150 Years
culture of
excellence

1 King Ludwig II. (1845 – 1886), King of Bavaria
Founder of the Polytechnic School of Munich

2 TUM emblem: "Scientiis Artibus"
Keystone made of shell limestone above the southern entrance to the Thiersch building, main campus

3 Ferrocene molecule
Symbolic molecular structure of ferrocene, the discovery of which earned Ernst Otto Fischer and Geoffrey Wilkinson a joint Nobel Prize in Chemistry in 1973

4 Professor Carl von Linde
Inventor of the first viable refrigeration machine

5 Doctoral student (Patricia Graef)
checking a sample in the lab at the Institute for Medical Microbiology, Immunology and Hygiene at TUM's Klinikum rechts der Isar university hospital

6 Rod of Asclepius
Symbol for medicine at TUM

7 WARR Hyperloop II
Test capsule with a top speed of 324 km/h, developed by students at the TUM Chair of Astronautics, winning the 2017 Hyperloop competition in the USA

8 Atomic Egg
First German research reactor, FRM I, established in 1957

9 Origami
Symbol of the DNA origami technique researched at TUM's Chair of Experimental Biophysics

10 Golden angel
"Allegory of Science" by sculptor Ludwig Dasio in the Thiersch building on TUM's main campus

11 Butterfly
Symbol of research in the field of protein engineering and design by Prof. Dr. Arne Skerra at the TUM Chair of Biological Chemistry

12 Oskar-von-Miller Tower
This met mast is a 62-meter-high meteorological measuring station and iconic landmark on the Garching campus

13 Clover
Symbol of natural sciences, engineering, medicine and life sciences at TUM

14 Thiersch Tower
Historic landmark of the Technical University of Munich, 37 meters high, built by Friedrich von Thiersch and home to the Tschira Forum since 2018

15 Tree of life
Inspired by the logo of the TUM University Foundation

16 Parabolic slide
Heart of the concourse at the Mathematics and Informatics departments on the Garching campus; installation by artist duo Brunner and Ritz

17 Surgeon (Prof. Dr. med. Marion Kiechle)
Chair and Medical Director of TUM's Department of Obstetrics and Gynecology at the university hospital

18 3D model of DNA nanostructure
From the laboratory of physicist Hendrik Dietz, TUM Chair of Experimental Biophysics

19 Augmented reality
A student from TUM's Department of Informatics putting an application through its paces

150th anniversary of the
Technical University of Munich

www.150.tum.de/en

TUM – success story of an entrepreneurial university

With its origins rooted in the Humboldtian model of higher education, the research-driven university as we know it today is a true “made in Germany” success story. Engineering and natural sciences have propelled the nation to its current position of technology leader, with German engineering enjoying global renown. The Technical University of Munich has played a key role in this achievement, having grown over the years into a world-class education institute.

Over the past 150 years, the Technical University of Munich has continually reinvented itself, paving the way for a steady stream of innovation since 1868.
From its modest origins as a polytechnic school, our institution has evolved into an international frontrunner. With its own unique personality, the "TUM brand" is an extremely valuable asset and TUM graduates are in high demand the world over. In his inaugural speech, the very first president of this institution Karl Max von Bauernfeind stated that his founding purpose was "to bring the igniting spark of science to the commercial and industrial world". Today, in the midst of a digital revolution, we are once again helping to shape an exciting new world.

Framed by its entrepreneurial spirit, TUM is a hotbed of research and science. It charts its own course, transforming scientific breakthroughs into real-world innovations. Our very first entrepreneur and one of our founding professors, engineer Carl von Linde, established a company to market a refrigeration system he had invented.

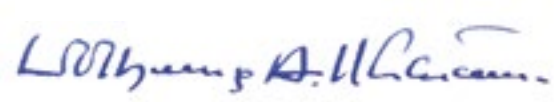
Over the past 150 years, the Technical University of Munich has continually reinvented itself.

The company quickly became – and remains – a huge international success. We are immensely proud of this. His achievement makes us all the more determined to foster an entrepreneurial spirit in our junior researchers. Since 1995, their spin-offs alone have created around 12,500 jobs in the high-tech industry.

The universal key to this success lies in embracing the adventure that is research – aligning our teaching with the latest scientific insights and contributing actively to the advancement of science and technology. Not as an extension of industry, but rather as a trailblazer, dedicated to the pursuit of new knowledge in uncharted terrain. This pioneering spirit has shaped the corporate identity of our university from 1868 onwards.

Academic excellence, global reach and an interdisciplinary approach – these are the guiding principles of our entrepreneurial university today. We inject entrepreneurialism into our culture by benchmarking ourselves against the very best on the international stage and flanking our disciplinary depth with cross-disciplinary breadth. And as an entrepreneurial university, we build on our rich and varied disciplinary cultures to tackle the great and evolving challenges of our time: Health & Nutrition • Environment & Climate • Energy & Natural Resources • Information & Communications • Mobility & Infrastructure. For us, the call to conserve the natural world is no hollow undertaking. It is a very concrete human commitment that we do our utmost to deliver on through scientific and technical research. Numerous inventors, innovators and Nobel Prize winners have joined us in this mission since 1868.

Reflecting the dynamic social changes sweeping our planet, we have now begun to round out our recognized strengths in technical fields by expanding horizontally into humanities, economics and the social sciences. Our aim is to continue to embed people at the heart of technical progress – helping to position technology as the driving force behind civilization. Our anniversary motto "Culture of Excellence" perfectly reflects this commitment to bridge the past and present and build on our track record of excellence as we step into the future.



Wolfgang A. Herrmann
PRESIDENT

TUM – on your 150th anniversary

Perhaps more than any other institution, the Technical University of Munich is an icon of Bavaria's impressive evolution from an agricultural economy to a high-tech hub. Its foundation in 1868 was inspired by King Ludwig II's vision that Bavaria should keep pace with the scientific and technical developments of his time. Over the intervening 150 years, TUM has far surpassed this initial aim. Today, in addition to being Germany's largest technical university, TUM is also an internationally recognized University of Excellence and one of the world's leading centers of research.

This success story is testament to the dedication of the university's staff, the thirst for knowledge of its students, the creativity of its lecturers and the foresight of its management – backed of course by generous support from the State of Bavaria, Bavarian industry and committed citizens.

Technology is advancing at breathtaking speed. Today, TUM is facing major new challenges and upheavals, from ubiquitous digitalization to developments in energy security, mobility and healthcare. Fortunately, the university is well equipped to seize the tremendous opportunities all of this brings, enabling it to drive change and shape our future.

Bavaria's success today is primarily built on its research institutes and on the ability of its companies to transition new findings from the lab to the real world. So we must continue to find and nurture the next generation of talent, and to discover and develop all that is new. Looking ahead, I wish our Technical University every success for the future.

Dr. Markus Söder
PRIME MINISTER OF THE GERMAN STATE OF BAVARIA

"The Technical University of Munich is a hotbed of creative and intellectual energy, a flagship for a wide scientific community and a unique showcase for Bavaria around the globe.

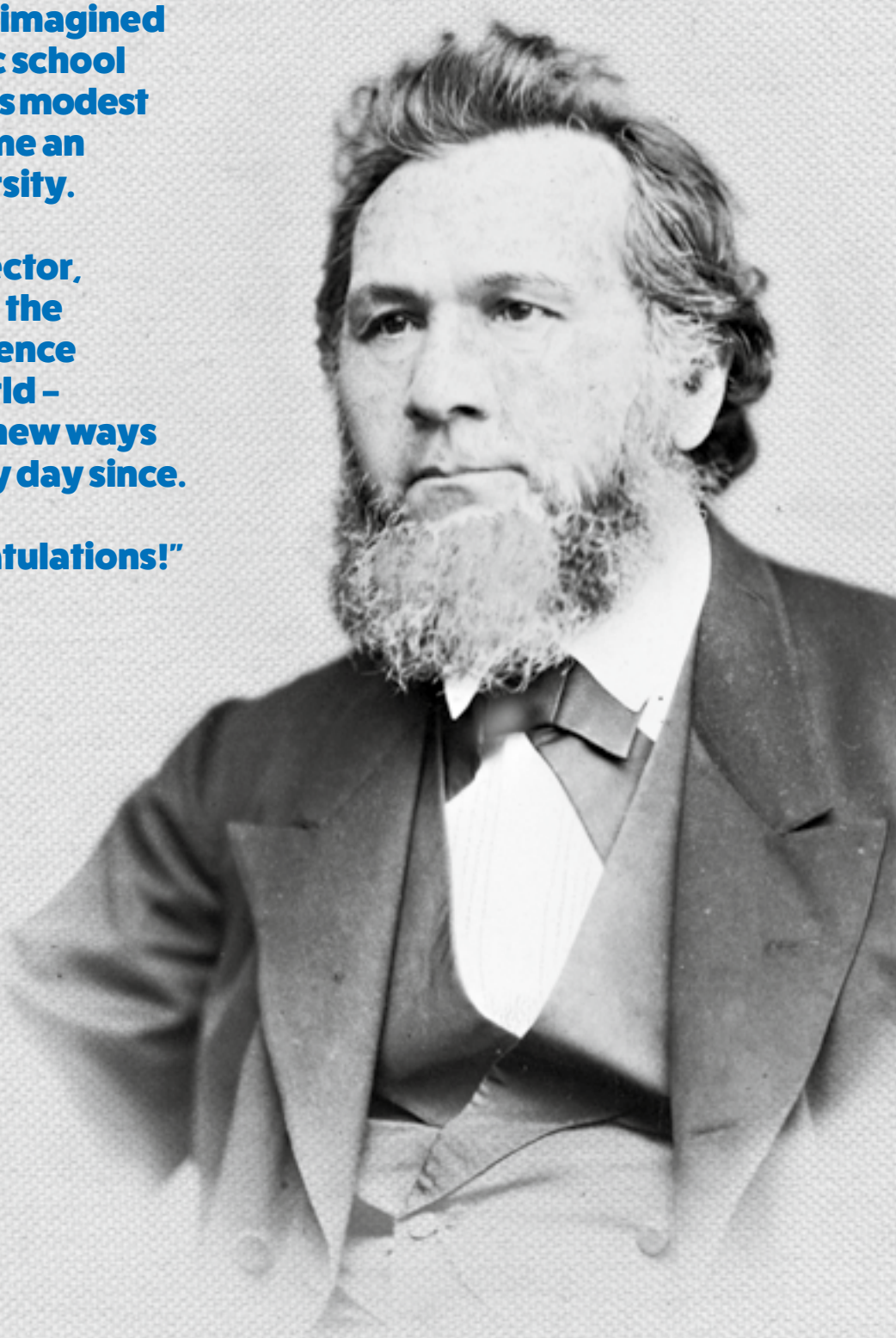
Congratulations on all these achievements!"

Dr. Markus Söder
PRIME MINISTER OF THE GERMAN
STATE OF BAVARIA

"I never would have imagined that the polytechnic school would evolve from its modest beginnings to become an international university.

As the founding director, my aim was to bring the igniting spark of science to the industrial world – and TUM has found new ways to achieve this every day since.

My heartiest congratulations!"



Karl Max von Bauernfeind
FOUNDING DIRECTOR, 1868

Congratulations!

TECHNICAL UNIVERSITY OF MUNICH CELEBRATES 150TH ANNIVERSARY

We don't just want to understand the world – we want to improve it!

The era when TUM was founded certainly has one thing in common with the present day: the rapid impact of new technologies on every facet of everyday life.
To this day, TUM's aim is to shape this transformation by harnessing the pioneering spirit, creative ideas and entrepreneurial mindset of its scientific talent. That is why the entire university revolves around one core goal: innovation.
We don't just want to understand the world – we want to improve it!

Each year, the British news agency Reuters assesses the extent to which universities are contributing to progress. TUM regularly ranks among the top five in Europe – alongside universities such as Cambridge and Imperial College London. So what's the secret to this success? It's not just down to one single factor. TUM builds on several key concepts that combine to shape its unique approach.

Fostering an entrepreneurial spirit

Demonstrating a sense of initiative and responsibility instead of just waiting for a helping hand from the state, competing internationally to attract the finest creative minds and identifying and developing talent at an early stage – these are the hallmarks of a truly entrepreneurial university. Here TUM has set a new benchmark nationwide for its dynamic approach to the management of science and research. And the results speak for themselves: an outstanding environment for research and tuition – extending from mentoring for first-year students right through to innovative career paths for top researchers. TUM has also been twice designated a center of excellence as part of the German Government's Excellence Initiative for universities.

Understanding society

You have to understand society before you can change it. Shaping technological transformation with a sense of responsibility means engaging with today's social, political and ethical issues. TUM is committed to embedding issues that are important to society into every research project and every study program. Which is why the university recently incorporated social sciences into its portfolio and networked these fields with its core disciplines.

Crossing faculty borders

It is not unusual at TUM to come across research groups or associated Master's programs that bring together a colorful mix of disciplines stretching from computer science through philosophy to medicine. The university focuses on unlocking the potential offered by its broad range of subjects, which is unparalleled in Europe, dovetailing engineering, medicine and economics with the natural, social and life sciences. And this multidisciplinary outlook is by no means limited to individual projects, but embedded in TUM's research and study programs.

Bringing breakthroughs from lab to market

From undergrads managing their own fastgrowing start-ups to university/industry alliances running on-campus laboratories, TUM excels at bridging the gap between the ivory tower of basic research and the high-tech world. Ever since Carl von Linde's day, spin-offs and close collaboration with industry partners have been key to stimulating continuous innovation. TUM recently developed its Industry on Campus strategy to build on this tradition. And, above all, it has succeeded in creating an entrepreneurial culture that continually incubates successful startups.

Fostering community spirit

PhD graduates funding student scholarships with their first salary; alumni supporting each other's careers on the far side of the globe; students helping refugees from crisis regions integrate into university life – there are countless examples that demonstrate the extraordinary bond between TUM's members, alumni and friends. This solidarity within the TUM family is strengthened by a strict equality policy, an open-minded, international atmosphere and shared cultural and sporting experiences. The returns include far-reaching social engagement and significant financial support. TUM bonds stand the test of time.

Top of the tables

TUM has been a frontrunner in the international rankings for years – across all underlying criteria.

TUM in the rankings

		
2017 Academic Ranking of World Universities (ARWU)	2	50
QS World University Rankings 2018	1	64
THE World University Rankings 2018	2	41
2018 Best Global Universities U.S. News & World Report	3	80
Nature Index – Top Academic Institutions 2017	2	62
Reuters Top 100 World's Most Innovative Universities 2017	1	40
Global Employability University Ranking 2017	1	8

Innovative university TUM holds first place in the Reuters ranking for Germany // **TUM ranks fourth among "Europe's most innovative universities"**

Ideal startup environment TUM takes **first place** among Germany's major universities // Startup barometer compiled by the Stifterverband für die Deutsche Wissenschaft (Donors' association for the promotion of humanities and sciences in Germany)

Number-one fundraiser 300 million euros since 1998

41,000 STUDENTS

>1.4
billion euros total budget in 2016 (including hospital)

300
million euros p. a. third-party research funding (including hospital)

9,000
graduates (2017)

13,000
first-year students (2017)

27%
international students

34%
female students

177
degree programs

550
professors (including hospital)

42
Humboldt awards (2012–2016)

86
ERC grants since 2008

3,200
non-academic staff (excluding hospital)

6
Humboldt professors

6,400
academic staff (including hospital)

7,000
publications in peer-reviewed journals each year

>1,000
research collaborations with companies annually

18
Leibniz prizes awarded by the German Research Foundation (DFG)

17
Nobel Prize winners

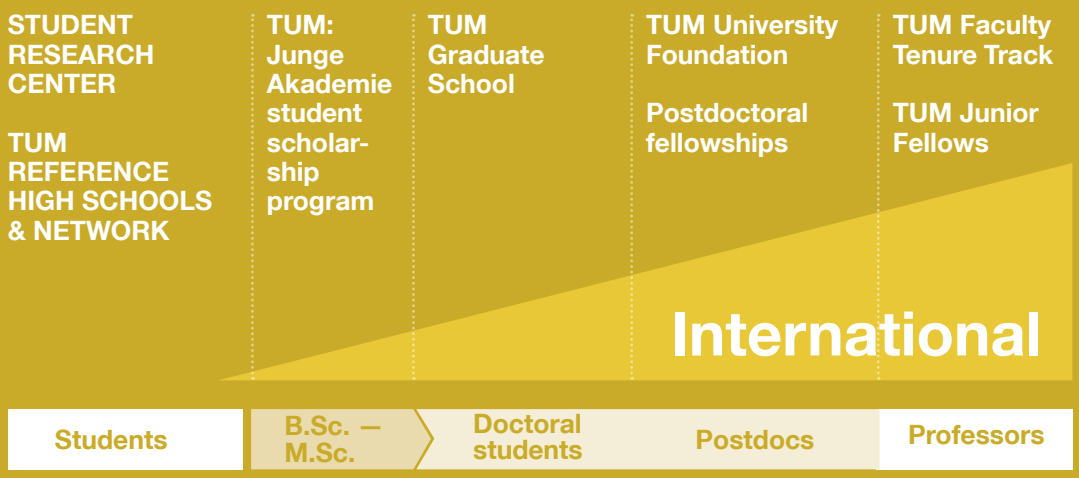
- **Heinrich Wieland** *1927*
- **Thomas Mann** *1929*
- **Hans Fischer** *1930*
- **Rudolf Ludwig Mößbauer** *1961*
- **Konrad Bloch** *1964*
- **Ernst Otto Fischer** *1973*
- **Klaus von Klitzing** *1985*
- **Ernst Ruska** *1986*
- **Johann Deisenhofer** *1988*
- **Robert Huber** *1988*
- **Wolfgang Paul** *1989*
- **Erwin Neher** *1991*
- **Rudolph A. Marcus** *1992*
- **Wolfgang Ketterle** *2001*
- **Gerhard Ertl** *2007*
- **Bernard L. Feringa** *2016*
- **Joachim Frank** *2017*

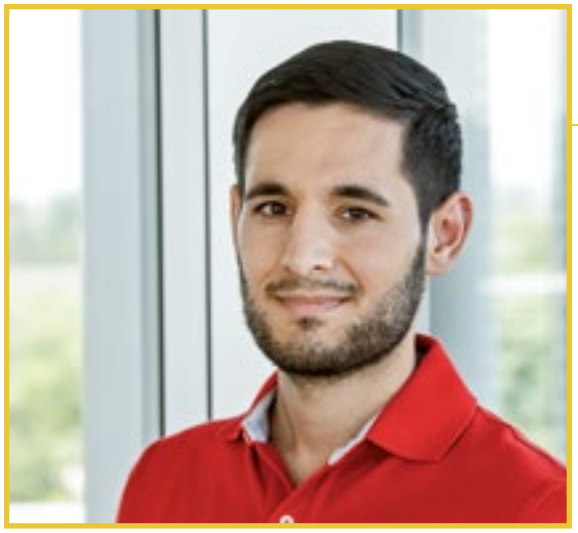
Talent development

Opportunities for bright minds

The driving forces behind scientific progress are passion, curiosity and the willingness to take risks. TUM is constantly on the lookout for the next generation of talented individuals endowed with these qualities. And it certainly has a lot to offer them – including intensive development opportunities and excellent career prospects. The TUM brand enjoys an outstanding reputation worldwide.

Talent development options





"The Germany Scholarship is a really welcome acknowledgment of my achievements - it motivates me to keep moving forward, even though my path to TUM has been anything but conventional or easy. I'm proud to have made it under my own steam."

ESER AYTEKIN
Student

The big picture. When selecting scholarship recipients, TUM looks beyond outstanding grades to also consider personal achievements. Soon after leaving lower-level high school with a basic certificate, Eser Aytekin knew he was capable of more. So he completed an apprenticeship, went back to take his intermediate school leaving certificate, and then moved on to take his university entrance exams at a higher-level vocational high school. Now he is studying for a degree in technology- and management-oriented business administration. The Germany Scholarship is jointly funded by the German government and sponsors of TUM.

"We receive active support and supervision while we work on our PhDs. The Graduate School organizes seminars and workshops and even finances trips to conferences abroad."

AURORE DUPIN, M.SC.
Doctoral student

Aurore Dupin came to Garching from Paris, France, to complete a physics PhD in synthetic biosystems. Students receive wide-ranging support throughout their doctoral paths – from methodology seminars to editorial assistance with research papers and from interdisciplinary training opportunities to a varied cultural program. Completing a doctorate at TUM extends well beyond the purely academic.

"Thanks to TUM, I was able to come back to Germany – and to one of the world's most highly regarded institutions. The Talent Factory for postdocs also helped me submit an EU funding application for my career grade – which I'm delighted to report was successful!"

MADLEEN BUSSE, PH.D.
Postdoc

Chemist Madleen Busse kick-started her career in biomedical physics with one of the sought-after postdoctoral fellowships from the TUM University Foundation. While completing her doctorate in Australia, she was invited along with fifty other up-and-coming international researchers to spend a week getting to know TUM – and identify the research lab that best fits her work. As a postdoc, she is now developing contrast agents and staining methods for detailed 3D X-ray images of tissue samples.

"This professorship is like a startup. My team and I are working autonomously to establish a new research field. At the same time, I have mentors who are among the best in their field. It's an intensive and dynamic process that is also very helpful to my own development."

PROF. DR.-ING. JIA CHEN
Assistant Professor

Electrical engineer Jia Chen returned to TUM from Harvard University. Tenure track professorships offer early independence for promising next-generation talent, as well as the opportunity to rise through the faculty ranks – assuming outstanding achievement, of course. TUM is breaking new ground in Germany with this career model. In Jia Chen's case, it allows her to pursue her aim at TUM of using innovative methods to measure urban greenhouse gas emissions, thus helping to mitigate climate change.

Research

Ideas without frontiers

Doctors and engineers are developing a technology that visualizes oxygen in tissue to track the growth of breast cancer. Political and computer scientists are working to detect software robots spreading political messages on social media. And engineers and natural scientists are using mathematical equations to calculate precisely how air is distributed in the lungs for the first time.

All of these projects demonstrate what sets research at TUM apart: a complete lack of boundaries between engineering sciences on the one hand and natural, medical and life sciences on the other. Instead, TUM pursues university-wide research programs focused on the mega-topics of our time: environmentally friendly energy, sustainable biotechnology, and the interface between technology and society. Its research profile has also been enriched by the recent additions of economic and social science institutions, which teach and research at the interfaces with technology.

TUM's research arsenal sets new standards worldwide, with pioneering technology such as the high-flux neutron source and the first mini particle accelerator for high-brilliance X-rays. Equally, researchers are also equipped to establish the ideal environment for their experiments themselves – with physicists creating a measuring room that boasts the weakest magnetic field in our solar system, for example. ■

Five research focuses, five success stories

Day in, day out, researchers grapple with nothing less than the grand challenges facing society today. At TUM, these are grouped into five focus areas: Health & Nutrition, Environment & Climate, Energy & Natural Resources, Information & Communications, Mobility & Infrastructure.

Health & Nutrition

Precisely 18,097 proteins have been identified by our biochemists and bioinformaticians, who have also described how and where they occur in the human body. This means that over 90% of the human proteome has been mapped. Proteins are the building blocks of life. They control almost all of our bodily functions. Proteome research thus holds the key to the medicine of the future.

Environment & Climate

Just like a potato, the Earth is covered in bumps and dents – if you're looking at a representation of its gravity, at least. That's because gravity is not uniform everywhere, and this has a crucial impact on the course of ocean currents. And these, in turn, are vital to research into climate change. So climate researchers also had good reason to be excited about the European Space Agency's GOCE satellite mission. Designed at TUM, this satellite was able to measure the Earth's gravitational field with unprecedented accuracy. Evaluated by an international, TUM-led consortium, the data constitutes a real treasure trove for a whole range of disciplines – from sea-level-based elevation data for construction right through to earthquake research.

Energy & Natural Resources

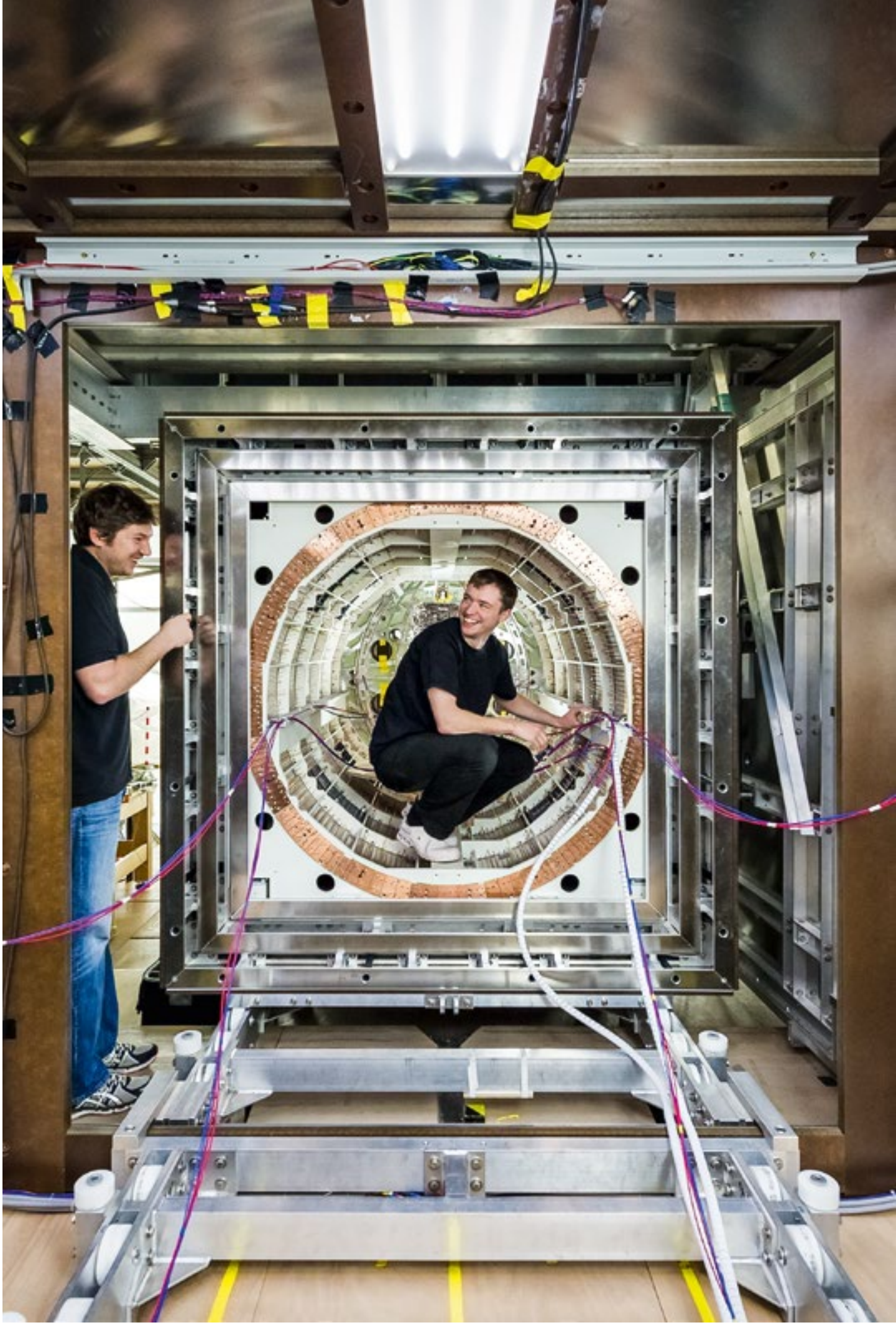
Generating clean energy from hydropower while protecting aquatic ecosystems – hydraulic engineers at TUM have united these goals in the shape of an innovative hydroelectric power station that is concealed in a riverbed shaft, allowing fish to pass by unscathed. Its design is so cost-effective that thousands of new sites in small bodies of water can now be considered as decentralized sources of energy. This eliminates the need for shoreline installations, leaving nature undisturbed.

Information & Communications

Data traffic around the world is increasing day by day. But how can our networks keep pace with these soaring volumes? TUM scientists and industry partners have set a new record in transmission capacity for fiber optic networks. Their method successfully minimizes noise and interference in optical data transmission. This has also enabled them to boost the range without adding to network complexity.

Mobility & Infrastructure

MUTE is a prime example of interdisciplinary research: an electric car designed and built from scratch by a team drawn from 21 TUM departments. Just 18 months after the project launched, the team presented the car at the International Motor Show (IAA). The research vehicle is now undergoing further development in collaboration with various companies – and delivering important findings for the future of electromobility.



"Putting my ideas into practice calls for well-trained staff and talented young scientists. Fortunately, here at TUM, both are in abundant supply."

PROF. DR. ARNE SKERRA

One of the world's first "protein designers" Arne Skerra, Professor of Biological Chemistry at the TUM School of Life Sciences Weihenstephan (WZW), is dedicated to developing novel proteins with functions not previously found in nature. His groundbreaking research has enabled significant advances in modern medicine and pharmacology. He not only established the new research field of anticalins – artificially produced proteins – but also invented processes now used as standard in numerous laboratories worldwide. He has also founded two companies to help translate his findings into industrial applications.

"People do not behave rationally. 'Homo economicus' does not exist – joy, fear, euphoria or compassion always play a role. This poses challenges for business that can only be solved in an interdisciplinary context – which is where TUM comes in."

PROF. DR. ISABELL M. WELPE

Tackling the future of work and organizations: Isabell Welpe is addressing one of the most pressing issues in business management with her efforts in this area. As Professor of Strategy and Organization at the TUM School of Management, her research and tuition is informed by behavioral science. She is also helping to shape higher education policy in Bavaria and throughout Germany as Director of the Bavarian State Institute for Higher Education Research and Planning (IHF).

"TUM provides the ideal environment for my research – deeply rooted in science and yet close to key project groups at the Fraunhofer Institute. It doesn't get any better than that!"

PROF. DR. CLAUDIA ECKERT

New concepts, methods and technologies in IT security: Claudia Eckert gives TUM's Department of Informatics an internationally acclaimed voice when it comes to the security and trustworthiness of IT-based systems and applications. As Professor of IT Security, her work has set new standards in the development of security solutions and is a major factor in the leading role of TUM Informatics in this field.

"TUM is ahead of its time. Our expertise in Earth observation satellites enables us to anticipate many risks to urban growth."

PROF. DR. XIAOXIANG ZHU

Earth observation to the nearest millimeter: Xiaoxiang Zhu and her team at the Department of Civil, Geo and Environmental Engineering (BGU) at TUM have developed an early detection method that uses satellite images to identify potential hazards on Earth – including ground subsidence of just 1 millimeter per year, which could ultimately lead to the collapse of buildings, bridges, tunnels or dams. With her new method, the Professor of Signal Processing in Earth Observation is improving urban safety all over the world.

"At TUM, the boundaries of science are blurred to the benefit of society, with electrical engineering, medicine and molecular biology all tightly interwoven."

PROF. DR. OLIVER HAYDEN

Detecting diseases through rapid electronic testing: Oliver Hayden develops new methods to meet diagnostic and biomedical challenges at TUM's Department of Electrical and Computer Engineering. As Professor of Biomedical Electronics, his focus lies on the interfaces between electronics, optics, microfluidics and materials science. In 2017, he received the European Inventor Award for developing an automated rapid blood test for malaria. He works in close collaboration with medics under the umbrella of the TranslaTUM research center in the grounds of TUM's university hospital.

"TUM operates at high speed – researchers sometimes spend years pondering ideas that we have already realized."

PROF. DR. MARKUS LIENKAMP

New vehicle concepts in the field of electromobility: Markus Lienkamp's research is highly topical, especially in an automotive powerhouse such as Germany. In 2011, the Professor of Automotive Technology at TUM's Department of Mechanical Engineering worked with students to develop the innovative MUTE electric vehicle, outpacing the car industry in bringing it to market maturity – a milestone in electromobility.

Expodach

Already a classic landmark of modern architecture – this roof structure was designed and engineered by TUM professor Thomas Herzog for the Expo 2000 world fair in Hanover, Germany.
Standing 20 meters tall, the intricate wooden construction was created using the most advanced production methods. It is made of solid wood yet nevertheless conveys an appealing aesthetic lightness.

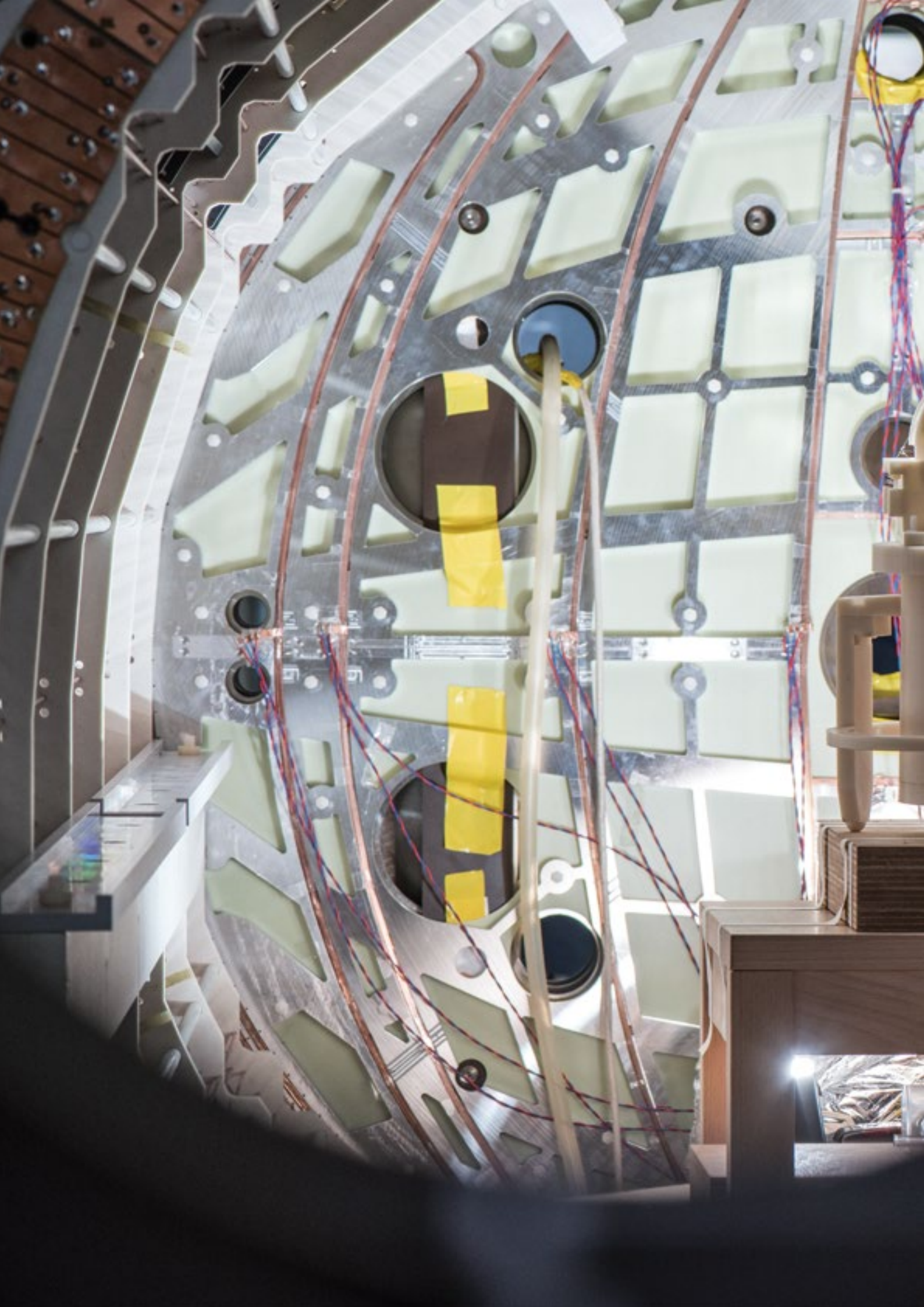
AlgaeTec facility

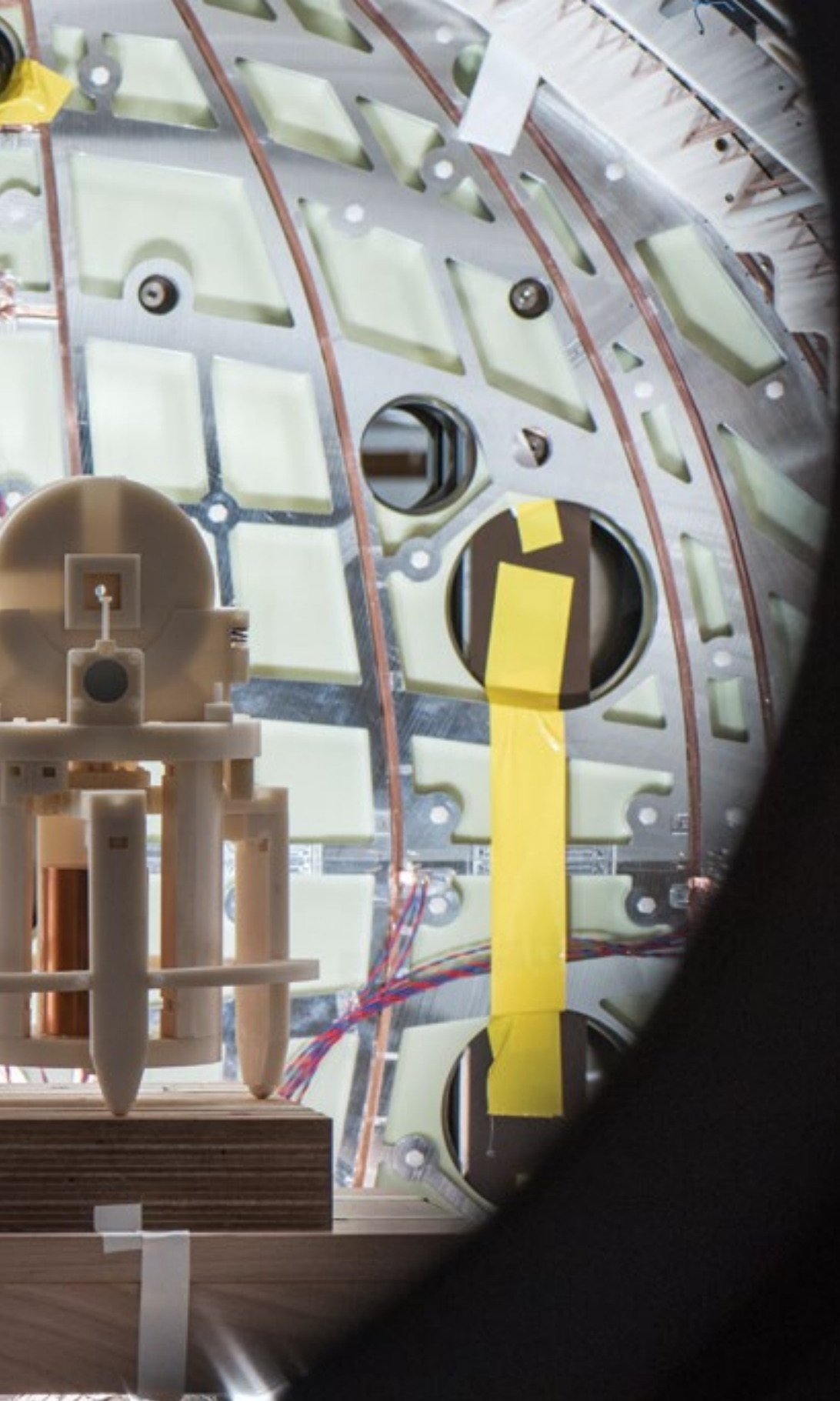
Unique worldwide – TUM's algae cultivation center. It provides 1,500 square meters for algae cultivation, complete with lighting and climatic control equipment that can simulate any location in the world. Thanks to its sophisticated building automation system, the AlgaeTec facility is also extremely energy-efficient.

From lecture theater to Olympic Stadium

They might be studying medical or civil engineering, molecular biotechnology or business administration – but at TUM, students also make time to participate in sports. Even up to Olympic level, with our athletes recently competing for medals in Rio de Janeiro, Brazil.


TUM
TUM





Minimal magnetism

Professor Peter Fierlinger's team at TUM's Universe Excellence Cluster has succeeded in constructing a 4.1-cubic-meter space on the Garching research campus with the weakest magnetic field of our solar system. Permanent and temporally variable magnetic fields are reduced over a million-fold here.

Tuition

Beyond the lecture theater

Professor Michael Krautblatter is carrying out investigations just below the Zugspitze summit in the Alps, focusing in particular on the development of permafrost. In the wake of climate change, scientists are already observing a rapid decline in this perennially frozen ground. Needless to say, students are also enthusiastic about the field trip.

July 2017: In Ghana, an international research group tests the aCar electric vehicle, specially designed for the African market. Among the team members are students from TUM's Institute of Automotive Technology.

August 2017: At 324 kilometers per hour, a transport capsule shoots through the Los Angeles Hyperloop – a tube system with a near-vacuum environment. This new record was set in a competition run by US entrepreneur Elon Musk, who intends to use the technology for passenger transport in the future. And the winning capsule? Designed by a team of students from TUM.

September 2017: A startup company visits hospitals to present a system that automates tissue sample analysis. In this way, errors in pathology can be minimized – to the evident enthusiasm of doctors. The company was founded by students from TUM.

Studying at TUM has a magnetic appeal – giving students the chance, for instance, to work at the cutting edge of research, set up their own projects and kick-start careers offering the best possible prospects. The university is a destination of choice for dedicated and talented individuals seeking answers to the major issues of our time, such as climate change or personalized medicine. After all, TUM systematically aligns its course offerings with global developments in business and society.

TUM also combines its broad spectrum of disciplines to offer pioneering fields of study, such as biomedical computing or neuroengineering. People with Bachelor's degrees from totally diverse disciplines thus come together to work on the Master's programs – mirroring real-life collaboration in the professional world.

Building space elevators and meeting the leading lights in business

These are just some of the reasons why thousands of HR managers from 20 countries regularly rank TUM graduates among the best in the world (Global University Employability Ranking). Rich contact with TUM's business partners – through project studies, internships or mentoring – also helps to ensure that students are thoroughly prepared for their first employment experience. Or, of course, they can start their own companies straight away, with TUM supporting them from the initial idea right through to the end of the product launch phase.

At TUM, there's no need for budding researchers to await their final examinations. Instead, they can get going as soon as they start their first semester, with students organizing all sorts of research groups of their own. These receive professional support and access to the university's facilities, but work entirely on their own initiative. Examples of early achievements range from building space elevators through developing biotech products to designing gas turbines. Knowledge and experience are passed down from one generation to the next here. The oldest group, the Akaflieg aircraft engineers, has been sharing knowledge for almost 100 years now. Other teams manage Germany's largest university career fair, IKOM, engage in numerous social initiatives or plan visits to TUM by leading business lights such as Bill Gates.

More and more young people are keen to benefit from this winning combination: In 2016, TUM hit a new record with 40,000 students – doubling its numbers within just 15 years. ■

From Burkina Faso to Vanuatu – benefiting from TUM tuition worldwide

Massive Open Online Courses (MOOCs) are interactive online courses that are accessible around the world free of charge. TUM began publishing its own MOOCs in 2013, becoming the first German university to enter into partnerships with the acclaimed Coursera and edX platforms.

Lecturers use dedicated MOOC platforms to share knowledge in compact video series, followed by automated tests to check learning progress. Web applications such as forums, blogs and social media services can also play a role, facilitating interaction with learners and between fellow students.

The MOOCs produced by TUM go well beyond merely filming lectures. In fact, the courses consist of several individual units, each lasting up to nine minutes and incorporating a number of video elements. The offering includes interactive tasks for participants and the ability to post and prioritize questions, as well as other digital learning materials and online forums to enable dialog. Learners can then take an exam at the end of each course.

Since TUM first launched its MOOCs, some 250,000 participants have taken advantage of the steadily growing offering. The university thus provides an international audience with access to education and current research of the highest quality as these interactive online courses are available worldwide. The format offers the ideal blend of face-to-face events and e-learning components. Equally, the "flipped classroom" can enrich conventional tuition, with professors using MOOCs as a basis for their lectures. Students prepare themselves beforehand by covering material at home on their laptops, and this is then enhanced with practical exercises – while also leaving more time for discussion or questions.

Since its first MOOCs were a major success, TUM then added another variant to its online offering: MOOC*s for* Masters. These courses are intended to prepare students for successful Master's degree programs. They convey the basics and offer learners the opportunity to familiarize themselves with the standards required to complete a Master's degree at TUM. These bridge courses are intended in particular to support international Master's applicants.

From MOOC to Master's at TUM:

After completing our Quality Engineering & Management MOOC, Taiwo Yusuff decided to come to Munich from Nigeria to pursue his Master's degree at TUM.

"My course places a great deal of emphasis on developing my own personality as a teacher. I was already working in a classroom as an intern from the end of my first semester. It is reassuring to have the opportunity to experience the job as it will be in the real world."

ANTONIA OHNER
Master's student
Vocational Education, specializing in Metal Engineering

"As students, we were often asked: How can you turn your idea into a product and bring it to market yourself? And then we received intensive support to do just that, with coaching, our own office space and equipment for building prototypes."

CLAUDIU LEVERENZ
Graduate
Business Informatics

Claudiu Leverenz founded the start-up Glasschair, which is developing a technology that allows people to steer their wheelchairs using head movements.

"Discussing about society is much more exciting when social scientists meet engineers – and everyone comes from a different country. The habitat of TUM is international. This makes the students feel like world citizens.

EMEK BARIS
Master's student
Science and Technology Studies

"As students, when it comes to our studies, it's important that we also have a voice. Participating in committees such as the Academic Affairs Board gives us the opportunity to help shape the future of our university."

PAUL MAROLDT
Student representative
Academic Affairs Board

"My mentor quickly dispelled my remaining misgivings about being taken seriously as a woman in a technical field – studying here, it's totally irrelevant."

MARIANNE TRINLEY
Bachelor's student
Electrical Engineering and Information Technology

Marianne Trinley participated in the Step Inside mentoring program, where experienced students spend around half a year familiarizing pupils with everyday student life.

Javier Luna Mazari is part of the team that won the iGEM Biotech competition at the Massachusetts Institute of Technology in 2016 by producing live tissue with a 3D printer.

"I have experienced the possibilities of research first-hand: working without boundaries, embracing responsibility, trying out ideas that sound impossible. And all with a single goal – building a better world."

JAVIER LUNA MAZARI
Bachelor's student
Molecular Biotechnology

Technology transfer

Startups from the lab

October always brings a hint of Hollywood to TUM, as three startup teams eagerly anticipate the moment the President announces the annual Entrepreneurship Award winner.

Around 70 companies are founded at TUM each year – and not just because the university motivates its students and researchers with incentives like the Presidential Entrepreneurship Award. It has also managed to create the only infrastructure of its kind in Europe, supporting startups in every possible way and at every stage of the lifecycle. Over the years, this stimulating TUM microclimate has become legendary. From advice on the best business model to management training, and from go-to-market preparations to funding applications, TUM is always quick to "roll up its sleeves". The university's incubator service also provides teams with office facilities to plan their startups, learning first-hand how to make them a success – with the TUM Entrepreneurship Research Institute focusing on this very topic just a few rooms away.

UnternehmerTUM, the university's center for innovation and business creation, runs its own venture capital fund and also offers support to young entrepreneurs looking to start their own companies. Here, people from diverse backgrounds and industries come together to take part in accelerator programs or build prototypes in the high-tech MakerSpace workshop. Equally, Techfest Munich draws engineers, hackers and designers from all over Europe. A rich and creative startup community has thus emerged at TUM, which is also making its mark on the wider economy in the European metropolitan region of Munich.

Industry on Campus

TUM's success is spurred on by established alliances with research-intensive industry partners. The Munich metropolitan region unites scientific excellence with financial success.

Practical know-how is essential to translate research outcomes into marketable innovations. To this end, TUM invests in long-term cooperation programs with research-oriented enterprises – ideally involving a jointly managed laboratory. This Industry on Campus strategy adds a new dimension to the success story of German engineering – with researchers from both stakeholders uniting as a team, a collaboration model that does not come to an abrupt halt when a project is terminated, and resources that flow into the laboratory instead of bureaucracy.

General Electric, Siemens and Dräxlmaier are already installed on the Garching campus or will soon be settling in there. And the Ludwig Bölkow Campus to the south of Munich was established specifically for this purpose, allowing TUM to work with partner companies on advancing new technologies for the aerospace industry. ■

Made at TUM, Germany

Brainlab

The success of a startup has nothing to do with the age of its founder – as Brainlab clearly shows. The brainchild of a 21-year-old computer science student at TUM, the company set out to use the latest imaging methods in what was a completely new approach to cancer treatment at the time. Founded in 1989 by Stefan Vilsmeier – sometimes referred to as the Bavarian Bill Gates – the company is now a global market leader in the field of computer-assisted surgery and employs over 1,000 people. It offers solutions for better patient care through minimally invasive methods, and supplies hospitals and medical practices in 80 countries around the world. In short, a unique success story of a high-flier from TUM!

Konux

For any new startup team, being able to access TUM and UnternehmerTUM's comprehensive offering is already a powerful launch pad, providing them with start-up consulting, coaching and the MakerSpace workshop. However, it's obviously even better if you also happen to meet your co-founders while preparing your business plan. And that is exactly what happened to Andreas Kunze, Dennis Humhal and Vlad Lata, who can now look back on an exciting startup phase since that fateful business plan seminar at TUM and their foundation of Konux in 2014. In the meantime, their idea of predictive maintenance using smart sensors and artificial intelligence has netted them a total of USD 16 million in Series A financing.

As the successful entrepreneurs like to say: "The way to get started is to quit talking and begin doing" – a fitting motto for TUM as a whole!

Celonis

When a startup hits the sweet spot by swiftly winning over big-name customers such as ABB, Bayer, Siemens and Vodafone, you know it's built on a unique concept – as well as interdisciplinary cooperation. For Celonis, it all started with three TUM students – Martin Klenk, Bastian Nominacher and Alexander Rinke – specializing in computer science, finance and information management, and mathematics. They came up with an intelligent process-mining technique on the back of a joint research project, harnessing big data technology to analyze and visualize all the processes within a company. Thanks to an EXIST startup grant from Germany's Federal Ministry for Economic Affairs and Energy along with support from UnternehmerTUM, Celonis is already world market leader in process mining. The Munich-based startup has thus developed into a successful global software company with over 200 employees – another success story from the entrepreneurial heart of TUM!

"Brainlab now employs more than 430 software engineers and developers. TUM is an exceptional hotbed of new ideas and talented staff, which for us is an important part of Munich's appeal as a business hub."

Stefan Vilsmeier
Founder of Brainlab

Konux
Andreas Kunze
Dennis Humhal
Vlad Lata

Celonis
Martin Klenk
Bastian Nominacher
Alexander Rinke

Brainlab
Stefan Vilsmeier


International reach

Connecting Bavaria with the world

Complex research topics call for an international and multidisciplinary approach.

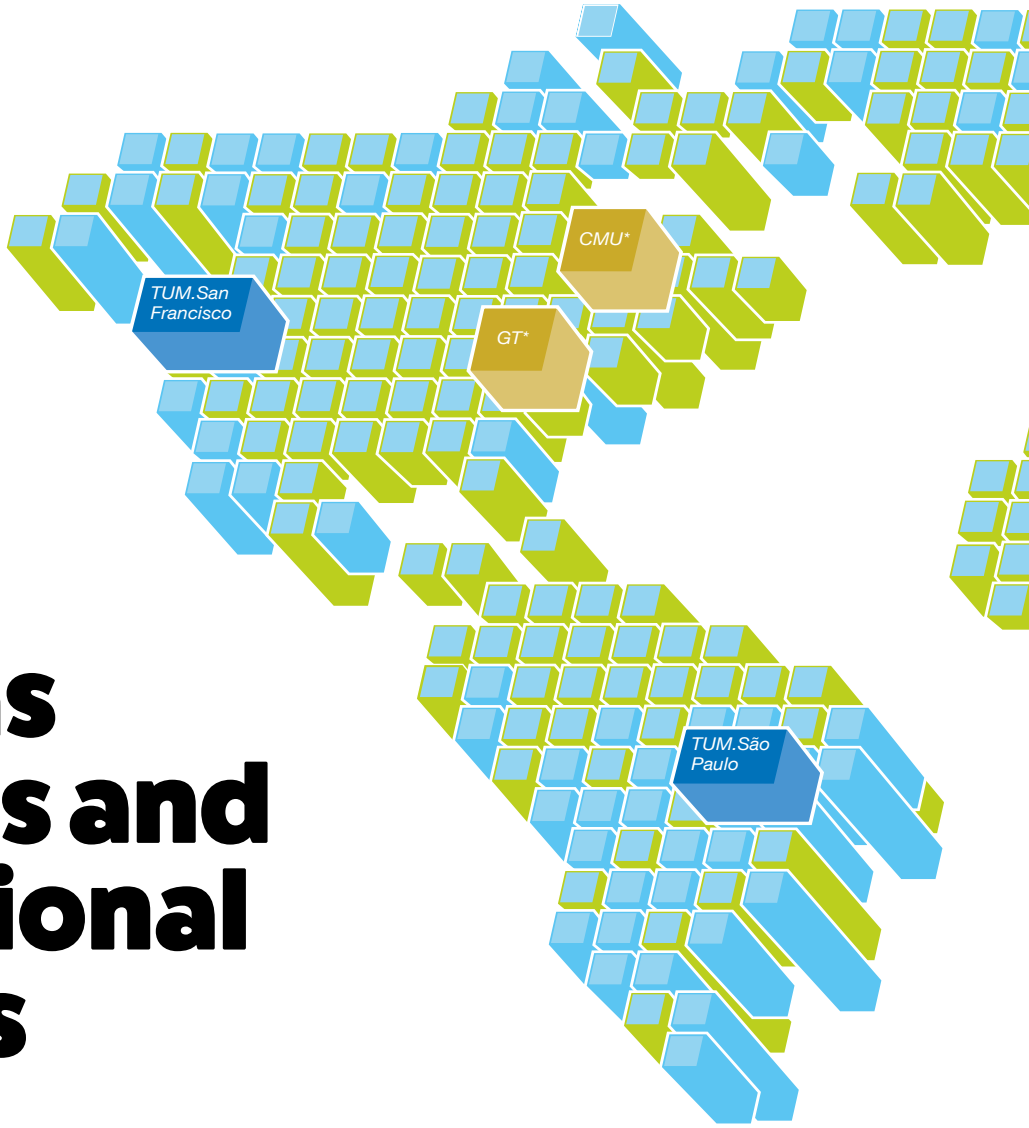
A focus group at the TUM Institute for Advanced Study (TUM-IAS) has succeeded in pioneering techniques to select exactly the right immune cells which, when genetically reprogrammed, will destroy cancer cells in the body – in some patients even resulting in complete remission of end-stage leukemia. At TUM-IAS, selected TUM high-fliers work alongside eminent visiting researchers from all over the world, tackling challenging topics with a "no risk, no reward" approach. In this particular case, the work was undertaken by TUM's Dirk Busch, Stanley Riddell from the Fred Hutchinson Cancer Research Center (US) and Chiara Bonini from the San Raffaele Scientific Institute (Italy). When they presented their findings at the annual meeting of the American Association for the Advancement of Science, the news spread right around the globe.

No-one can master the grand challenges of science on their own – and ambitious research endeavors call for a deep dive into the underlying complexities. To this end, TUM places great emphasis on international and interdisciplinary collaboration, both in research and in education. "Our project partners round out our expertise and reinforce our strengths," confirms TUM's President, Wolfgang A. Herrmann.

TUM's partners come from international universities and companies around the globe, with particularly close links to the leading technical universities within the GlobalTech and EuroTech alliances. Here, institutions such as Imperial College London, NTU Singapore and EPF Lausanne join forces for research purposes.

Distributed across four continents, TUM's international offices give the university a key competitive advantage. Staffed by liaison officers with an in-depth knowledge of their regions, these provide an ideal platform for building new partnerships. For many outstanding individuals looking to pursue their studies or research endeavors at TUM, these offices are the first point of contact on their path to Munich. As it stands, 26% of students and 20% of research and teaching staff already come from countries outside Germany, rising to 33% for Master's programs. TUM has appointed 145 faculty members from abroad since 2006.

Today, TUM enjoys global reach as an international brand. It has even exported its successful model to Asia – founded in 2002, Singapore-based TUM Asia Pte. Ltd. is still the only campus run by any German university abroad. ■



Overseas locations and international alliances

At home in Bavaria, successful the world over. TUM has locations of its own across four continents – and maintains links with leading technical universities around the globe.

TUM

TUM's global reach

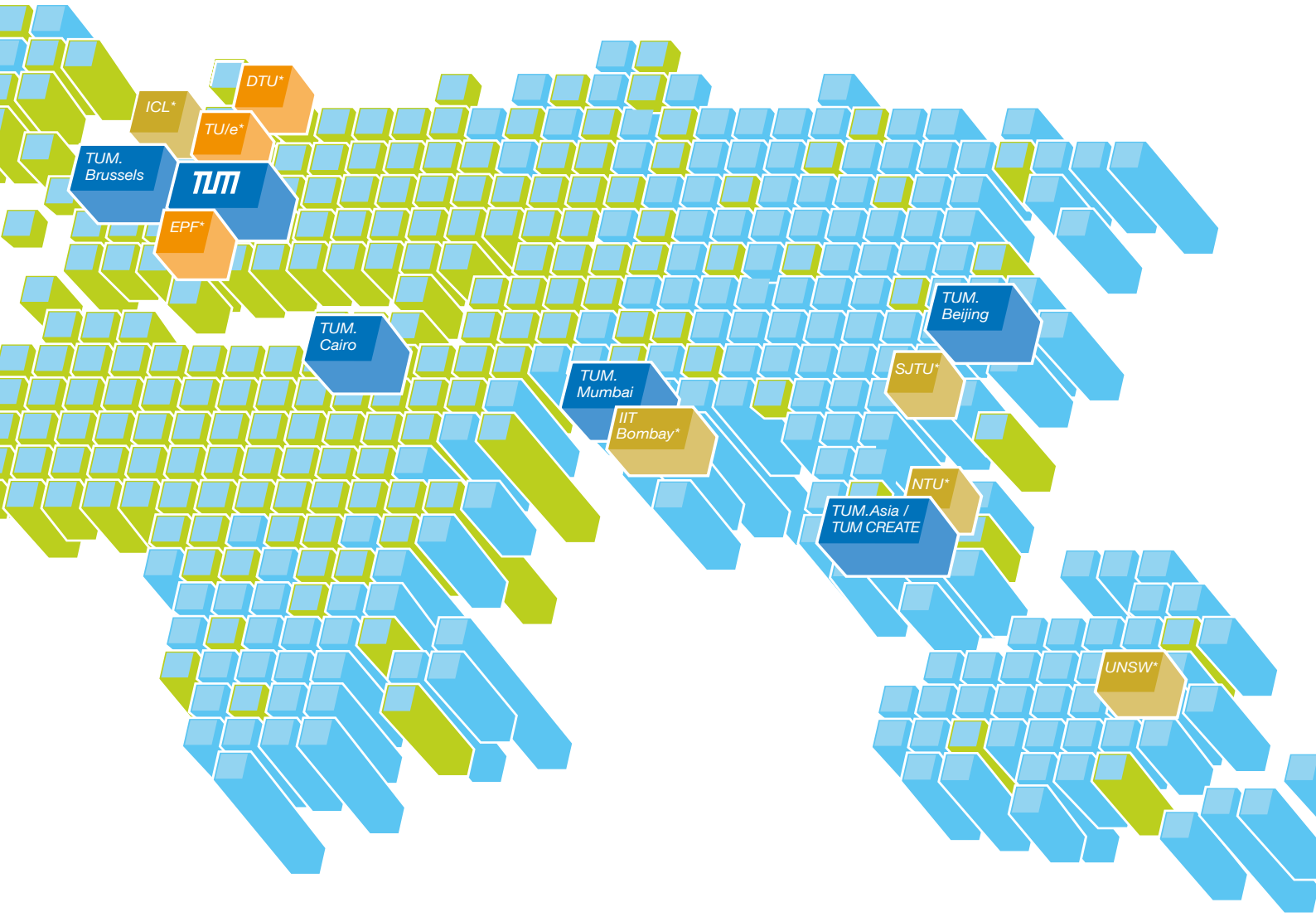
- 1 TUM offshore campus
- 6 international liaison offices
- 160+ partner universities
- 300+ ERASMUS partner institutions
- 50 Master's programs in English
- 26% international students
- 20% international research and teaching staff
- 49 double degree agreements

GlobalTech

*TUM – Technical University of Munich
*GT – Georgia Institute of Technology
*ICL – Imperial College London
*SJTU – Shanghai Jiao Tong University
*NTU – Nanyang Technological University, Singapore
*UNSW – University of New South Wales
*IITB – Indian Institute of Technology Bombay
*CMU – Carnegie Mellon University

EuroTech

*TUM – Technical University of Munich
*TU/e – Eindhoven University of Technology
*DTU – Technical University of Denmark
*EPFL – École Polytechnique Fédérale de Lausanne



TUM Asia Pte. Ltd., Singapore

The first campus run by a German university abroad, TUM Asia equips around 600 regional students every year for international careers.

The study program blends German engineering with management skills and an understanding of South-east Asian culture. It culminates in a TUM degree – on a par with the German original.

TUM CREATE, Singapore

This research alliance with Nanyang Technological University (NTU) focuses on developing mobility solutions for megacities in the tropics – which are growing at breakneck speed. TUM is one of just a few top universities worldwide selected by the Singapore government to participate in the CREATE center.

TUM family

Community connects generations

Building bonds that stand the test of time. On more than one occasion, TUM has demonstrated its ability to turn tough times (during war or post-war periods, for instance) into new beginnings, and to build on times of prosperity to raise its game to the ranks of the world's best. All of these achievements are the work of an entire community – a community that bridges generations.

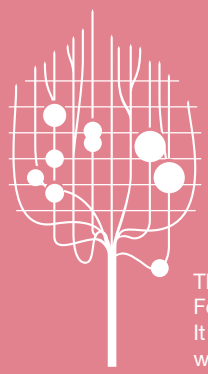
TUM's alumni network is excellent proof of the sense of connectedness and friendship that defines the university community, uniting over 60,000 TUM enthusiasts and spanning the entire globe. Many alumni contribute to their "TUM family" by mentoring students or researchers, or by supporting other alumni within regional groups. TUM alumni clubs spring up in every region of the world.

Equally noteworthy are the many alumni who choose to make a financial contribution. Over the years, TUM has developed a donation culture that was previously unheard of in Germany – and this tradition is now being passed down from one generation to the next. For instance, graduates awarded a Germany Scholarship during their studies themselves go on to fund scholarships for their successors at the beginning of their careers.

The catalyst for this development was the establishment of the TUM University Foundation in 2010. The Foundation reinvests its endowment income in programs to foster young talent.

More than 120 patrons and companies have already contributed to this – not only alumni, but also sponsors who see TUM as a valuable investment in our future.

A shining example here is the Ingeborg-Ortner daycare center on the Garching campus (shown left), named after its founder, who financed it completely. ■



The logo of the TUM University Foundation symbolizes the tree of life. It represents successive generations, with their talents constantly growing and regenerating. Cultivating these unique talents is the Foundation's mission. It invests in people and in strengthening their connections.

Alumni

"I owe my professional success to my studies in physics at TUM. I am proud of our university of excellence and want to ensure it continues to lead the way."

PROF. RANDOLF RODENSTOCK
Managing Partner of family holding company
Optische Werke G. Rodenstock
GmbH & Co. KG (OWGR)
Alumnus 1976

"What do I associate with TUM today? Entrepreneurial thinking! It's my academic home."

DR.-ING. NORBERT REITHOFER
Chair of the Supervisory Board of BMW AG
Alumnus 1983

"I never expected that the TUM of the 21st century would attract so many women. In 1930, when I started studying architecture, women were quite a novelty!"

ANNELISE EICHBERG
(1910-2016)
Architect
Alumna 1934

"Our family company recently celebrated the best year in its history, which stretches back more than four decades. I credit a large part of this success to my own studies at TUM, which is why I was glad to become a donor."

DR.-ING. DANIEL TOMIC
Managing Director of Tomic TEC
Alumnus 2003

"People and their skills form the basis of our society, so I feel a strong personal obligation to support them. And TUM is the best place to do just that."

JOHANNES WINKLHOFER
Managing Director of iwis-Joh. Winklhofer Beteiligungs GmbH & Co. KG
Alumnus 1988

"Special thanks to TUM for its excellent engineering program!"

DR. SAMANTHA CHRISTOFORETTI
European astronaut
Member of ISS expeditions
Futura 42 and 43 (2014/15)
Alumna 2001

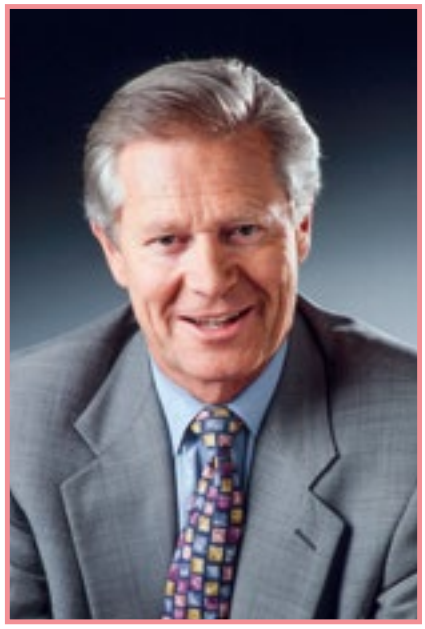
Sponsorship and support

"Responsible entrepreneurs think ahead. Giving talented young people a chance to develop their potential and mobilize their strengths is the long-term and sustainable path to prosperity for everyone. TUM and its donors are thus making a significant contribution to a brighter future."

INGEBORG ORTNER AND JOHANNES B. ORTNER
Chair of the Johannes B. Ortner Foundation and former property developer, Munich
Honorary TUM Senators

"TUM leads the way when it comes to supporting business startups, with 70 new companies originating here every year. Students and researchers have the perfect springboard to turn their ideas into innovative products and services. The secret to this success is a combination of research excellence, top talent from all over the world, and professional startup coaching from UnternehmerTUM. Through this 'entrepreneurial university', I look forward to continuing to support brave individuals and their inspiring ideas – and warmly congratulate TUM on its 150th anniversary!"

SUSANNE KLATTEN
Entrepreneur, Honorary TUM Senator
Founder and patron of UnternehmerTUM GmbH



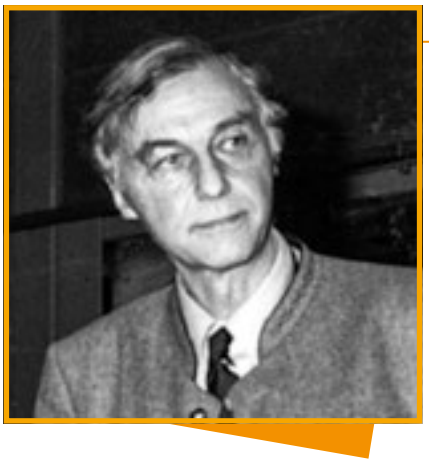
"TUM is one of Europe's most innovative universities, demonstrating leadership excellence and active engagement with all relevant emerging technologies. The university is in a position to attract the best professors from around the globe, educating its students to world-class standards. All this, in turn, helps to secure jobs for the future and establish social stability. So it's a pleasure to be able to support this exceptional momentum through the TUM Foundation."

FRIEDRICH SCHWARZ
President of Rohde & Schwarz GmbH & Co. KG
Honorary TUM Senator

"TUM has done a wonderful job of converting the former monastery in Raitenhaslach into a center for networking and creative exchange. Here, I am particularly pleased to support female students and researchers on their path into their chosen professions. Every euro spent here is a sound investment in the future."

INGEBORG POHL
Entrepreneur
Honorary TUM Senator

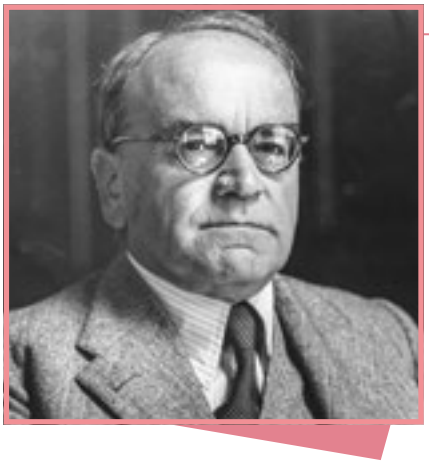
Nobel Prize winners



Robert Huber

Born 1937 / Student, Doctoral Student, Post-Doctoral Student, Professor

Nobel Prize in Chemistry (1988) for determination of the three-dimensional structure of a photosynthetic reaction center.



Heinrich Otto Wieland

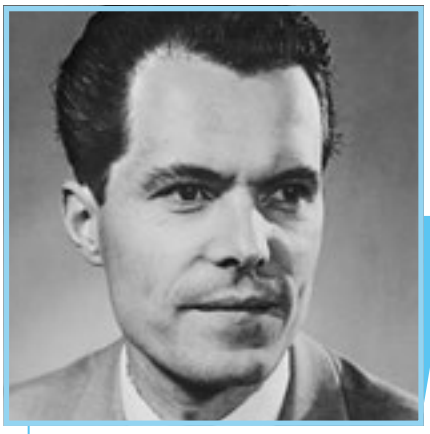
1877–1957 / Professor

Nobel Prize in Chemistry (1927) for his research into the composition of bile acids and related substances.

Hans Fischer

1881–1945 / Professor

Nobel Prize in Chemistry (1930) for research into the constitution of blood and plant pigments and for his synthesis of hemin.



Rudolf Mößbauer

1929–2011 / Student, Doctoral Student, Professor

Nobel Prize in Physics (1961) for his research concerning the resonance absorption of gamma radiation and discovery of the Mößbauer effect.

Ernst Otto Fischer

1918–2007 / Student, Doctoral Student, Professor
Nobel Prize in Chemistry (1973) in recognition of his pioneering work on organometallic sandwich compounds.

Klaus von Klitzing

*** 1943 / Professor**
Nobel Prize in Physics (1985) for the discovery of the quantized Hall effect.

Nobel laureates who studied and worked at TUM:

Thomas Mann 1875–1955
Guest student in the General Department 1894/95, Nobel Prize in Literature 1929

Konrad Bloch 1912–2000
Chemistry and Engineering course 1930–1934, Nobel Prize in Medicine 1964

Ernst Ruska 1906–1988
Engineering course 1925–1927, Nobel Prize in Physics 1986

Johann Deisenhofer * 1943
Physics course 1965–1971, lecturer qualification at TUM 1987, Nobel Prize in Chemistry 1988

Wolfgang Paul 1913–1993
Physics and Engineering course 1932–1934, Nobel Prize in Physics 1989

Erwin Neher * 1944
Physics course 1963–1966, doctorate at TUM 1970, Nobel Prize in Medicine 1991

Wolfgang Ketterle * 1957
Physics course 1978–1982, Nobel Prize in Physics 2001

Gerhard Ertl * 1936
Doctorate and lecturer qualification at TUM 1965–1967, Nobel Prize in Chemistry 2007

Joachim Frank * 1940
Doctorate at TUM 1970, Nobel Prize in Chemistry 2017

University of the future

Uniting diverse disciplines

A top university emerges through the convergence of excellence in numerous different fields at the point of research. In this way, the “research adventure” can rise to the critical challenges facing society today. This is also one of the secrets behind TUM’s success, powered by an exceptionally broad spectrum of subjects: Natural Sciences & Engineering • Life Sciences & Medicine • Economics & Social Sciences. The interaction between these disciplines has created world-class powerhouses of research.

Core research areas

Health & Nutrition

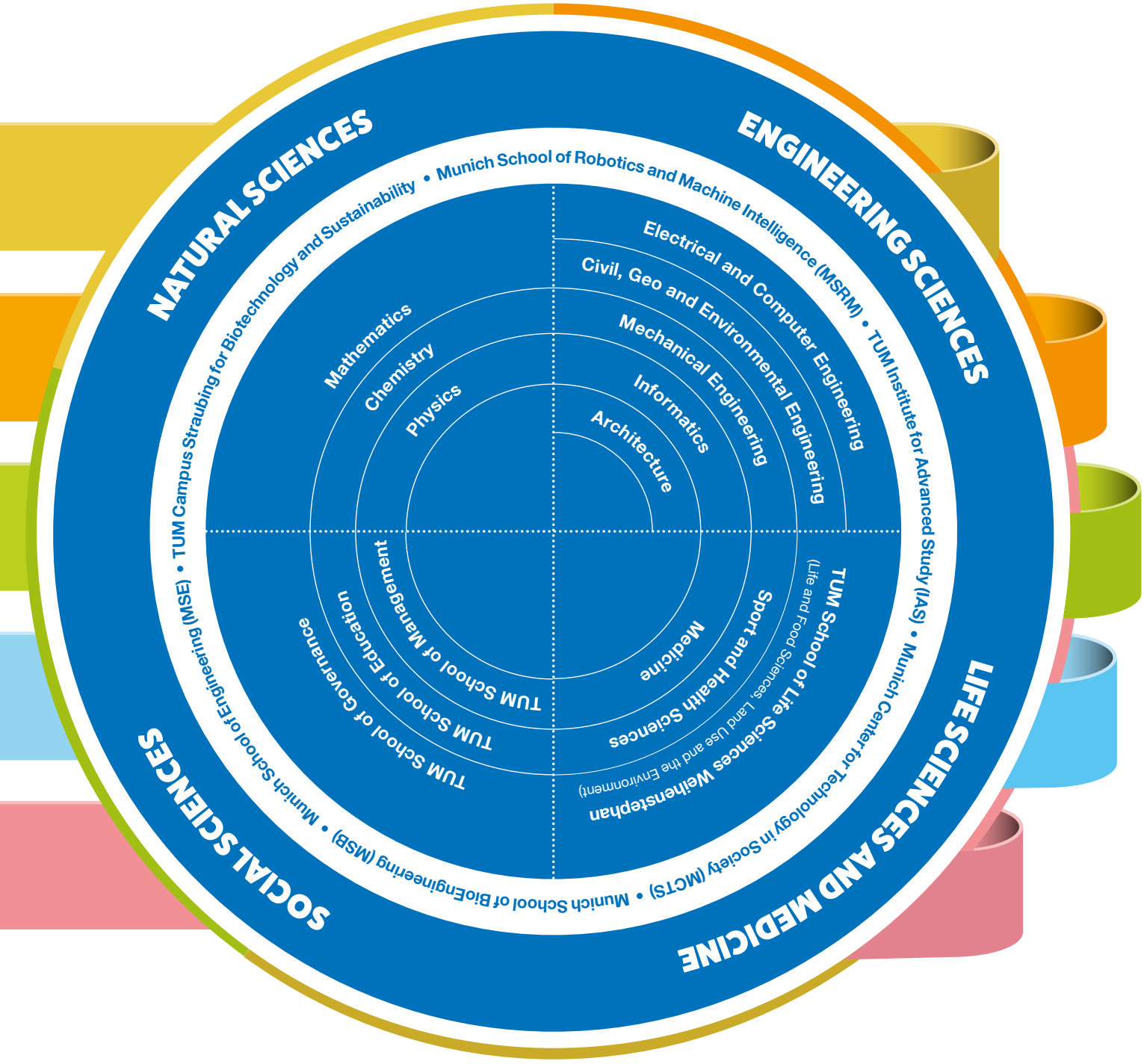
Energy & Natural Resources

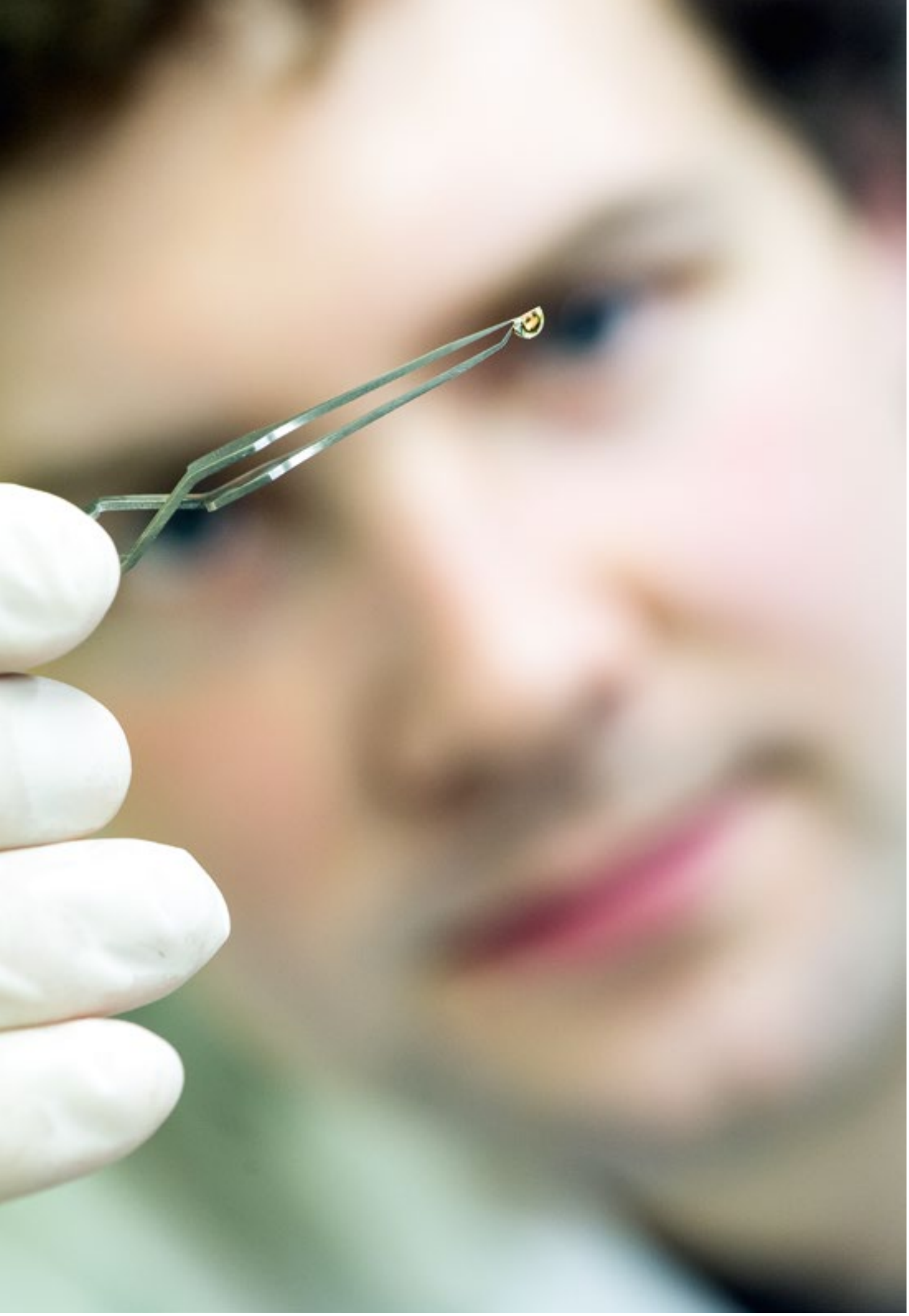
Environment & Climate

Information & Communications

Mobility & Infrastructure

Faculties and integrative research centers





Integrative research centers

Dedicated to fields of research with a major impact on society, TUM's integrative research centers build on the strengths of a research culture that fosters collaboration across the entire university. They also offer their own courses of study, training world-class interdisciplinary researchers at the touchpoints between conventional disciplines. The TUM Institute for Advanced Study plays a particularly important role here, bringing together elite researchers from Germany and abroad and freeing them up to focus entirely on ambitious research undertakings.

TUM Institute for Advanced Study (TUM-IAS)

"Risking creativity" is the motto at the heart of TUM-IAS. Bold plans, crazy-sounding ideas, previously unheard-of methods – you'll find it all at TUM-IAS, where researchers have the freedom to tackle particularly challenging, high-risk projects. During their multi-year fellowships, they are released from all other obligations. This enables TUM's top talents to pursue their research endeavors in collaboration with leading lights from other research institutions and from industry. Interdisciplinary focus groups work under TUM's emerging fields policy. This elite forum also provides the ideal networking hub, promoting the exchange of knowledge and driving scientific debate between the disciplines and with the public.

www.ias.tum.de

Munich Center for Technology in Society (MCTS)

MCTS is a powerful platform at the interface between technoscientific advances and the challenges facing society today. Here, experts in the social sciences and humanities work together with researchers in technical and natural science fields. The program is geared both to TUM's particular research priorities, such as biotechnology and digitalization, and to fundamental questions around responsibility, risk and participation in technological innovations. How do we deal with biofacts or with genetically modified organisms? How should citizens influence infrastructural design? How can robots be usefully integrated into our everyday lives? The center engages with the public, business and politics to explore questions such as these.

www.mcts.tum.de/en

Munich School of Engineering (MSE)

Paving the way for a sustainable and reliable energy supply – that is the mission of the Munich School of Engineering. MSE's research scope extends all the way from energy generation through power networks to electromobility and infrastructure. What technologies could help us use renewable energy more efficiently? How can conventional power plants become more climate-friendly? How can we integrate energy from decentralized sources into smart energy systems? What strategies can we use to secure the future of electromobility? How can we plan and design our built environment in a sustainable and energy-efficient way? The Engineering Science study program marks a cultural shift in education in this field. Its interdisciplinary approach effectively equips students to take on the engineering challenges of the future.

www.mse.tum.de/en

TUM Campus Straubing for Biotechnology and Sustainability

Industrial biotechnology is emerging as one of the key technologies of the 21st century. It focuses on the use of biocatalysts to generate chemical products from biogenic and fossil fuels, thus preparing for the post-oil era. In a new direction for the chemical industry, the value chains will build on numerous established disciplines, with microbiology, biochemistry, bioinformatics, agriculture and forestry all joining forces to develop renewable raw materials that are viable for industrial use. At the Straubing Campus, process engineering and technical chemistry teams are investigating new production processes, while bioeconomics looks at how to market these innovations.

www.cs.tum.de/en

Munich School of BioEngineering (MSB)

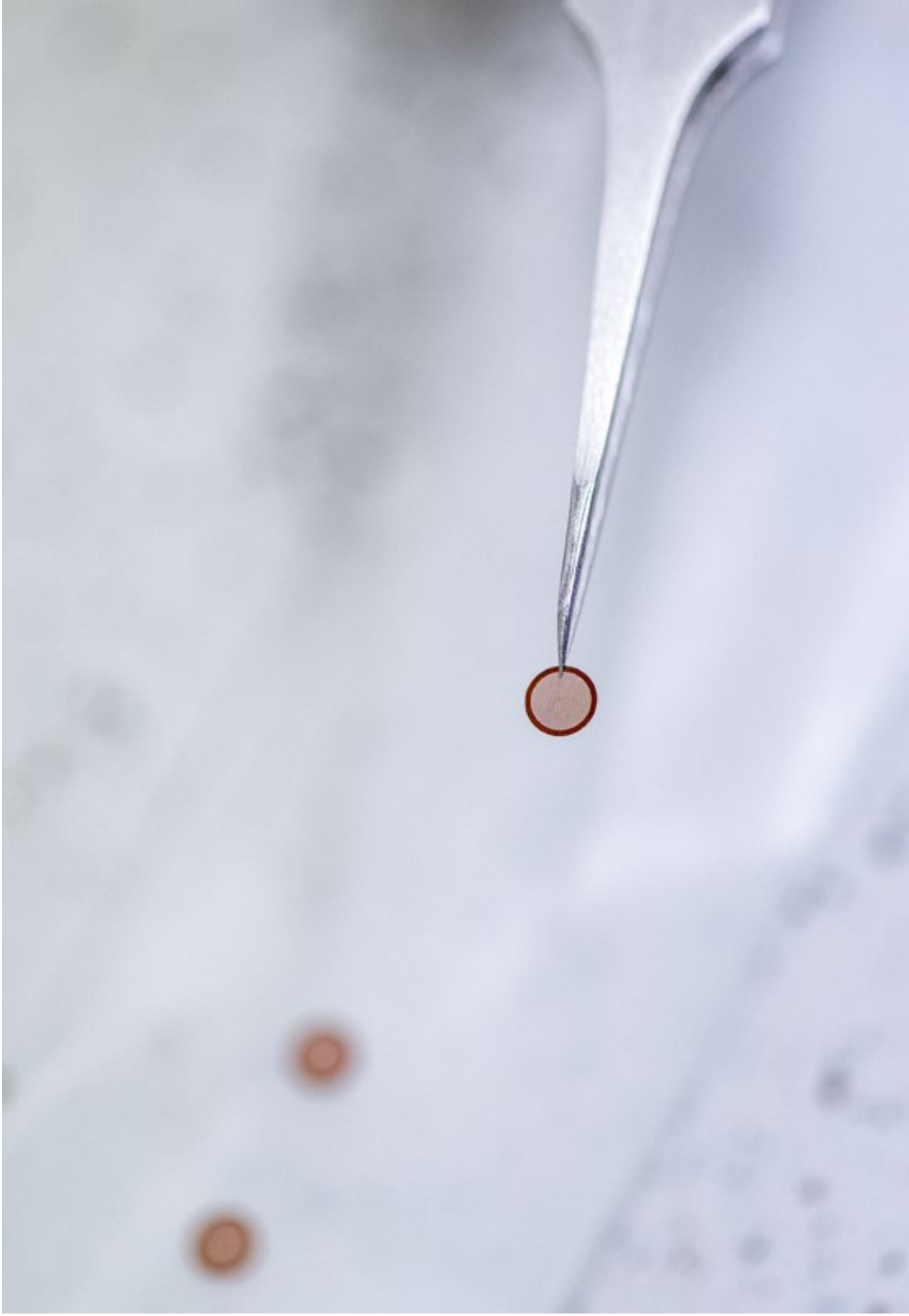
The MSB is Europe's most multi-disciplinary university institution focused on the interface between medicine, engineering and the natural sciences. It brings together TUM research groups, enabling them to draw on expertise in physics, chemistry, computer science and electrical engineering to tackle questions about the basic principles of life and the relationship between health and illness. Bioengineering begins at the molecular level. How can we harness molecular imaging to diagnose disease? How can we build DNA nanomachines for therapeutic use? How can we use algorithms to gain insights into the multitude of different molecules in the genome and their interactions? The MSB is dedicated to investigating all of these issues – and many more besides.

www.bioengineering.tum.de

Munich School of Robotics and Machine Intelligence (MSRM)

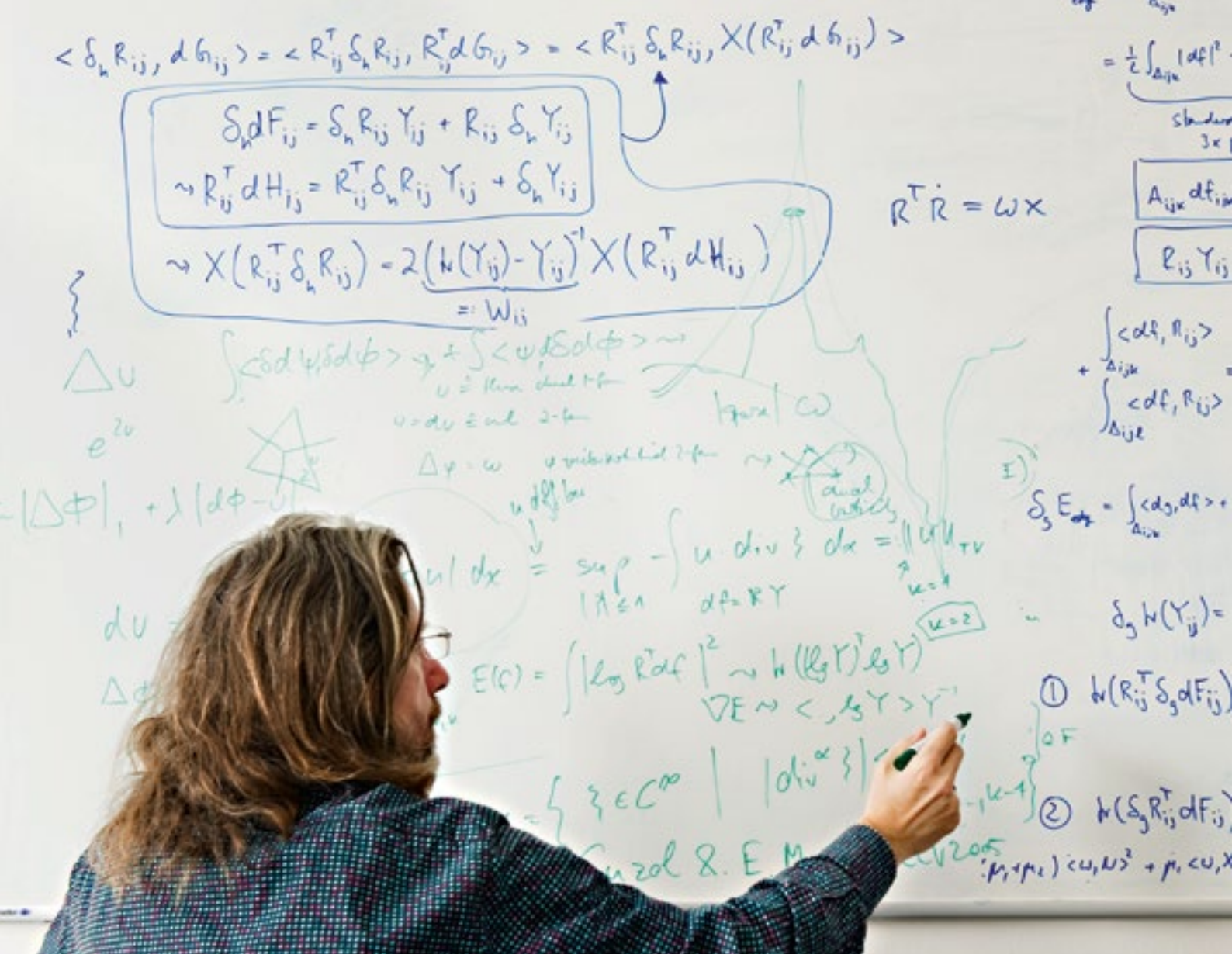
This unique new center explores universal questions around how robotic assistants could support people in their everyday lives in the future. Internationally acclaimed scientists are working on the human-machine interface here to enable a wide range of new robotics applications. How can we use robotic assistance systems to support elderly, sick or disabled people? How can inexpensive, flexible and intuitively operated robots help people? MSRM is a core element of TUM's overall strategy and an innovation driver for robotics.

www.rmi.tum.de



Departments, institutes & clinics

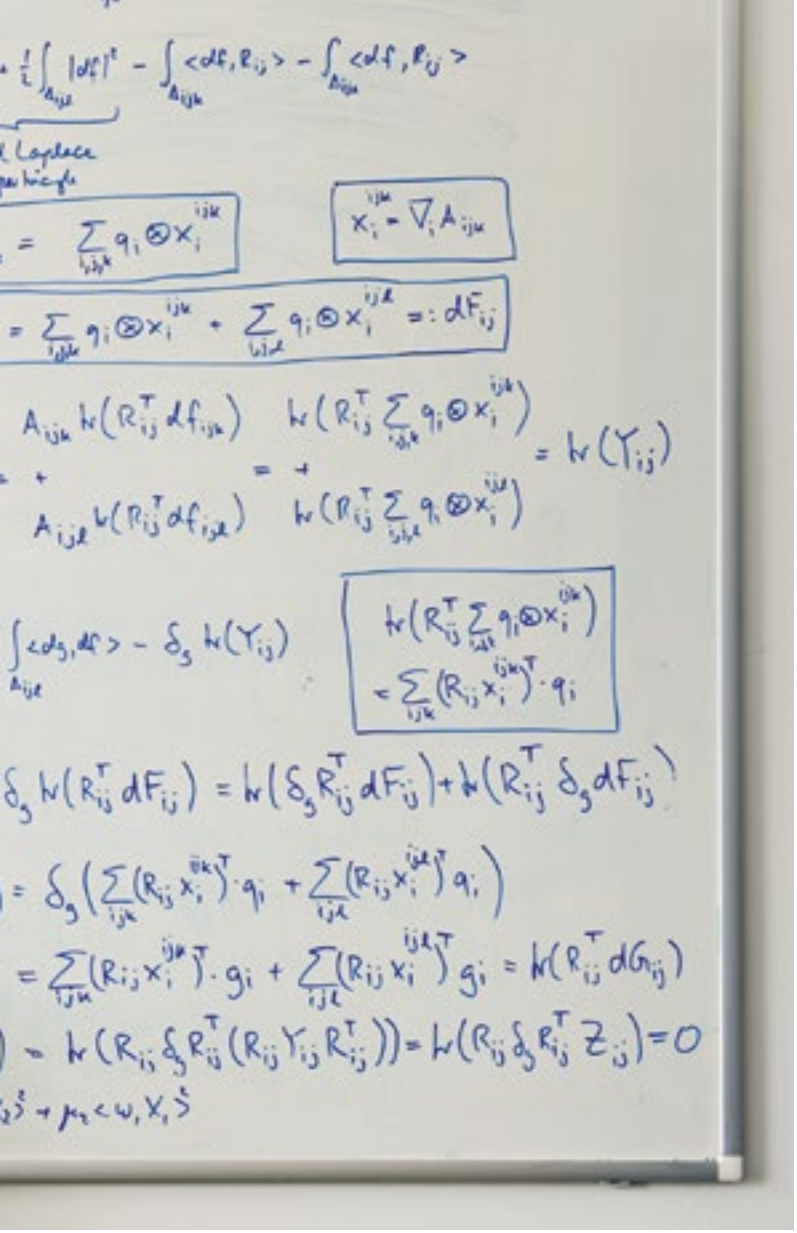
TUM's fourteen academic departments form the bedrock of its expertise. On top of this, the university maintains its research leadership with highly specialized institutes focusing on key fields such as semiconductor physics, protein science and catalysis. TUM's clinics translate research outcomes into diagnostics and therapeutic concepts, ensuring patient care of the highest standard.



Mathematics

Internationally acclaimed and repeatedly endorsed by rankings and awards, this department is one of the go-to places for applied mathematics. It bridges theory and practice by tackling mathematical problems across all areas of science and business. After all, the digital age depends on advanced mathematics and algorithms. Applied degree courses in financial and business mathematics reinforce this application-driven approach. This also pays dividends when it comes to student prospects, with 99% employed within a year of graduation – a faculty with its feet firmly on the ground.

www.ma.tum.de/Mathematik/WebHomeEn



Physics

TUM's Garching campus is home to one of Europe's major physics centers, which has produced several Nobel Prize winners. It has achieved a particularly high standing in biophysics, semiconductor physics, and nuclear, particle and astrophysics. Garching's high-flux neutron source is a magnet for top researchers from all over the world, while the "Universe" excellence cluster is the number-one destination for astrophysics researchers. The department's immediate proximity to several Max Planck Institutes has proved especially productive. However, its reach also extends a lot further afield, with TUM physics researchers working in the underground laboratories beneath Italy's Gran Sasso mountain and even at the IceCube research station at the South Pole.

www.ph.tum.de

Chemistry

One of the world's leading chemistry faculties, this department spearheads a global cooperation network while also maintaining close links with the chemical industry. Building on its proven excellence at the interface between basic research and practical application, it has also developed outstanding research expertise in catalysis, bioorganic chemistry and biotechnology. A transdisciplinary approach bridges the specifics of chemical engineering, construction chemistry, electrochemistry, hydrochemistry and radiopharmacy. TUM has produced nine Nobel laureates in chemistry to date, with the department ranking among the top ten worldwide.

www.ch.tum.de/en

Architecture

From planning and design right through to construction – TUM's architects seek to transform our built environment with climate-friendly building technologies, innovative digital methods and sustainable urban and landscape development. This tradition stems from such luminaries as Friedrich Thiersch, Robert Vorhoelzer, Hans Döllgast, Sep Ruf and Thomas Herzog, not to mention the momentous achievements of master sculptor Fritz König. Today, close networking with the construction and creative industries ensures that this department keeps its finger on the pulse of the real world. The architecture program at TUM is also unique in incorporating a year of study abroad. Housed in Munich's modern art museum, the Pinakothek der Moderne, TUM's Architecture Museum is one of the world's leading collections of its kind.

www.ar.tum.de/en

Civil, Geo and Environmental Engineering

Framed by the mission statement, "Construction – Infrastructure – Environment – Planet Earth", this department is committed to the sustainable design of living space for modern society. This includes the development of self-healing concrete, for instance, as well as methods enabling satellite-based detection of ground subsidence with millimeter precision, identifying risks to bridge structures or dams. This department has built up particular expertise in the fields of mobility, transport and traffic. Its engineering geology teams investigate dynamic processes on the Earth's surface and interior, while geodesy plays a prominent role in international satellite missions. Computer models and digital simulation techniques are the hallmark of this department's pioneering activities. Meanwhile, specialized institutes focus on TUM's strategic priorities, such as the research station for hydraulic engineering and water management established by Oskar von Miller in Obernach, near the Walchensee lake in the German Alps.

www.bgu.tum.de/en


MAC – Munich Centre
of Advanced Computing
tum.3D

Electrical and Computer Engineering

Germany's largest faculty of its kind and firmly at the forefront of research, TUM's Electrical and Computer Engineering department enjoys strong international ties. Over 50% of its students come from abroad, and many of its professors are IEEE Fellows. As a business innovation catalyst, the department collaborates with numerous high-tech companies in sectors ranging from automotive engineering through telecommunications to satellite navigation. It also focuses on medical technology research and robotics, reflecting the increasing impact of biology on the engineering sciences. In 1956, electrical engineer Hans Piloty and informatics pioneer Friedrich L. Bauer, working at the Electrical and Computer Engineering department, built PERM. This program-controlled electronic computer was the first of its kind worldwide.

www.ei.tum.de/en

Mechanical Engineering

As demonstrated by its top positions in the international rankings, mechanical engineering at TUM is a powerful innovation driver for the wider economy. Since its foundation in 1868, this department has played a significant role in shaping technology advances – a tradition set in motion by the founding generation of Carl von Linde, August Föppl and Ludwig Prandtl, and continued to this day with a steady stream of ideas to inspire new products. Alongside aerospace and energy and production technologies, automotive engineering is a core focus area. Pioneering developments in electromobility are also currently emerging here, fueled partly through research partnerships with key automotive players such as BMW and Audi.

www.mw.tum.de/en

Informatics

TUM is actively shaping the digital transformation process with one of the world's best informatics departments. The impact of this discipline, which emerged from mathematics, can now be seen in new subjects such as bio- and medical informatics. Software engineering also has its origins here. Today, software development for the latest supercomputers is a major focus, combining big data analytics, machine pattern recognition and network architectures. With five Leibniz Prize winners on its staff, this department offers an outstanding scientific education with a clear practical slant, thanks to its connections with leading software companies.

www.in.tum.de/en

Medicine

TUM is one of the few technical universities in Europe with its own medical department. Thanks to its strong ties with the natural and engineering sciences, TUM's School of Medicine is often unparalleled in its research and therapeutic approaches. It regularly achieves significant scientific breakthroughs in interdisciplinary cancer research, for instance, as well as in the fields of cardiovascular, neurological and immune diseases. TUM's university hospital, Klinikum rechts der Isar, and cardiovascular clinic, the German Heart Centre Munich, are among the international frontrunners in research-based healthcare. The primary focus here is on next-generation diagnostic technologies, especially pioneering imaging methods such as photoacoustics, laser and X-ray technology, and radiopharmacy. The Helmholtz Zentrum München (German Research Center for Environmental Health) is the School of Medicine's primary research partner, particularly under the umbrella of the German Centers for Health Research specializing in cardiovascular medicine (DZHK), neurodegenerative diseases (DZNE) and diabetes (DZD). Founded in 2017, the translational tumor research center TranslaTUM has marked a new chapter in German university medicine by uniting medical and engineering research under one roof.

www.med.tum.de/en

Klinikum rechts der Isar university hospital

TUM's university hospital, Klinikum rechts der Isar, covers the entire spectrum of modern medicine and provides the highest standards of patient care. Here, the latest scientific findings flow directly into therapies for improved outcomes. The hospital harnesses trailblazing medical technology, which in many cases is available nowhere else in the world. It has also repeatedly made medical history, for instance with the world's first double arm transplant by surgeon Professor Edgar Biemer and his team in 2008.

www.mri.tum.de

German Heart Centre Munich

Integrated in the TUM network, the German Heart Centre Munich is the leading university clinic for cardiovascular diseases in Europe. Professor Rudolf Zenker and his surgical team performed Germany's first successful heart transplant here in 1981. The center bundles all the disciplines relevant to the diagnosis and treatment of cardiovascular diseases to provide optimum care for children, adolescents and adults. Its outstanding work in pediatric heart surgery and the treatment of congenital heart defects sets new standards worldwide.

www.dhm.mhn.de

Sport and Health Sciences

Inherited from the 1972 Olympic Games, this department is equipped with the most extensive university sports facilities in Europe. Its research spectrum ranges from performance diagnostics for elite athletes to the prevention of lifestyle diseases. The department is exceptional in its multi-disciplinary approach to health science, interlinking it with medicine and the life sciences. This alliance trio enables unparalleled performance in fields typical of this discipline such as nutritional medicine, preventive pediatrics and the sociology of diversity. At the same time, the department trains sports instructors, organizes recreational student sports for all Munich universities and reaches out to the public with its further education program. It also maintains close ties with world-class sporting organizations, not least with FC Bayern in the soccer-loving city of Munich.

www.sg.tum.de

TUM School of Life Sciences Weihenstephan

At the Weihenstephan life sciences campus in Freising, biology is the lead discipline. The focus here is on the major issues of the 21st century: food science and nutrition, land use and the environment. These are explored through a uniquely diversified range of subjects. In interdisciplinary cooperation with engineering, natural sciences and medicine, this school investigates the basic foundations and needs of life on Earth from economic, ecological and social perspectives and explores holistic answers and practical applications in these areas. Originating from an agricultural and brewing academy, this TUM location has undergone sweeping reforms to emerge as one of the world's leading authorities for integrated life sciences. Its unique position on the international stage is also attributable to its work on beverage technology in partnership with affiliated Bavarian State Brewery Weihenstephan, and its research with the Leibniz Institute for Food Systems Biology as well as with ZIEL, the Institute for Food & Health.

www.wzw.tum.de

TUM School of Education

Founded in 2009, this young department sets the gold standard for modern teacher training. It works on a cross-disciplinary basis, with responsibility for the entire teacher training program in the STEM subjects (science, technology, engineering and mathematics). In this way, it ensures the course content is suitably tailored to future careers in teaching. Right from the beginning, students are thoroughly prepared for their future classrooms with school internships, role plays and video analyses. These teaching methods draw on findings from the latest empirical research on education. The TUM School of Education is one of the most prestigious international authorities in its field, leading the Programme for International Student Assessment (PISA) studies in Germany, for instance.

www.edu.tum.de/en

TUM School of Governance

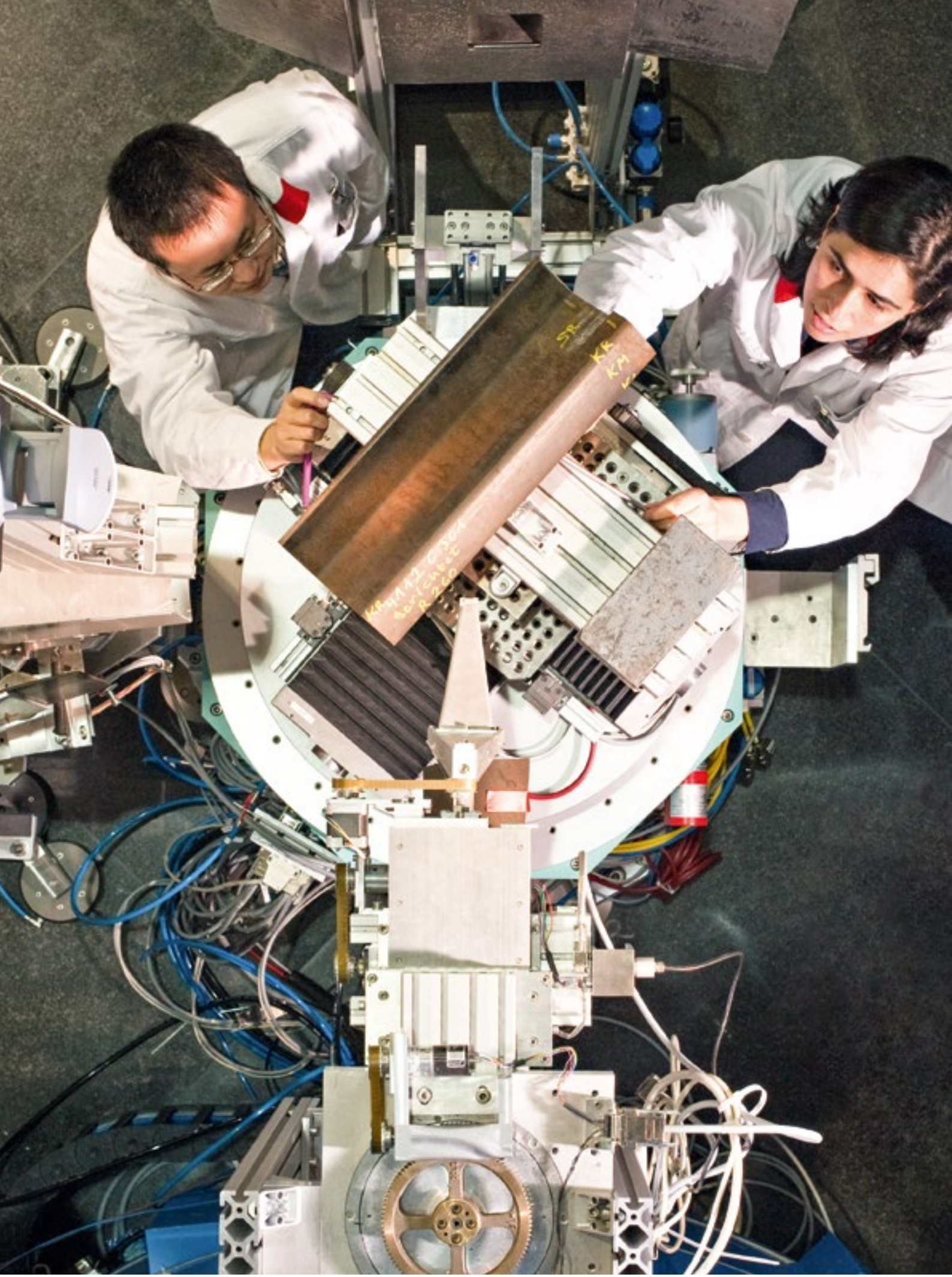
The TUM School of Governance integrates emerging technologies into political dialog and decision-making. This makes it an important partner for policy-makers at state, federal and European level. Technology influences almost every aspect of society, but political decision-making impacts how technology is used by society. This department provides an academic platform for the Bavarian School of Public Policy (Hochschule für Politik München), since TUM is now the host university for this traditional institution (founded in 1950).

www.gov.tum.de

TUM School of Management

Established in 2001, the TUM School of Management enjoys excellent ratings from science and industry, including the prestigious Triple Crown management accreditation. Its graduates combine management qualifications with expertise in technology, since a technical subject is a mandatory part of Bachelor's studies in management at TUM. Research and teaching take place at the interface between the engineering and life sciences here, in fields as diverse as the energy markets or food value creation. This department has also made a name for itself as a bastion of European entrepreneurship research. In 2018, TUM will be expanding the scope of its Heilbronn campus in the German state of Baden-Württemberg to include courses in management and innovation, taught in an economic region densely populated with "hidden champion" companies.

www.wi.tum.de



Research Neutron Source Heinz Maier-Leibnitz (FRM II)

The Garching high-flux neutron source is a magnet for researchers and industrial users from all over the world. Around 30 different scientific instruments provide insights into the atomic structures of matter and molecular dynamics that cannot be obtained with any other method. The globally unique neutron spectrum also enables innovative industrial and medical applications, such as the production of homogeneously doped silicon for high-performance semiconductors and radiopharmaceuticals. The latter are targeted at clinical applications, supported by unparalleled testing and validation capabilities at TUM's university hospital.

www.frm2.tum.de/en

TUM Center for Functional Protein Assemblies (CPA)

In protein research, TUM bundles its competencies across disciplines to gain a better understanding of highly complex protein interactions in the human organism. This is intended to facilitate new (bio-)medical applications for the diagnosis and treatment of diseases. This research institute unites expertise from the natural and engineering sciences – extending from biochemistry and biophysics, including DNA nanotechnology, through bioinformatics to medicine. TUM has thus become a stronghold of integrated protein research.

Walter Schottky Institute – Center for Nanotechnology and Nanomaterials

TUM is internationally renowned for its semiconductor research thanks to the Walter Schottky Institute. This center has set new standards and several world records in the production of laser and nanoelectronic structures. Its basic research findings are a powerful driving force for industrial applications.

www.wsi.tum.de

Center for Translational Cancer Research (TranslaTUM)

Located in the immediate vicinity of the university's medical facilities, TranslaTUM is a center dedicated to translational research in oncology. Here, medics, engineers and natural scientists work closely together to develop new diagnostic and therapeutic options for cancer and translate them into clinical applications as quickly as possible.

www.translatum.tum.de

TUM Catalysis Research Center (CRC)

Catalysts are used to save energy and resources in chemical reactions. The TUM Catalysis Research Center is dedicated to the investigation of the mechanisms behind catalytic processes and the development of new reaction and synthesis paths. This has been a prominent research focus for TUM since the work of Nobel Prize winner Ernst Otto Fischer. Chemistry and physics are closely interlinked with process engineering and biotechnology here, as well as with research into renewable raw materials. The CRC works with partners at the forefront of science and industry around the world.

www.crc.tum.de/en

TUM universe

More than a traditional technical university

TUM spans six major research and teaching locations: Munich, Garching, Freising-Weihenstephan, Straubing, Heilbronn and Singapore. They are home to its academic departments and numerous interdisciplinary research centers. The university also maintains an international presence with offices across four continents. Members of the TUM community not only enjoy outstanding study and research opportunities, but also a rich social life on campus with sports, art and music, social projects and much more on offer. ■

Locations

Garching campus

TUM's high-tech hub – one of Europe's most advanced research and training facilities – is the university's largest campus.

Departments: Chemistry / Physics / Informatics / Mechanical Engineering / Mathematics
Research centers: Research Neutron Source Heinz Maier-Leibnitz / Munich School of BioEngineering / Munich School of Engineering / TUM Institute for Advanced Study / Walter Schottky Institute – Center for Nanotechnology and Nanomaterials / TUM Catalysis Research Center

Munich campus

TUM's vibrant core – downtown Munich is home to TUM's main campus, the university clinics and the sports facilities (Olympic Park).

Departments: Architecture / Electrical and Computer Engineering / Civil, Geo and Environmental Engineering / Medicine / Sport and Health Sciences / TUM School of Education / TUM School of Governance / TUM School of Management
Research centers: MCTS – Munich Center for Technology in Society / TranslaTUM – Center for Translational Cancer Research

Freising-Weihenstephan campus

TUM's green lungs – the modern life sciences department is based at this campus in the cathedral town of Freising.

Department: TUM School of Life Sciences Weihenstephan
Research centers: Hans Eisenmann-Zentrum – Institute for Agricultural Sciences / ZIEL – Institute for Food & Health / Leibniz Institute for Food Systems Biology

TUM Science and Study Center Raitenhaslach

Located near the town of Burghausen on the Salzach river, the former Cistercian monastery Raitenhaslach was converted into a sophisticated study center and communication forum for the university in 2016. This new facility encourages interdisciplinary exchange and promotes dialog between science, business and the general public.

Straubing campus

Unparalleled in Europe, the Straubing center places a unique focus on biogenic raw materials and a sustainable bioeconomy.

Integrative research center: TUM Campus Straubing for Biotechnology and Sustainability

Heilbronn campus

Here, next-generation leaders pursue their studies at the TUM School of Management, situated in one of Europe's foremost regions for innovation.

Department: TUM School of Management

TUM Asia

The first German university to establish an offshore campus, TUM celebrated its tenth anniversary in Singapore in 2012.

Graduates from the German Institute of Science and Technology (GIST) – TUM Asia Pte. Ltd. – a privately operated TUM affiliate – are in high demand among companies thanks to an exceptional curriculum blending German engineering, management skills and an understanding of Southeast Asian culture. This initiative is flanked by the TUM CREATE research center, where scientists are developing new electromobility concepts for the tropics.

Life on campus

Beyond the lecture theater and laboratory, TUM staff and students also come together to make music, produce art, engage in social initiatives, play sports, and much more. This diversity enriches our university family.

Culture and leisure

A movie in TUM's historic lecture theater, a comedy show in the Audimax or exhibitions by architecture students: the semester calendar is packed full of cultural events. Particular highlights include the TUNIX and GARNIX student festivals in summer and the Advent concerts in the Munich Philharmonic Hall in winter. A love of music unites many members of the university, who come together in orchestras, choirs and bands.

Sporting endeavors

From the Alps through the lakes of Bavaria to the 1972 Olympic grounds – the university sports venues are as varied as the pursuits on offer. Varsity teams enjoy success in international competitions, with students regularly participating in the Olympic Games. Whether competitive sport or recreational pleasure, there's something here for everyone.

Getting involved in university life

Many students find time outside of their busy study schedule to participate in university life. Some of them play an active role in shaping university policy, for instance. Others pursue their own research projects, join student initiatives such as TUfast to develop formula racing cars – which they then drive to victory at Hockenheim (Germany) and Silverstone (UK) – or build gliders with unrivaled aerodynamics in the Akaflieg group. Meanwhile, there are always events to organize and social projects to support. These characterbuilding activities are an integral part of student life at TUM. You will always find someone who shares your hobby or passion at TUM.

At home in Munich

TUM is based in the European metropolitan region of Munich: a research, business and cultural hub of global standing. Munich is Europe's leading IT center and Germany's innovation engine – as evidenced by economic indicators and national and international city rankings.

TUM Partners of Excellence
Airbus · Altana · Audi · Bayerischer Bauindustrieverband · BMW · Bosch · Clariant · Dräxlmaier · Evonik Industries · Google · Herrenknecht · Linde · MAN · Nestlé · Rohde & Schwarz · RWE · SGL Carbon · Siemens · Süd-Chemie · TÜV Süd · Volkswagen · Wacker Chemie

The Bavarian capital is the chosen headquarters for a raft of blue chip companies, including seven DAX 30 enterprises and numerous startups. Almost all major branches of industry establish a presence or even a hub in the city. This is particularly true of high-tech fields such as IT and communications, as well as for medical engineering, biotechnology and pharmaceutical companies, and of course the cultural and creative industries.

Thanks to the economic power of the surrounding region, the city's first-rate educational and research institutions, and its location at the heart of Europe, Munich ranks as Europe's leading ICT hub – as an EU study confirms. Against this backdrop, TUM has built up a dense network of research partnerships, collaborating with companies such as BMW, MAN, Siemens, TÜV SÜD and Wacker Chemie. It also maintains close ties with the Max Planck and Fraunhofer Institutes and the

Helmholtz Zentrum München (German Research Center for Environmental Health), ensuring the best possible platform for scientific and entrepreneurial careers.

Munich and the surrounding area also offer a virtually unlimited range of leisure activities. With its sights, cultural attractions and shopping facilities, the region attracts millions of tourists and business travelers every year. Similarly, in rankings of the world's best or most livable cities for students, such as Mercer or QS, Munich regularly occupies the top spots.

With museums, palaces, churches and historic buildings, Munich is renowned for its warmth and cosmopolitan flair. More than fifty theaters, music venues, jazz cellars and clubs ensure a varied nightlife. The English Garden – one of the world's largest inner-city parks – and the Isar river create an oasis of green within the city. Here, locals and tourists alike gather to walk or play sports, surf the man-made wave on the Eisbach canal or go on bike rides. Outside the city, the Alps lie to the south and the lakes of Bavaria are easily accessible.

A particular highlight of any visit is surely the Deutsches Museum – one of the oldest, largest and most visited science and technology museums in the world. Founded by three TUM alumni, Oskar von Miller, Carl von Linde and Walter von Dyck, it continues to play an important role for the university today, supporting efforts to engage with the wider public and spark interest in complex research topics. The TUMlab within the museum is a case in point. Each year, this laboratory allows 3,000 children to explore computer science and robotics in a playful setting.

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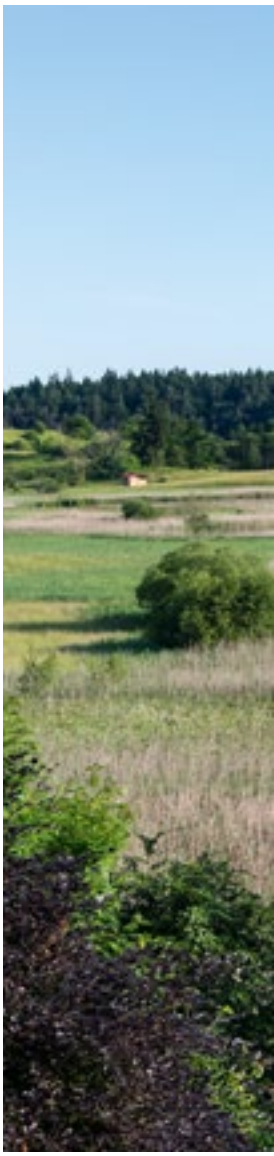

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