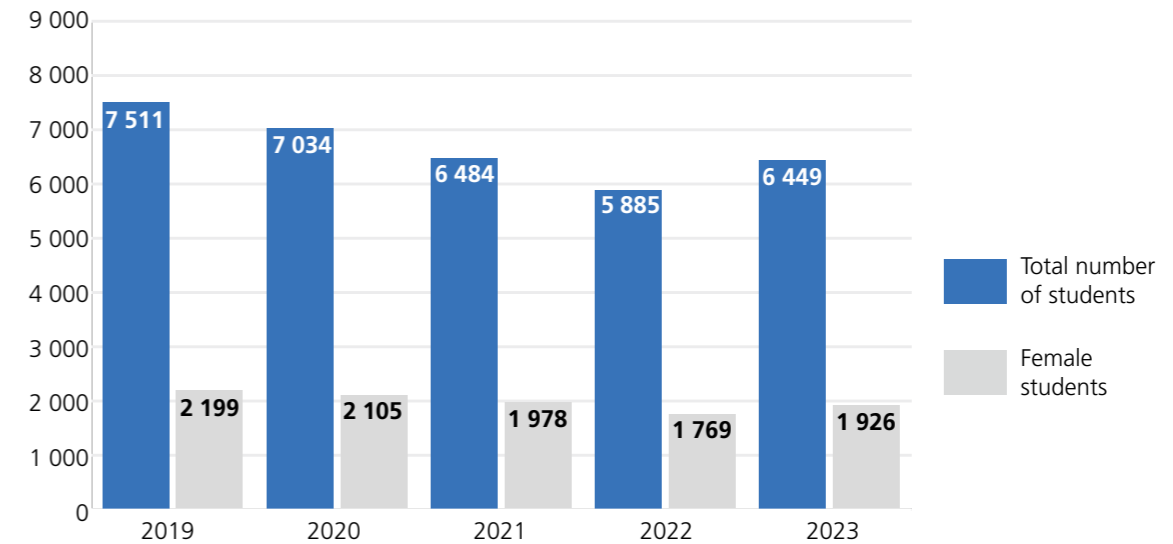


## Students

Home Countries of Foreign Students (Top 20 of 127)



Number of Student Beginners in the 1st Semester\*



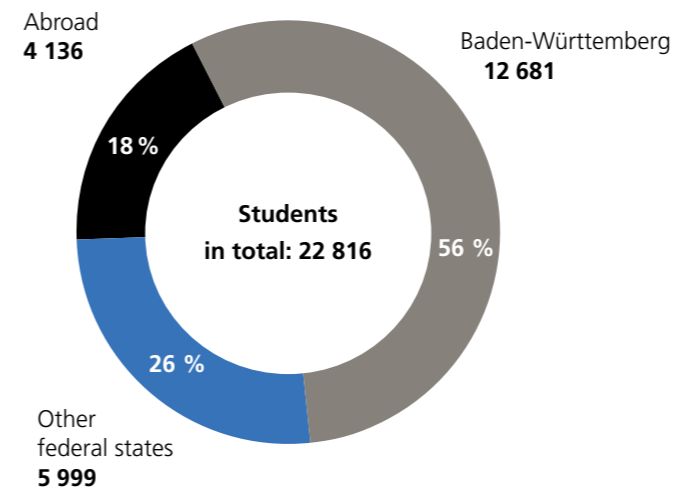
\* Without doctoral students and exchange students, who do not pursue a degree at KIT.

Student Beginners and Degrees Targeted in the 1st Semester\*

Desired degree	2019	2020	2021	2022	2023
Bachelor	4 038	3 935	3 454	3 071	3 430
Master	2 924	2 602	2 596	2 403	2 550
Bachelor's degree in teaching at secondary schools	213	185	173	178	160
Bachelor's degree in teaching at vocational schools	16	17	12	8	9
Master's degree in teaching at secondary schools	33	50	83	81	89
Master's degree in teaching at vocational schools	27	22	22	17	21
Studienkolleg	260	223	144	127	190
<b>Total</b>	<b>7 511</b>	<b>7 034</b>	<b>6 484</b>	<b>5 885</b>	<b>6 449</b>

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

Origin of Students in the 2023/24 Winter Semester\*



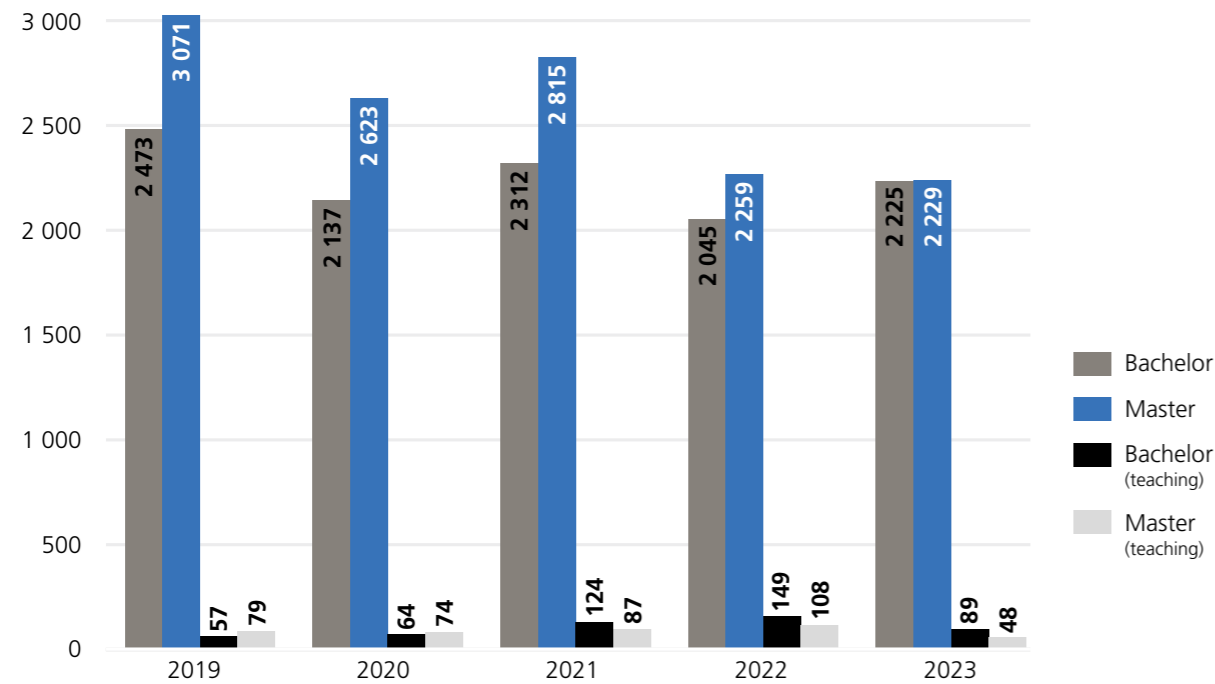
\*Place of acquisition of university entrance qualification.

Region	Students
Karlsruhe city and district	3 687
Karlsruhe Regional Council District	3 483
Rest of Baden-Württemberg	5 511
<b>Baden-Württemberg in total</b>	<b>12 681</b>
Rhineland-Palatinate	1 832
Bavaria	1 001
North Rhine-Westphalia	930
Hesse	832
Lower Saxony	406
Other federal states	998
<b>Germany without Baden-Württemberg</b>	<b>5 999</b>
Asia	2 345
Europe	1 254
Africa	162
America	368
Australia and Oceania	7
Abroad	4 136
<b>KIT in total</b>	<b>22 816</b>



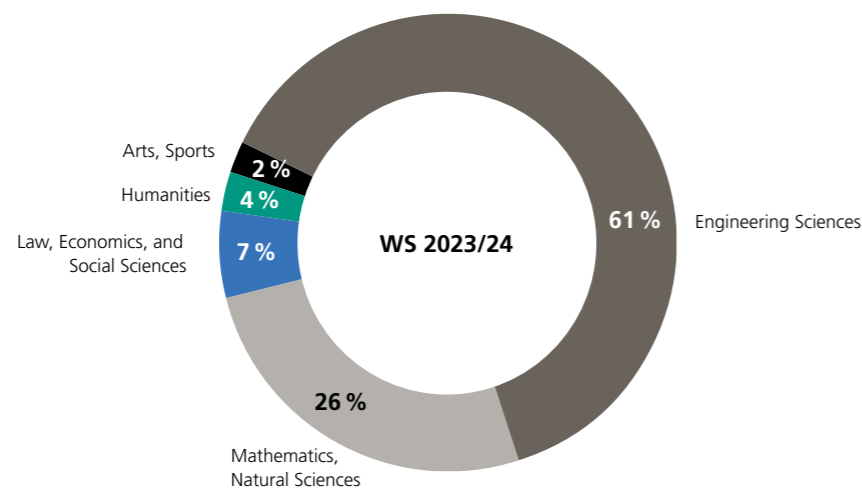
### Students

Number of Graduates



Doctoral Candidates in the Different Subject Groups

Subject group	Male	Female	Non-binary	Total
Engineering Sciences	1 628	480	0	2 108
Mathematics, Natural Sciences	527	352	1	879
Law, Economics, and Social Sciences	122	77	0	199
Humanities	61	51	0	112
Arts, Sports	31	37	0	68
<b>Total</b>	<b>2 369</b>	<b>997</b>	<b>1</b>	<b>3 367</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 (École Nationale Supérieure d'Architecture de Strasbourg, France)
Bauingenieurwesen	●	●			
Bioingenieurwesen	●	●			
Chemieingenieurwesen und Verfahrenstechnik	●	●			
Elektrotechnik und Informationstechnik	●	●			German-French Double Degrees B.Sc. and M.Sc. (Institut National Polytechnique Grenoble, France) ENTECH Master's Program (IST Lisboa, Portugal; Uppsala Universitet, Sweden; INP Grenoble, France) German-Hungarian Double Bachelor (Budapest University of Technology and Economics, Hungary)
Energy Engineering and Management				●	
Financial Engineering				●	
Funktionaler und Konstruktiver Ingenieurbau – Engineering Structures		●			
Geodäsie und Geoinformatik	●	●			German-French Double Master (Institut National des Sciences Appliquées Strasbourg, France)
Information Systems Engineering and Management				●	
Informatik	●	●	●		Double Master Informatics (Institute National Polytechnique Grenoble, France)
Management of Product Development				●	
Mobility Systems Engineering and Management				●	
Maschinenbau	●	●			German-French Bachelor's and Master's Program (Arts et Métiers ParisTech, France) German-French Bachelor's and Master's Program (Institut National des Sciences Appliquées de Lyon, France)





## Students

### → Study Programs in the Area of Engineering Sciences

Subject (program)	Bachelor	Master (consecutive)	Teacher	Master (cont. education)	Double degree
Maschinenbau (Forts.)	●	●			Dual Master's Program ( <i>Korea Advanced Institute of Science and Technology, South Korea</i> ) Double Master Vehicle or Production Technology ( <i>CDHK, Tongji University, China</i> ) Dual Master's Program ( <i>Instituto Tecnológico de Buenos Aires, Argentina</i> ) ENTECH Master's Program Energy Technologies ( <i>IST Lisboa, Portugal; Uppsala Universitet, Sweden; INP Grenoble, France</i> )
Materialwissenschaft und Werkstofftechnik	●	●			
Mechanical Engineering (International)	●				
Mechatronik und Informationstechnik	●	●			German-Bulgarian Double Degree B.Sc. ( <i>Technical University of Sofia, Bulgaria</i> )
Medizintechnik	●				
Mobilität und Infrastruktur		●			
Naturwissenschaft und Technik			●		
Optics and Photonics		●			Double Master's Program ( <i>Aix Marseille Université, France; École Centrale de Marseille, France; Universitat de Barcelona, Spain; Tampere University of Technology, Finland; Vilnius University, Lithuania</i> )
Production and Operations Management				●	
Regionalwissenschaft		●			German-Chilean Double Master's Program ( <i>Universidad de Concepción, Chile</i> )
Remote Sensing and Geoinformatics		●			
Technologie und Management im Baubetrieb		●			
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	●	●			
Geografie			●		
Geoökologie	●	●			
Geophysik / Geophysics	●	●			
Lebensmittelchemie	●	●			
Mathematik	●	●	●		German-French Bachelor-Master-Program ( <i>École Polytechnique technique Paris, Palaiseau, France</i> )
Meteorologie	●	●			
Physik / Physics	●	●	●		German-French Double Master ( <i>Université Grenoble Alpes, 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
Digital Economics (from WS 2023/2024)	●	●			
Ingenieurpädagogik			●		
Ingenieurpädagogik für Ingenieurinnen und Ingenieure			●		
Pädagogik	●	●			
Technische Volkswirtschaftslehre (expiring)	●	●			
Wirtschaftsingenieurwesen	●	●			German-French Double Master (M.Sc.) (Institut National Polytechnique Grenoble, France)

### Study Programs 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

Clusters of Excellence as Part of the Excellence Strategy Launched by the Federal and the State Governments

Spokesperson, institute, division	Title	Duration	Partner(s)
Prof. Dr. Maximilian Fichtner, Helmholtz Institute Ulm for Electrical Energy Storage, Division I Prof. Dr. Helmut Ehrenberg, Institute for Applied Materials, Division III	EXC 2154: POLiS – Post Lithium Storage Cluster of Excellence – Energiespeicherung jenseits von Lithium	01/2019 – 12/2025	Universität Ulm
Prof. Dr. Martin Wegener, Institute of Applied Physics, Division V	EXC 2082: 3D Designer Materialien / 3D Matter Made To Order	01/2019 – 12/2025	Ruprecht-Karls-Universität Heidelberg

Collaborative Research Centers with KIT Being the Coordinating University

Number	Title	Spokesperson	Duration
SFB 1173/3	Wellenphänomene: Analysis und Numerik	Prof. Dr. Marlis Hochbruck, Institut für Angewandte und Numerische Mathematik, Division V	2015 – 2027
SFB-TRR 257/2	Phänomenologische Elementarteilchenphysik nach der Higgs-Entdeckung	Prof. Dr. Gudrun Heinrich, Institut für Theoretische Physik, Division V	2019 – 2026
SFB 1441/1	Verfolgung der aktiven Zentren in heterogenen Katalysatoren für die Emissionskontrolle / Tracking the Active Site in Heterogeneous Catalysis for Emission Control (TrackAct)	Prof. Dr. Jan-Dierk Grunwaldt, Institut für Technische Chemie und Polymerchemie, Division I	2021 – 2024
SFB 1527/1	High Performance Compact Magnetic Resonance – HyperION	Prof. Dr. Jan Gerrit Korvink, Institut für Mikrostrukturtechnik, Division III	2022 – 2026
SFB 1573/1	4f for Future	Prof. Dr. Peter Roesky, Institut für Anorganische Chemie, Division I	2023 – 2026
SFB 1608/1	Konsistenz in der sichtenbasierten Entwicklung Cyber-Physikalischer Systeme / Consistency in the View-Based Development of Cyber-Physical Systems	Prof. Dr. Ralf Reussner, KASTEL – Institut für Informationssicherheit und Verlässlichkeit, Division II	2023 – 2027

The typical budget approved for a Collaborative Research Center/Transregio Project is about EUR 1 to 3 million per year of duration. The duration indicates the funding period approved to date and 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 5230	Finanzmärkte und Friktionen – ein intermediärsbasierter Ansatz im Asset Pricing	Prof. Dr. Marliese Uhrig-Homburg, Institut für Finanzwirtschaft, Banken und Versicherungen, Division II	2021 – 2025
FOR 5339	KI-basierte Methodik für die schnelle Ertüchtigung unreifer Produktionsprozesse	Prof. Dr. Jürgen Beyerer, Institut für Anthropomatik und Robotik, Division II	2022 – 2025
FOR 2824	Amorphe molekulare Materialien mit extrem nichtlinearen optischen Eigenschaften	Prof. Dr. Stefanie Dehnen, Institut für Nanotechnologie, Division V	2023 – 2025

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 indicates the funding period approved to date and refers to the complete project. Partial projects at KIT may deviate.

## Collaborative Research Centers with Institutional Participation of KIT

Number	Title	Spokesperson / KIT participation	Duration
SFB/TRR 165/2	Waves to Weather: Wellen, Wolken, Wetter	Prof. Dr. George C. Craig, LMU München (Spokesman) Prof. Dr. Volkmar Wirth, JGU Mainz Prof. Dr. Peter Knippertz, Institut für Meteorologie und Klimaforschung, KIT	2015 – 2025
SFB/TRR 150/3	Turbulent chemisch reagierende Mehrphasenströmungen in Wandnähe	Prof. Dr. Andreas Dreizler, TU Darmstadt (Spokesman) Prof. Dr. Olaf Deutschmann, Institut für Technische Chemie und Polymerchemie, KIT	2015 – 2026
SFB/TRR 288/1	Elastic Tuning and Response of Electronic Quantum Phases of Matter	Prof. Dr. Roser Valentí, Universität Frankfurt (Spokeswoman) Prof. Dr. Jairo Sinovar, JGU Mainz Prof. Dr. Jörg Schmalian, Institut für Theorie der Kondensierten Materie, KIT	2020 – 2024

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

## DFG-funded Research Units with Institutional Participation of KIT

Number	Title	Spokesperson / KIT participation	Duration
FOR 2083	Integrierte Planung im öffentlichen Verkehr	Prof. Dr. Anita Schöbel, Technische Universität Kaiserslautern (Spokeswoman) Prof. Dr. Peter Vortisch, Institut für Verkehrswesen, KIT	2015 – 2023
FOR 2290	Understanding Intramembrane Proteolysis	Prof. Dr. Dieter Langosch, Technische Universität München (Spokesman) Dr. Claudia Muhle-Goll, Institut für Biologische Grenzflächen, KIT	2015 – 2023
FOR 2325	Interactions at the Neurovascular Interface	Prof. Dr. Ralf H. Adams, Max-Planck-Institut für molekulare Biomedizin, Münster (Spokesman) Prof. Dr. Ferdinand le Noble, Zoologisches Institut, KIT	2016 – 2023
FOR 2063	The Epistemology of the Large Hadron Collider	Prof. Dr. Gregor Schieman, Bergische Universität Wuppertal (Spokesman) Prof. Dr. Rafaela Hillerbrand, Institut für Technikfolgenabschätzung und Systemanalyse, KIT	2016 – 2023
FOR 2397	Multiskalen-Analyse komplexer Dreiphasensysteme	Prof. Dr. Thomas Turek, Technische Universität Clausthal (Spokesman) Prof. Dr. Ulrike Krewer, Institut für Angewandte Materialien, KIT	2016 – 2023
FOR 2589	Zeitnahe Niederschlagsschätzung und -vorhersage	Dr. Silke Trömel, Rheinische Friedrich-Wilhelms-Universität Bonn (Spokeswoman) Dr. Christian Chwala, Institut für Meteorologie und Klimaforschung, KIT	2018 – 2025
FOR 2730	Umweltveränderungen in Biodiversitäts-Hotspot-Ökosystemen Süd-Ecuadors: Systemantwort und Rückkopplungseffekte (RESPECT)	Prof. Dr. Nina Farwig, Philipps-Universität Marburg (Spokeswoman) Prof. Dr. Wolfgang Wilcke, Institut für Geographie und Geoökologie, KIT	2018 – 2025
FOR 2820	Revisiting The Volcanic Impact on Atmosphere and Climate – Preparations for the Next Big Volcanic Eruption	Prof. Dr. Christian von Savigny, Universität Greifswald (Spokesman) Prof. Dr. Corinna Hoose, Dr. Gholamali Hoshyaripour, Dr. Bernhard Vogel, Institut für Meteorologie und Klimaforschung, KIT	2019 – 2025





## Research

### → DFG-funded Research Units with Institutional Participation of KIT

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 (Spokesman) Dr. Torben Boll, Prof. Dr. Martin Heilmaier, Prof. Dr. Michael Hoffmann, Dr. Peter Franke, Prof. Dr. Hans Jürgen Seifert, Dr. Susanne Wagner, Institut für Angewandte Materialien, KIT	2020 – 2026
FOR 5199	Suche nach Verletzung der Lepton-Familienzahl mit dem Mu3e-Experiment	Prof. Dr. André Schöning, Universität Heidelberg (Spokesman) Prof. Dr. Ivan Peric, Institut für Prozessdatenverarbeitung und Elektrotechnik, KIT	2021 – 2025
FOR 5507	ExRef: Explosionsgefahren von Kältemitteln mit geringem Treibhauspotenzial; Teilprojekt SP5: Hierarchische Modellierungskonzepte für Zündprozesse von fluorierten Kältemitteln	Dr. Detlev Markus, Physikalisch-Technische Bundesanstalt (Spokesman) Prof. Dr. Ulrich Maas, Institut für Technische Thermodynamik, KIT	2023 – 2027
FOR 5595	Öl-Kältemittel-Mehrphasenströmungen in Spalten mit bewegten Berandungen – Neuartige mikroskopische und makroskopische Ansätze für Experiment, Modellierung und Simulation	Prof. Dr. Markus Richter, Technische Universität Chemnitz (Spokesman) Dr. Jochen Kriegseis, Institut für Strömungsmechanik, KIT	2023 – 2027
FOR 5455	Deformationsanalyse mit Messungen terrestrischer Laserscanner; TP 01: Deformationsanalyse mit Messungen terrestrischer Laserscanner	Prof. Dr. Heiner Kuhlmann, Rheinische Friedrich-Wilhelms-Universität Bonn (Spokesman) Prof. Dr. Corinna Harmening, Geodätisches Institut, KIT	2023 – 2027

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 indicates the funding period approved to date and refers to the complete project. Partial projects of KIT may deviate.

### ERC Grants

Name, institute, division	Title of project	Duration
Dr. Frank Biedermann, Institut für Nanotechnologie, Division I	ERC Consolidator Grant SupraSense: Development of Suprasensors and Assays for Molecular Diagnostics	07/2023 – 06/2028
Dr. Dominic Bresser, Helmholtz-Institut Ulm für Elektrochemische Energiespeicherung, Division I	ERC Starting Grant RACER: Highly Redox-active Atomic Centers in Electrode Materials for Rechargeable Batteries	09/2022 – 08/2027

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### → ERC Grants

Name, institute, division	Title of project	Duration
Prof. Dr. Johannes Brumm, Institut für Volkswirtschaftslehre, Division II	ERC Starting Grant SOLG for Policy: The Old, the Young, and the Uncertain Future: Using High-Dimensional Stochastic Overlapping-Generations Models to Evaluate Fiscal Policies that Shift Risk and Resources Across Generations	10/2022 – 09/2027
Prof. Dr. Stefanie Dehnen, Institut für Nanotechnologie, Division V	ERC Advanced Grant BICMat: Bismuth Cluster-Based Materials	10/2022 – 05/2027
Prof. Dr. Christian Greiner, Institut für Angewandte Materialien, Division III	ERC Consolidator Grant TriboKey – Deformation Mechanisms are the Key to Understanding and Tailoring Tribological Behaviour	09/2018 – 08/2024
Dr. Lars Heinke, Institut für Funktionelle Grenzflächen, Division I	ERC Consolidator Grant DYNOCON: Dynamic Ions under Nano-Confinement for Porous Membranes with Ultrafast Gas Permeation Control	07/2022 – 06/2027
Prof. Dr. Inge Hinterwaldner, Institut Kunst- und Baugeschichte, Division IV	ERC Consolidator Grant COSE: Coded Secrets: Artistic Interventions Hidden in the Digital Fabric	09/2022 – 08/2027
Prof. Dr. Corinna Hoose, Institut für Meteorologie und Klimaforschung, Division IV	ERC Starting Grant C2Phase – Closure of the Cloud Phase	04/2017 – 09/2023
Prof. Dr. Christoph Kirchlechner, Institut für Angewandte Materialien, Division III	ERC Consolidator Grant TRITIME: Isolation, observation and quantification of mechanisms responsible for hydrogen embrittlement by TRITium based microMEchanics	11/2022 – 10/2027
Prof. Dr. Christian Koos, Institut für Photonik und Quantenelektronik, Division III	ERC Consolidator Grant TeraSHAPE – Terahertz Waveform Synthesis and Analysis Using Hybrid Photonic-Electronic Circuits	05/2018 – 01/2024
Prof. Dr. Jan G. Korvink, Institut für Mikrostrukturtechnik, Division III Dr. Benno Meier, Institut für Biologische Grenzflächen, Division I	ERC Synergy Grant HISCORE: Highly Informative Drug Screening by Overcoming NMR Restrictions	05/2021 – 04/2027
Prof. Dr. Moritz Kreysing, Institut für Biologische und Chemische Systeme, Division I	ERC Starting Grant GHOSTS: Genetically enhanced, optically superior tissues	02/2023 – 05/2025
Prof. Dr. Uli Lemmer, Lichttechnisches Institut, Division III	ERC Advanced Grant ORTHOAGONAL: Origami inspired thermoelectric generators by printing and folding	07/2023 – 06/2028

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## Research

### → ERC Grants

Name, institute, division	Title of project	Duration
Tenure-Track-Prof. Dr. Ulrich W. Paetzold, Institut für Mikrostrukturtechnik, Division III	ERC Consolidator Grant LAMI-PERO: Laminated Perovskite Photovoltaics: Enabling large area processing of durable and high efficiency perovskite semiconductor thin films	10/2023 – 09/2028
Dr. Julian Quinting, Institut für Meteorologie und Klimaforschung, Division IV	ERC Starting Grant ASPIRE: Advancing Subseasonal Predictions at Reduced computational Effort	09/2023 – 08/2028
Prof. Dr. Peter Sanders, Institut für Theoretische Informatik, Division II	ERC Advanced Grant ScAlBox – Engineering Scalable Algorithms for the Basic Toolbox	01/2020 – 08/2025
Prof. Dr. Katharina Scherf, Institut für Angewandte Biowissenschaften, Division I	ERC Starting Grant GLUTENOMICS: Tracking gluten immunoreactive peptides from the grain to the gut and beyond	09/2022 – 08/2027
Prof. Dr. Laurent Schmalen, Communications Engineering Lab, Division III	ERC Consolidator Grant RENEW: Reinventing Energy Efficiency in Communication Networks	06/2021 – 05/2026
Jun.-Prof. Dr. Matti Schneider, Institut für Technische Mechanik, Division III	ERC Starting Grant BeyondRVE: Beyond Representative Volume Elements for Random Heterogeneous Materials	07/2022 – 08/2023
Prof. Dr. Frank Schröder, Institut für Astroteilchenphysik, Division V	ERC Starting Grant PeV-Radio – Digital Radio Detectors for Galactic PeV Particles	02/2019 – 01/2025
Prof. Dr. Mehdi Baradaran Tahoori, Institut für Technische Informatik, Division II	ERC Advanced Grant PRICOM: Printed Computing: Enabling Extremely Low Cost Pervasive Near Sensor Computing	10/2022 – 09/2027
Prof. Dr. Alexey Ustinov, Physikalisches Institut, Division V	ERC Advanced Grant MILLI-Q: Millimetre-Wave Superconducting Quantum Circuits	10/2022 – 09/2027
Dr. Tonya Vitova, Institut für Nukleare Entsorgung, Division III	ERC Consolidator Grant ACTINIDE BOND properties in gas, liquid and solid state	02/2021 – 01/2026

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
Jun.-Prof. Dr. Jens Bauer, Institut für Nanotechnologie, Division V	Gerichtete Architektur in Tensegrity Fachwerken: Hin zu „Muskel-Knochen“ Metamaterialien	08/2022 – 07/2028
Dr. Frank Biedermann, Institut für Nanotechnologie, Division V	In vitro und in vivo Sensing von (Bio)organischen Analyten mit neuartigen Hoch-Affinitätsrezeptoren	10/2016 – 03/2023
Dr. Johannes Bracher, Institut für Volkswirtschaftslehre, Division II	Multi-Modell Nowcasting und Kurzzeitvorhersage der Ausbreitung von Infektionskrankheiten / Multi-Model Nowcasting and Short-Term Forecasting of Infectious Disease Spread	04/2023 – 03/2029
Dr. Elia Fioravanti, Institut für Algebra und Geometrie, Division V	Grobe Mediane als Ersatz für Hyperbolizität / Coarse Medians as Hyperbolicity Surrogate	10/2023 – 09/2029
Dr. Manuel Hinterstein, Institut für Angewandte Materialien, Division III	BNT-BT als zukünftige bleifreie Funktionswerkstoffe für PTCR-, Aktor- und Sensoranwendungen	04/2016 – 09/2023
Dr. Alexander Hinz, Institut für Anorganische Chemie, 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>	10/2020 – 09/2026
Tenure-Track-Prof. Dr. Felix Kahlhöfer, Institut für Theoretische Teilchenphysik, Division V	Methoden und Werkzeuge für die Analyse und Interpretation von Experimenten und kosmologischen Beobachtungen zum Nachweis Dunkler Materie	04/2022 – 03/2024
Prof. Dr. Belina von Krosigk, Institut für Astroteilchenphysik, Division V	Suchen nach Dunkler Materie jenseits des WIMPs und Verbesserung des Trigger und DAQ Systems von SuperCDMS SNOLAB (1. Förderperiode)	11/2021 – 06/2025
Tenure-Track-Prof. Dr. Rudolf Lioutikov, Institut für Anthropomatik und Robotik, Division II	Intuitive Robot Intelligence: Efficiently Learning and Improving of Explainable Skills and Behaviors for Intuitive Human-Robot Interaction	06/2021 – 05/2027
Prof. Dr. Anja Metelmann, Institut für Theorie der Kondensierten Materie, Division V	Direktionalität in Quantensystemen	04/2022 – 12/2023
Tenure-Track-Prof. Dr. Philip 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
Prof. Dr. Hartwig Anzt, Scientific Computing Center, Division II	Fixed-Point Methods for Numerics at Exascale (FiNE)	05/2017 – 04/2023
Tenure-Track-Prof. Dr. Giovanni De Carne, Institut für Technische Physik, Division III	Hybrid Networks: a multi-modal design for the future energy system	07/2021 – 06/2026
Prof. Dr. Torben Ferber, Institut für Experimentelle Teilchenphysik, Division V	Searches for Dark Matter and Axion-Like Particles at Belle II	01/2022 – 02/2024
Jun.-Prof. Dr. Christian Grams, Institut für Meteorologie und Klimaforschung, Division IV	Sub-seasonal atmospheric predictability: understanding the role of diabatic outflow	10/2017 – 09/2023
Jun.-Prof. Dr. Emilia Graß, KASTEL – Institut für Informationssicherheit und Verlässlichkeit, Division II	Building Network Resilience in Healthcare against Cyber-Attacks	09/2023 – 08/2028
Dr. Emma Järvinen, Institut für Meteorologie und Klimaforschung, Division IV	Solving the Cirrus Cloud Puzzle – Do Cirrus Warm or Cool Our Climate?	05/2020 – 03/2026
Dr. Martina Klose, Institut für Meteorologie und Klimaforschung, Division IV	A big unknown in the climate impact of atmospheric aerosol: Mineral soil dust	11/2020 – 10/2026
Dr. Benno Meier, Institut für Biologische Grenzflächen, Division I	Hyperpolarized Magnetic Resonance	03/2019 – 02/2025
Tenure-Track-Prof. Dr. Benjamin Schäfer, Institut für Automation und angewandte Informatik, Division II	Data-Driven Analysis of Complex Systems for a Sustainable Future	01/2022 – 12/2026

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

## BMBF Junior Research Groups

Name, institute, division	Title of group	Duration
Dr. Simon Fleischmann, Helmholtz-Institut Ulm, Division I	InfinBat: Zwischenschicht-funktionalisierte Materialien für neuartige elektrochemische Interkalationsbatterien	11/2021 – 10/2026
Dr. Florian Strauß, Institut für Nanotechnologie, Division V	MELLi: Maßgeschneiderte Elektrolyte für Lithium Feststoffbatterien	03/2022 – 02/2027

The annual budget of a group typically is EUR 1.5 to 3.2 million.

## Freigeist Fellowship

Name, institute, division	Title of group	Duration
Dr. Susanne Benz, Institut für Photogrammetrie und Fernerkundung, Division IV	Large scale assessment of the effects of sustainable heat recycling in the shallow sub-surface on above ground temperature	10/2022 – 09/2028

Typical total budget per group: EUR 1 to 2.2 million.

## Industry Fellowship (IF)

Name, institute, division	Title of group	Duration
Dr. Frederik Zanger, wbk Institut für Produktionstechnik, Division III	Optimierte Prozesse und Prozessketten für additiv gefertigte Bauteile	10/2019 – 07/2023

KIT junior research groups in cooperation with industry, funding levels vary, at least 50% of the funds come from the industry partner.

## NEXUS Program of the Carl Zeiss Foundation

Name, institute, division	Title of group	Duration
Dr. Gözde Kabay, Institut für Funktionelle Grenzflächen, Division I	Interdigitated electrode biosensor decorated with artificially imprinted polymer receptors for rapid diagnosis of Acute Kidney Injury (IDEart)	10/2023 – 09/2028

Typical total budget per group: EUR 1.5 million.



## Other Recognized KIT Young Investigators Groups (Junior Research Groups) and Funding

Name, institute, division	Title of group	Duration	Funding
Dr. Cihan Ates, Institut für Thermische Strömungsmaschinen, Division III	Machine Intelligence in Energy Systems (MAI)	03/2022 – 03/2024	DFG und Baden-Württemberg-Stiftung
Dr. Claudia Bizzarri, Institut für Organische Chemie, Division I	Künstliche Photosynthese	12/2021 – 08/2023	SFB/TRR and others
Dr. Dominic Bresser, Helmholtz-Institut Ulm, Division I	Neuartige Elektrodenmaterialien für Wiederaufladbare Elektro-chemische Energiespeicher (NEW E <sup>2</sup> )	05/2017 – 04/2023	Vector Stiftung
Dr. Jan Haußmann, Institut für Produktentwicklung, Division III	Sensorbasierte Brennstoffzellentwicklung	05/2022 – 11/2025	MWK
Dr. Robert Heinrich, Institut für Programmstrukturen und Datenorganisation, Division II	Quality-driven System Evolution	03/2018 – 04/2023	MWK and BMBF
Dr. Tobias Käfer, Institut für Angewandte Informatik und Formale Beschreibungsverfahren, Division II	Knowledge Graph-based Artificial Intelligence Systems	02/2021 – 12/2026	BMBF
Dr. Mathias Krause, Institut für Angewandte und Numerische Mathematik 2/ Institut für Mechanische Verfahrenstechnik und Mechanik, Division V und III	Lattice Boltzmann Research Group	05/2018 – 04/2024	DFG and others
Dr. Sebastian Lerch, Institut für Volkswirtschaftslehre, Division II	Artificial Intelligence for Probabilistic Weather Forecasting	05/2021 – 03/2025	Vector Stiftung
Dr. Wilfried Liebig, Institut für Angewandte Materialien, Division III	Hybride Werkstoffe und Leichtbau	02/2023 – 12/2024	DFG, Federal ministries and others
Dr. Axel Loewe, Institut für Biomedizinische Technik, Division III	Computational Cardiac Modelling	11/2018 – 12/2024	DFG and MWK

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## → Other Recognized KIT Young Investigators Groups (Junior Research Groups) and Funding

Name, institute, division	Title of group	Duration	Funding
Dr. Ralf Loritz, Institut für Wasser und Gewässerentwicklung, Division IV	Energy and information flows in hydrological systems	10/2022 – 03/2028	VolkswagenStiftung
Dr. Kathrin Menberg, Institut für Angewandte Geowissenschaften, Division IV	Nachhaltige Geoenergie	05/2022 – 09/2025	MWK and others
Dr. Klarissa Niedermeier, Institut für Thermische Energie-technik und Sicherheit, Division III	Wärmespeicher auf Flüssigmetallbasis – Schlüssel für CO <sub>2</sub> -freie Hochtemperaturprozesse	04/2022 – 11/2026	BMWK
Dr. Claudia Niessner, Institut für Sport und Sportwissenschaft, Division II	Health Related Fitness and Physical Mobility in children, youth and young adulthood	12/2021 – 04/2024	MWK and others
Dr. Annika Oertel, Institut für Meteorologie und Klimaforschung, Division IV	Erhöhung des Wertes von Kampagnenbeobachtungen durch Datenassimilation zur Verbesserung der konvektiven Vorhersagefähigkeit	09/2023 – 04/2027	BMDV
Dr. Björn de Rijk, Institut für Analysis, Division V	Stability of Nonlinear Waves	08/2022 – 12/2024	SFB „Wellenphänomene“, DFG
Dr. Philipp Röse, Institut für Angewandte Materialien, Division III	Elektrokatalyse	12/2023 – 01/2026	BMBF
Dr. Somidh Saha, Institut für Technikfolgenabschätzung und Systemanalyse, Division II	Sylvanus	08/2019 – 12/2024	BMBF and others
Dr. Ulrike van der Schaaf, Institut für Bio- und Lebensmitteltechnik, Division I	Interfacial properties of peptin-based biopolymers	10/2020 – 11/2026	Arbeitsgemeinschaft industrieller Forschungsvereinigungen
Dr. Thomas Sheppard, Institut für Technische Chemie und Polymerchemie, Division I	X-ray Microscopy in Catalysis	02/2020 – 03/2025	BMBF and others
Dr. Christian Sprau, Lichttechnisches Institut, Division III	Druckbare semitransparente organische Solarzellen für Photovoltaikflächen der Zukunft	07/2023 – 03/2027	Vector Stiftung

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## Research

### → Other Recognized KIT Young Investigators Groups (Junior Research Groups) and Funding

Name, institute, division	Title of group	Duration	Funding
Dr. Alexander Stroh, Institut für Strömungs- mechanik, Division III	Multiphase flows and heat transfer	05/2022 – 06/2025	DFG and BMBF
Dr. Rebekka Volk, Institut für Industriebetriebsleh- re und Industrielle Produktion, Division II	Projekt- und Ressourcenman- agement in der bebauten Umwelt	02/2023 – 06/2027	Bundesministerien, Helmholtz, EU and others
Dr. Ruming Zhang, Institut für Angewandte und Numerische Mathematik, Division V	Waves in Periodic Structures	05/2021 – 09/2023	DFG research grant
Dr. Christian Zillinger, Institut für Analysis, Division V	Stabilität und Instabilität in Flüs- sigkeiten und Materialien	08/2022 – 07/2024	SFB „Wellenphänomene“

### Junior Professorships

Name, institute, division	Area	Duration
Jun.-Prof. Dr. Jens Bauer, Institut für Angewandte Materialien, Division III	Metamaterialien	10/2023 – 09/2029
Tenure-Track-Prof. Dr. Thomas Bläsius, Institut für Theoretische Informatik, Division II	Skalierbare Algorithmik und Verfahren für große Datenmengen	10/2020 – 09/2026
Tenure-Track-Prof. Dr. Barbara Bruno, Institut für Anthropomatik und Robotik, Division II	Künstliche Intelligenz für Autonome Systeme	05/2023 – 04/2029
Tenure-Track-Prof. Dr. Giovanni De Carne, Institut für Technische Physik, Division III	Echtzeitsysteme in der Energietechnik	11/2022 – 11/2028
Tenure-Track-Prof. Moritz Dörstelmann, Institut Entwerfen und Bautechnik, Division IV	Digital Design and Fabrication	04/2021 – 03/2027
Tenure-Track-Prof. Dr. Yolita Eggeler, Laboratorium für Elektronenmikroskopie, Division V	Elektronenmikroskopie	10/2020 – 09/2026
Tenure-Track-Prof. Dr. Pascal Friederich, Institut für Theoretische Informatik, Division II	KI-Methoden in der Materialwissenschaft	12/2019 – 12/2025
Tenure-Track-Prof. Dr. Schirin Hanf, Institut für Anorganische Chemie, Division I	Fundamentale Anorganische Chemie: Nachhaltige Nutzung von Metallen	11/2021 – 10/2027
Tenure-Track-Prof. Dr. Lennart Hilbert, Zoologisches Institut, Division I	Systembiologie/Bioinformatik	10/2018 – 09/2024
Tenure-Track-Prof. Dr. Felix Kahlhöfer, Institut für Theoretische Teilchenphysik, Division V	Theoretische Teilchenphysik	04/2022 – 03/2028
Tenure-Track-Prof. Dr. Christoph Klahn, Institut für Mechanische Verfahrenstechnik und Mechanik, Division I	Prozessintensivierung in der Verfahrenstechnik durch Additive Fertigung	05/2021 – 05/2027
Tenure-Track-Prof. Dr. Manuel Krannich, Institut für Algebra und Geometrie, Division V	Geometrie	04/2022 – 03/2028
Tenure-Track-Prof. Dr. Sebastian Krumscheid, Scientific Computing Center, Division V	Uncertainty Quantification	08/2022 – 08/2025





## Research

### → Junior Professorships

Name, institute, division	Area	Duration
Tenure-Track-Prof. Dr. Xian Liao, Institut für Analysis, Division V	Analysis partieller Differentialgleichungen	11/2018 – 07/2025
Tenure-Track-Prof. Dr. Rudolf Lioutikov, Institut für Anthropomatik und Robotik, Division II	Maschinelles Lernen und Robotik	12/2022 – 11/2028
Jun.-Prof. Dr. Claudio Llosa Isenrich, Institut für Algebra und Geometrie, Division V	Geometrie	10/2020 – 09/2026
Jun.-Prof. Dr. Reza Maalek, Institut für Technologie und Management im Baubetrieb, Division IV	Digital Engineering and Construction	11/2020 – 10/2026
Tenure-Track-Prof. Dr. Roland Maier, Institut für Angewandte und Numerische Mathematik, Division V	Numerik partieller Differentialgleichungen	07/2023 – 09/2027
Tenure-Track-Prof. Dr. Peer Nowack, Institut für Theoretische Informatik, Division II	KI in den Klima- und Umweltwissenschaften	03/2023 – 02/2029
Tenure-Track-Prof. Dr. Ulrich W. Paetzold, Institut für Mikrostrukturtechnik, Division III	Next Generation Photovoltaics	03/2021 – 02/2027
Jun.-Prof. Dr. Rania Rayyes, Institut für Fördertechnik und Logistiksysteme, Division III	Hochwandlungsfähiges, flächen- und raumbewegliches System für die Produktion	12/2022 – 12/2028
Tenure-Track-Prof. Dr. Benjamin Schäfer, Institut für Automation und angewandte Informatik, Division III	Künstliche Intelligenz für das Energiesystem	05/2023 – 04/2029
Jun.-Prof. Dr. Maïke Schwammberger, KASTEL – Institut für Informationssicherheit und Verlässlichkeit, Division II	Modellierung und Analyse im Mobility Software Engineering	12/2022 – 12/2028
Jun.-Prof. Dr. Jan Stühmer, Institut für Anthropomatik und Robotik, Division II	Maschinelles Lernen	09/2022 – 08/2028
Tenure-Track-Prof. Dr. Julian Thimme, Institut für Finanzwirtschaft, Banken und Versicherungen, Division II	Finance	08/2019 – 07/2025



### → Junior Professorships

Name, institute, division	Area	Duration
Tenure-Track-Prof. Dr. Nevena Tomašević, Institut für Angewandte Geowissen- schaften, Division IV	Allgemeine Geologie	04/2021 – 03/2027
Jun.-Prof. Dr. Ingo Wagner, Institut für Schulpädagogik und Didaktik, Division II	Interdisziplinäre Didaktik der MINT-Fächer und des Sports	10/2018 – 09/2024
Tenure-Track-Prof. Dr. Philip Willke, Physikalisches Institut, Division V	Quantenkontrolle von Spins auf Oberflächen	05/2022 – 04/2028
Tenure-Track-Prof. Dr. Moritz Wolf, Engler-Bunte-Institut, Division I	Katalysatormaterialien für die Energiewende	05/2022 – 04/2028
Tenure-Track-Prof. Dr. Christian Wressnegger, KASTEL – Institut für Informationssicherheit und Verlässlichkeit, Division II	KI-Methoden in der IT-Sicherheit	12/2019 – 11/2025
Tenure-Track-Prof. Dr. Frederike Zufall, Institut für Informations- und Wirtschaftsrecht, Division II	Öffentliches Recht und Informatik	06/2023 – 05/2029

### Graduate Schools Funded by the German Research Foundation (DFG), Helmholtz Association (HGF) or Federal Ministry of Education and Research (BMBF)

Graduate School	Funded by	Spokesperson / participant	Duration
Graduate School „Electrochemical Energy Storage“	DFG	Prof. Dr. Jürgen Behm, Universität Ulm (Spokesman) apl. Prof. Christine Kranz, Universität Ulm (Co-Spokeswoman) Prof. Dr. Rolf Schuster, Institut für Physikalische Chemie, KIT (Co-Spokesman)	2019 – 2025
HEiKA Graduate School „Functional Materials“	DFG	Prof. Dr. Martin Wegener, Institut für Angewandte Physik/ Institut für Nanotechnologie, KIT (Spokesman) Prof. Dr. Uwe Bunz, Universität Heidelberg (Co-Spokesman)	2019 – 2025





## Research

### → Graduate Schools Funded by the German Research Foundation (DFG), Helmholtz Association (HGF) or Federal Ministry of Education and Research (BMBF)

Graduate School	Funded by	Spokesperson / participant	Duration
HIDSS4Health: Helmholtz Information and Data Science School for Health	HGF	Prof. Dr. Ralf Mikut, Institut für Automation und angewandte Informatik, KIT	2019 – 2029
MPSP: Max Planck School of Photonics	BMBF	Prof. Dr. David Hunger, Physikalisches Institut, KIT Prof. Dr. Christian Koos, Institut für Mikrostrukturtechnik, KIT Prof. Dr. Uli Lemmer, Lichttechnisches Institut, KIT Prof. Dr. Uli Nienhaus, Institut für Angewandte Physik, KIT Prof. Dr. Carsten Rockstuhl, Institut für Theoretische Festkörperphysik, KIT Prof. Dr. Martin Wegener, Institut für Angewandte Physik, KIT	2019 – 2025

### Graduate Schools of KIT

Graduate School	Funded by	Spokesperson / participant	Duration
CyberSec: KIT Graduate School Cyber Security	Funded in the Framework of the Excellence Strategy	Tenure-Track-Prof. Dr. Christian Wressnegger, KASTEL – Institut für Informationssicherheit und Verlässlichkeit, KIT Prof. Dr. Thorsten Strufe, KASTEL – Institut für Informationssicherheit und Verlässlichkeit, KIT	2021 – 2026 funding duration 5 years
KCDS: KIT Graduate School Computational and Data Science	Funded in the Framework of the Excellence Strategy	Prof. Dr. Martin Frank, Scientific Computing Center, KIT	2021 – 2026 funding duration 5 years
ENZo: KIT Graduate School Enabling Net Zero	Funded in the Framework of the Excellence Strategy	Prof. Dr. Jörg Sauer, Institut für Katalyseforschung und -technologie, KIT	2021 – 2026 funding duration 5 years

### → Graduate Schools of KIT

Graduate School	Funded by	Spokesperson / participant	Duration
KSQM: KIT Graduate School of Quantum Matter	Funded in the Framework of the Excellence Strategy	Prof. Dr. Markus Garst, Institut für Theoretische Festkörperphysik / Institut für QuantenMaterialien und Technologien, KIT	2021 – 2026 funding duration 5 years
UpGrade Mobility: KIT Graduate School UpGrade Mobility	Funded in the Framework of the Excellence Strategy	Prof. Dr. Frank Gauterin, Institut für Fahrzeugsystemtechnik, KIT	2021 – 2025 funding duration 5 years
CuKnow: KIT Graduate School Cultures of Knowledge	Funded in the Framework of the Excellence Strategy	Prof. Dr. Ingrid Ott, Institut für Volkswirtschaftslehre, KIT Prof. Dr. Darko Jekauc, Institut für Sport und Sportwissenschaft, KIT	2021 – 2025 funding duration 5 years
KSOP: Karlsruhe School of Optics & Photonics	KIT	Prof. Dr. Uli Lemmer, Lichttechnisches Institut, KIT	Since 2006 Meanwhile perpetuated
KSETA: Karlsruhe School of Elementary Particle and Astroparticle Physics: Science and Technology	KIT	Prof. Dr. Ulrich Nierste, Institut für Theoretische Teilchenphysik, KIT	Since 2012 Meanwhile perpetuated
GRACE: Graduate School for Climate and Environment	KIT	Prof. Dr. Stefan Hinz, Institut für Photogrammetrie und Fernerkundung, KIT	Since 2011 Meanwhile perpetuated
BIF-IGS: BioInterfaces International Graduate School	KIT	Prof. Dr. Nicholas Foulkes, Institut für Biologische und Chemische Systeme, KIT	Since 2011 Meanwhile perpetuated



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

Research training group	Funded by	Spokesperson / participant	Duration
Molecular Architectures for Fluorescent Cell Imaging	DFG	Prof. Dr. Hans-Achim Wagenknecht, Institut für Organische Chemie, KIT	2015 – 2024
Integrated Engineering of Continuous-Discontinuous Long Fiber Reinforced Polymer Structures	DFG	Prof. Dr. Thomas Böhlke, Institut für Technische Mechanik, KIT jointly with: University of Waterloo, University of Western Ontario, University of Windsor (alle Kanada)	2015 – 2024
Energy Status Data – Informatics Methods for its Collection, Analysis and Exploitation	DFG	Prof. Dr. Klemens Böhm, Institut für Programmstrukturen und Datenorganisation, KIT	2016 – 2025
Asymptotic Invariants and Limits of Groups and Spaces	DFG	Prof. Dr. Roman Sauer, Institut für Algebra und Geometrie, KIT jointly with: Prof. Dr. Anna Wienhard, Ruprecht-Karls-Universität Heidelberg	2016 – 2025
Simulation of Mechano-Electro-Thermal Processes in Lithium-Ion Batteries	DFG	Prof. Dr. Thomas Wetzel, Institut für Thermische Verfahrenstechnik, KIT	2017 – 2026
HIRSAP: Helmholtz International Research School for Astroparticle Physics and Enabling Technologies	HGF	Prof. Dr. Ralph Engel, Institut für Astroteilchenphysik, KIT	2018 – 2024
Tailored Scale-Bridging Approaches to Computational Nanoscience	DFG	Prof. Dr. Marcus Elstner, Institut für Physikalische Chemie, KIT	2019 – 2028
MatCom-ComMat: Materials Compounds from Composite Materials for Applications in Extreme Conditions	DFG	Prof. Dr. Martin Heilmaier, Institut für Angewandte Materialien, KIT	2020 – 2024
KD <sup>2</sup> School: Designing Adaptive Systems For Economic Decision-Making	DFG	Prof. Dr. Christof Weinhardt, Institut für Wirtschaftsinformatik und Marketing, KIT	2021 – 2026

## Innovation

### Innovation Characteristics

Year	Invention disclosures	Priority-establishing patent applications	Property rights (existing)	Royalties [million euros]	New companies (spinoffs)	Participation in spinoffs
2019	97	40	1 889	1.27	50 (9)	9
2020	105	50	1 772	2.05	28 (7)	9
2021	120	51	1 677	4.42	37 (12)	9
2022	91	43	1 654	1.79	48 (18)	9
2023	70	38	1 577	1.58	49 (19)	12

### Establishments of New Companies

Spinoffs	Startups	Startups
Aixelo Inc.	Agile Scaling Agency UG	Steelizioso UG
FastCast Ceramics GmbH	AI.Remove UG	stemdive GbR
FORMIC Transportsysteme GmbH	AnswerAI UG	TischPunkt GmbH
InnoCharge GmbH	Baskind GmbH	Tobi Technologies UG
inventife GmbH	Baueno GmbH	Vinesia Sarl
Keystone Photonics GmbH	bread & Salt GbR	VISS UG
Litona GmbH	Craft AEC GmbH	WeatherX Analytics LLC
NeWood GbR	Impac Labs GmbH	
NOXON GmbH	Insourcify GmbH	
Phabioc GmbH	iVerify Inc.	
platomo GmbH	meinDein GmbH	
revyve GbR	Mocap UG	
semorAI GmbH	mousebouncer GmbH	
Single Atom Technologies GmbH	nextstep HR	
Spotium GmbH	Nightlyfe GbR	
Validator GbR	Octomind GmbH	
Valoon GmbH	ONINO GmbH	
Vitru Water GbR	Onlygreens GbR	
zebrafant.ai GmbH	Pabolo GmbH	
	Pathium UG	
	PHABIOC IP GmbH	
	scorr UG	
	smartEden GmbH	



## Awards

### External Awards

(see separate chapter of this Annual Report from page 110)

### KIT Department Teaching Awards

KIT Department	Award winners
Architecture	Tenure-Track-Prof. Moritz Dörstelmann and his team
Civil Engineering, Geo- and Environmental Sciences	Prof. Dr. Philipp Dietsch
Chemistry and Biosciences	Dr. Annette Häser, Maren Riemann, Dr. Sascha Wetters, Dr. Beatrix Zaban
Chemical and Process Engineering	Dr. Marco Gleiß, Volker Bächle, Lucas Jakob, Dr. Frank Rhein, Marvin Winkler
Electrical Engineering and Information Technology	Florian Schade, Iris Walter, Christian Maximilian Karle
Humanities and Social Sciences	Prof. Dr. Rolf-Ulrich Kunze
Informatics	Tenure-Track-Prof. Dr. Thomas Bläsius
Mechanical Engineering	Prof. Dr. Astrid Pundt
Mathematics	Jun.-Prof. Dr. Claudio Llosa Isenrich
Physics	Dr. Alexander Lemburg
Economics and Management	Prof. Dr. Hagen Lindstädt and his team

### Awards for Doctoral Researchers

KIT Doctoral Awards

Name	Institut
Dr. Bianca Schacherl	Institut für Nukleare Entsorgung
Dr. Constantin Seibold	Institut für Anthropomatik und Robotik
Dr. Jan van der Linden	Institut für Experimentelle Teilchenphysik

Other Doctoral Awards

Name	Institute	Institution
Dr. Marc Keller	Institut für Thermische Strömungsmaschinen	Promotion award of der Friedrich und Elisabeth Boysen-Stiftung
Dr. Xiaofei Sun	Institut für Anorganische Chemie	Südwestmetall-promotion award
Dr. Richard Gebauer	Institut für Prozessdatenverarbeitung und Elektronik	Helmholtz-promotion award
Dr. Nick Karcher	Institut für Prozessdatenverarbeitung und Elektronik	Helmholtz-promotion award
Dr. Hannes Radinger	Institut für Angewandte Materialien	Helmholtz-promotion award

## Media/Publications

### Development of Visibility in the Media

	2019	2020 *	2021	2022	2023
Printed articles	24 739	17 837	20 384	19 298	18 127
Online articles	19 375	15 598	20 109	22 851	21 049

\* Due to the pandemic, interest of the media mainly focused on medical issues / KIT has no Department of Medicine.

### Publications

Publications in the year	2019	2020	2021	2022	2023
Publications of researchers of KIT	10 195	8 605	9 582	9 515	9 051
of these, books and proceedings	1 084	1 044	1 261	1 356	1 236
of these, articles in proceedings	1 396	1 076	1 372	1 250	1 411
of these, articles in journals	4 435	4 408	4 662	4 331	4 209
of these, in WoS- or Scopus-referenced journals	4 119	4 063	4 424	4 133	4 003
of these, open access articles	2 852	3 230	3 606	3 471	3 258



## Rankings

### National Rankings

		2019	2020	2021	2022	2023
Wirtschaftswoche	Electrical Engineering	3	5	5	5	7
	Informatics	2	4	4	4	7
	Mechanical Engineering	3	3	4	4	4
	Natural Sciences	8	10	9	8	–
	Business Engineering	2	2	2	3	3

### International Rankings

		2019	2020	2021	2022	2023
National Taiwan University Ranking	International – Overall	228	251	249	276	346
	International – Natural Sciences	67	70	80	102	123
	International – Engineering Sciences	106	101	115	154	301–350
	National – Overall	19	21	20	25	27
	National – Natural Sciences	1	1	1	3	5
	National – Engineering Sciences	1	1	1	4	5
QS World University Rankings	International – Overall	124	131	136	141	119
	International – Natural Sciences	48	58	53	48	50
	International – Engineering Sciences & IT	59	68	70	56	50
	National – Overall	5	6	6	6	6
	National – Natural Sciences	3	4	3	3	4
	National – Engineering Sciences	4	4	4	4	2
Times Higher Education	International – Overall	175	201–250	180	189	140
	International – Natural Sciences	69	70	77	100	86
	International – Engineering Sciences	74	78	56	64	64
	National – Overall	20	19–23	18–20	19–20	14
	National – Natural Sciences	7	7	8	8	8
	National – Engineering Sciences	4	4	4	4	3
Academic Ranking of World Universities	International – Overall	201–300	201–300	201–300	201–300	301–400
	International – Natural Sciences	–	–	–	–	–
	International – Engineering Sciences	–	–	–	–	–
	National – Overall	11–21	11–19	11–20	11–20	20–24

## Sustainability

### CO<sub>2</sub> Emissions, CO<sub>2</sub> Equivalents Incl. Upstream Chains Resulting from Energy Supply\* of All KIT Campuses in Tons per Year [t CO<sub>2</sub>eq/a], ,, Dual Reporting According to the Greenhouse Gas Protocol (GHGP) for Electrical Power

Campus North	2019	2020	2021	2022	2023
Use of natural gas for heat/cold/power	40 187	41 644	50 141	39 767	39 273
Power consumption (according to current supplier – market-specific)	10 499	9 309	7 141	11 251	8 615
Reference power (federal power mix – site-specific)	16 316	13 591	13 270	16 738	11 440

Campuses South, West, East	2019	2020	2021	2022	2023
Use of natural gas for heat/cold/power	450	548	635	338	249
Power consumption (according to current supplier – market-specific)	2 808	2 800	2 679	2 793	3 328
Reference power (federal power mix – site-specific)	24 840	21 900	22 795	23 765	25 896
District heat consumption	3 479	2 911	4 840	4 136	3 995

Campus Alpine	2019	2020	2021	2022	2023
Use of natural gas for heat/cold/power	440	384	410	343	279
Power consumption (according to current supplier – market-specific)	31	33	33	34	37
Reference power (federal power mix – site-specific)	272	257	284	290	291



### Energy Consumption and Energy Production of KIT

Type of energy / Campus North	2019	2020	2021	2022	2023
Primary energy consumption (natural gas)* [GWh]	162.7	168.6	203	161	159
Electricity from the public grid* [GWh]	78.8	76.3	68	78.9	68.2
Installed el. capacity, cogeneration/trigeneration plants [MW]	13	13	13	13	13
Electricity produced by own cogeneration/trigeneration plants [GWh]	44.1	47	58.9	45.5	47.3
Installed photovoltaics capacity [MW]	1	1.2	1.2	1.4	1.4
Electricity produced by own photovoltaics facilities [GWh]	0.9	0.9	1.2	1.1	1.2
Heat produced* (excluding heat for thermal refrigeration plants) [GWh]	76.6	76	83	67	57
District heating from public grid [GWh]	–	–	–	–	–

\* For CN, including third institutions on campus

Type of energy / Campuses South, West, East	2019	2020	2021	2022	2023
Primary energy consumption (natural gas) [GWh]	1.82	2.22	2.57	1.37	1.01
Electricity from the public grid [GWh]	54	50	47	49	52
Installed el. capacity, cogeneration/trigeneration plants [MW]	0.21	0.21	0.21	0.21	0.21
Electricity produced by own cogeneration/trigeneration plants [GWh]	0.59	0.72	0.83	0.44	0.35
Installed photovoltaics capacity [MW]	–	–	0.03	0.11	0.11
Electricity produced by own photovoltaics facilities [GWh]	–	–	–	–	0.02
Heat produced (excluding heat for thermal refrigeration plants) [GWh]	0.75	0.82	0.93	0.57	0.46
District heating from public grid [GWh]	49	41	55	47	47

Type of energy / Campus Alpine	2019	2020	2021	2022	2023
Primary energy consumption (natural gas) [GWh]	1.78	1.55	1.66	1.39	1.13
Electricity from the public grid [GWh]	0.59	0.59	0.59	0.60	0.58
Installed el. capacity, cogeneration/trigeneration plants [MW]	0.05	0.05	0.05	0.05	0.05
Electricity produced by own cogeneration/trigeneration plants [GWh]	0.38	0.41	0.39	0.33	0.32
Installed photovoltaics capacity [MW]	–	–	–	–	–
Electricity produced by own photovoltaics facilities [GWh]	–	–	–	–	–
Heat produced (excluding heat for thermal refrigeration plants) [GWh]	0.73	0.72	0.76	0.52	0.45
District heating from public grid [GWh]	–	–	–	–	–

### Supply and Waste Management Services

Type of service / Campus North	2019	2020	2021	2022	2023
Electricity consumption KIT (excl. grid losses) [GWh]	77	74	82	76	67
Heat consumption KIT* [GWh]	40	35	42	35	31
Heat consumption KIT (excl. grid losses, weather-adjusted) [GWh]	42	40	38	39	36
Water supply [m <sup>3</sup> ]	86 058	74 182	81 407	91 289	82 994
Compressed air generation [10 <sup>6</sup> m <sup>3</sup> ]	6.04	5.79	6.03	6.25	6.34
Wastewater disposal** [m <sup>3</sup> ]	84 009	83 702	77 501	82 270	76 861
Waste disposal KIT**/** [t]	12 370	4 664	4 073	5 515	14 944

\* excluding grid losses and without heat consumption of thermal refrigeration plants

\*\* For CN, including third institutions on campus

\*\*\* Quantities of residual waste CS, CW, CE, for recyclables CW, CE, and for data-protected material on all campuses are lacking. Companies are not able to provide any weights of these wastes.

Type of service / Campuses South, West, East	2019	2020	2021	2022	2023
Electricity consumption KIT (excl. grid losses) [GWh]	54	50	47	49	52
Heat consumption KIT* [GWh]	49	41	55	47	47
Heat consumption KIT (excl. grid losses, weather-adjusted) [GWh]	51	46	49	52	54
Water supply [m <sup>3</sup> ]	220 941	198 573	165 027	201 188	202 966
Waste disposal KIT** [t]	1 629	1 125	1 115	1 001	3 099

\* excluding grid losses and without heat consumption of thermal refrigeration plants

\*\* Quantities of residual waste CS, CW, CE, for recyclables CW, CE, and for data-protected material on all campuses are lacking. Companies are not able to provide any weights of these wastes.

Type of service / Campus Alpine	2019	2020	2021	2022	2023
Electricity consumption KIT (excl. grid losses) [GWh]	0.97	0.99	0.98	0.93	0.90
Heat consumption KIT* [GWh]	0.73	0.73	0.78	0.53	0.46
Heat consumption KIT (excl. grid losses, weather-adjusted) [GWh]	0.70	0.65	0.71	0.58	0.50
Water supply [m <sup>3</sup> ]	932	865	605	875	850
Compressed air generation [10 <sup>6</sup> m <sup>3</sup> ]	–	–	–	–	0.03
Wastewater disposal** [m <sup>3</sup> ]	–	–	–	–	805

\* excluding grid losses and without heat consumption of thermal refrigeration plants



**Central Fleet of KIT Vehicles on CN, CS, CW, CE, Including Trucks for Transporting Loads and Special Vehicles**

	2019	2020	2021	2022	2023
Vehicles (centrally administrated cars, mini-buses/vans, buses, trucks, special vehicles)	132	134	129	129	124
Vehicles with a combustion engine (of these, hybrid)	123	114 (1)	104 (8)	104 (9)	97 (10)
Battery vehicles	7	18	23	23	31
Fuel cell vehicles (H2 buses for KIT shuttle services)	2	2	2	2	2
Average CO <sub>2</sub> emission factor of the fleet [gCO <sub>2</sub> /km]	166	147	136	133	125
Gasoline consumption of the fleet [l]	22 306	16 626	17 097	21 724	21 819
Diesel consumption of the fleet, including truck diesel [l]	59 732	41 980	38 676	32 945	33 355
Hydrogen consumption of the fleet [kg]	5 039	1 830	6 567	5 734	5 110
Driven kilometers of the fleet	1 009 567	541 073	618 383	738 018	687 883
CO <sub>2</sub> emissions resulting from fuel use, including upstream chains [tCO <sub>2</sub> p.a.]	316	203	253	237	231

**Use of Shared Cars**

	2019	2020	2021	2022	2023
Trips	1 502	887	1 496	3 016	3 884
Km	457 560	216 533	384 259	771 274	958 169
CO <sub>2</sub> emissions [tCO <sub>2</sub> p.a.]	57	27	48	111	122
Company ebikes	6	6	6	6	6

**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)	174 208	35.3%	101 868	34.1%	72 340	37.1%
Laboratories, workshops, experiment halls	174 308	35.3%	88 376	29.6%	85 932	44.1%
Storage and similar facilities	69 672	14.1%	40 301	13.5%	29 371	15.1%
Teaching and studies (lecture halls, seminar rooms, practice rooms)	58 473	11.9%	52 792	17.7%	5 681	2.9%
Library areas (central + decentralized libraries)	12 334	2.5%	11 026	3.7%	1 308	0.7%
Sports areas	4 426	0.9%	4 209	1.4%	217	0.1%
<b>Total usable area</b>	<b>493 421</b>	<b>100.0%</b>	<b>298 572</b>	<b>100.0%</b>	<b>194 849</b>	<b>100.0%</b>
of this, rented areas			20 237 m <sup>2</sup>		5 002 m <sup>2</sup>	

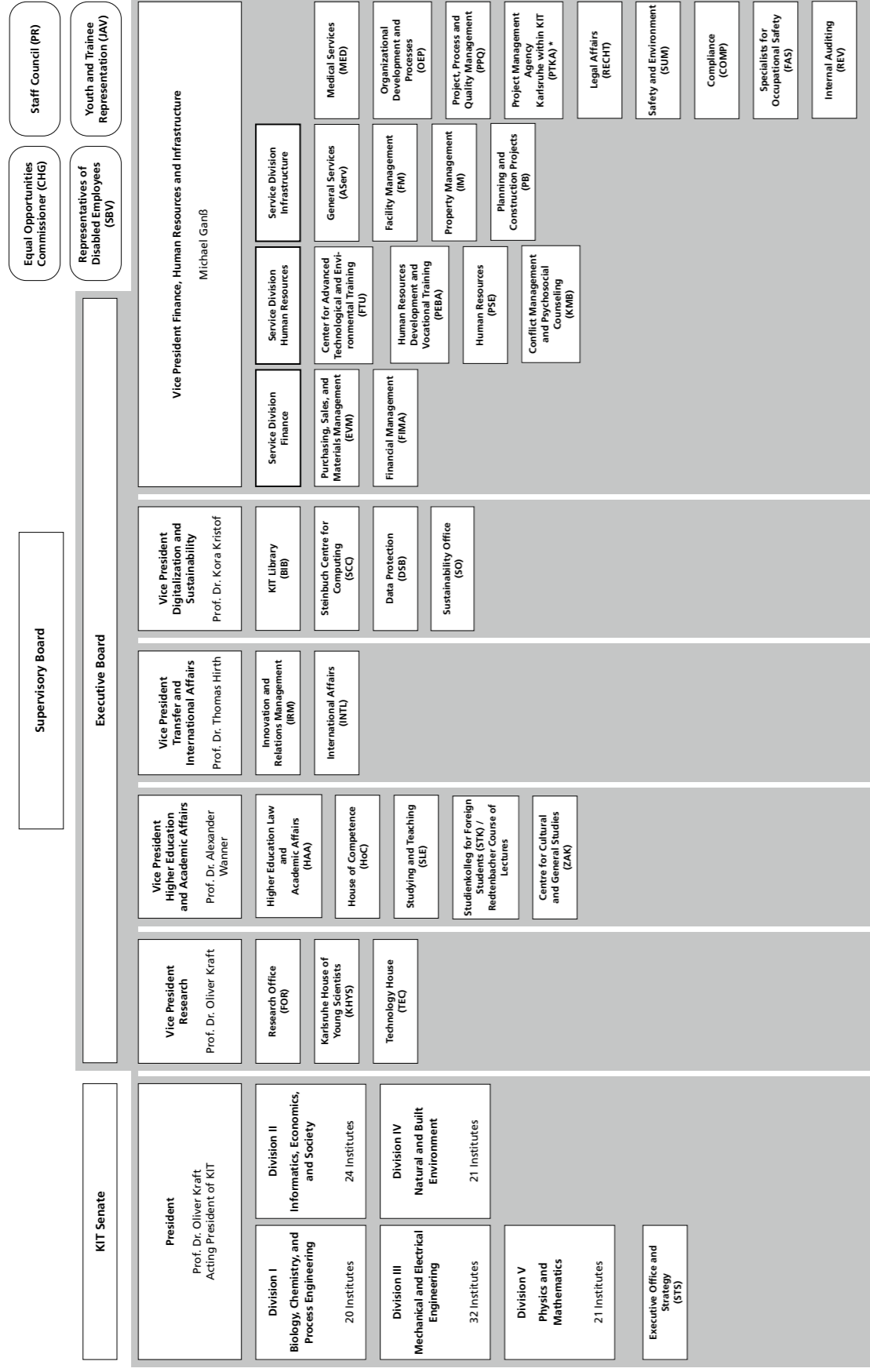
\* incl. Campus East and Campus West

\*\* incl. Campus Alpine

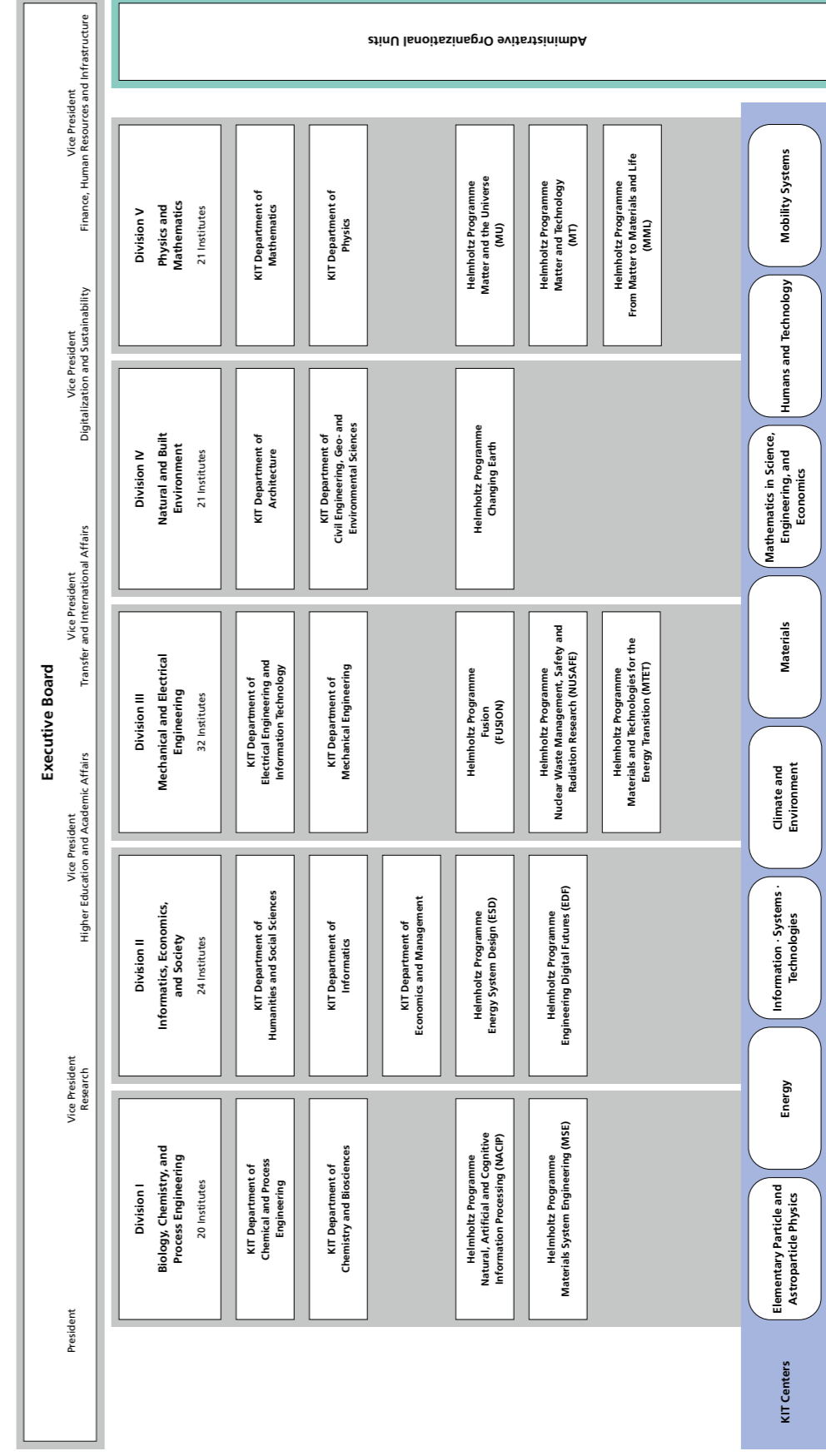


# Organizational Charts

## Organizational Structure



## Science Organization





**Issued by**

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