FACULTY 08

PHYSICS, MATHEMATICS AND COMPUTER SCIENCE

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

JG|U

CONTENTS

Main entrance of the JGU campus at the ‘Forum universitatis’, showing the statue of Johannes Gutenberg

WELCOME TO FACULTY 08

Dear readers,

In 2005, our faculty was established as a new organizational unit during a structural reform of universities in Rhineland-Palatinate. From the present perspective, this administrative process, in which Johannes Gutenberg University Mainz (JGU) also participated, has proven to have had considerable influence on the direction we have taken. What is remarkable is the interdisciplinary character of the five academic fields that have since been united under the same roof: the Institute of Physics, the Institute of Nuclear Physics, the Institute for Atmospheric Physics, the Institute of Mathematics and the Institute of Computer Science. Since the faculty was founded, our researchers have been working even more closely with each other – they share ideas, knowledge and working methods, and their discoveries have created an important basis for innovation and progress. This special quality also characterizes the collaboration with partner institutions within and beyond the university as well as in global research networks.

The aim of this brochure is to give you an insight into our work.
I hope you enjoy reading it!

Professor Patrick Windpassinger
Dean of the Faculty of Physics, Mathematics and Computer Science

CAMPUS PLAN

JGU is the only German university of its size to accommodate almost all of its institutes on a campus near the city center – including the non-university Max Planck Institute for Chemistry, Max Planck Institute for Polymer Research and the Helmholtz Institute Mainz.

1 INSTITUTE OF PHYSICS
Staudingerweg 7
55128 Mainz, Germany
www.blogs.uni-mainz.de/
fb08-iph-eng

2 INSTITUTE OF NUCLEAR PHYSICS
Johann-Joachim-Becher-Weg 45
55128 Mainz, Germany
www.blogs.uni-mainz.de/
fb08-nuclear-physics

3 INSTITUTE FOR ATMOSPHERIC PHYSICS
Johann-Joachim-Becher-Weg 21
55128 Mainz, Germany
www.blogs.uni-mainz.de/
fb08-ipa-en

4 INSTITUTE OF MATHEMATICS
Staudingerweg 9
55128 Mainz, Germany
www.math.uni-mainz.de

5 INSTITUTE OF COMPUTER SCIENCE
Staudingerweg 9
55128 Mainz, Germany
www.cs.uni-mainz.de

6 HELMHOLTZ INSTITUTE MAINZ
Staudingerweg 18
55128 Mainz, Germany
www.hi-mainz.de

7 CENTER FOR FUNDAMENTAL PHYSICS I
MESA Experimental Hall
Johann-Joachim-Becher-Weg 45
55128 Mainz, Germany
www.prisma.uni-mainz.de

8 CENTER FOR FUNDAMENTAL PHYSICS II
Office and laboratory building
Staudingerweg 16
55128 Mainz, Germany
www.prisma.uni-mainz.de

9 MAX PLANCK INSTITUTE FOR CHEMISTRY
Hahn-Meitner-Weg 1
55128 Mainz, Germany
www.mpic.de/2285/en

10 MAX PLANCK INSTITUTE FOR POLYMER RESEARCH
Ackermannweg 10
55128 Mainz, Germany
www.mpip-mainz.mpg.de

Here a titanium-sapphire laser is being used to excite short-lived radioactive molecules that act as 'miniature molecular laboratories' for studying fundamental properties of elementary particles and atomic nuclei.

INSTITUTE OF PHYSICS

The Institute of Physics at JGU is characterized by the wide range of the subjects taught and the high quality of its research program. It focuses on the theoretical and experimental aspects of the physics of elementary particles, condensed matter and quantum physics.

More than 40 professors and over 200 research associates work at the faculty's largest institute in a broad range of cutting-edge research fields, such as clarifying unresolved aspects of the Standard Model of particle physics and deciphering the interactions within complex many-body systems. In addition, more than 70 skilled employees work in the craft, technical and administrative areas. The institute's excellent infrastructure encompasses a comprehensively equipped mechanical workshop, which can fabricate individual components for all experimental setups and also customize these with a high degree of precision. The academic staff conducts research in a wide range of fields, from fundamental research to application-oriented projects in the fields of:

- Astroparticle and elementary particle physics, including the search for extensions to the Standard Model and the hunt for dark matter
- Imaging techniques and detector development in connection with solid-state, surface, and semiconductor physics in order to investigate superconductivity, exotic magnetism, and spin dynamics with the corresponding applications in data storage technologies

www.blogs.uni-mainz.de/fb08-iph-eng

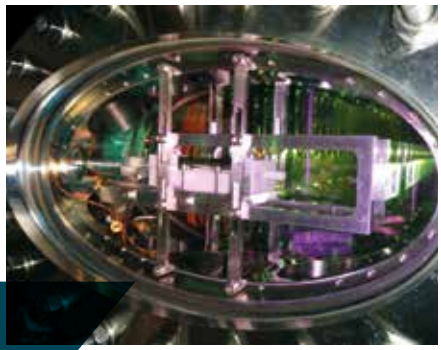
1.

In 2021, the German Research Foundation (DFG) ranked JGU's Institute of Physics as Germany's leading physics institute on the strength of its funding success, having acquired some €45 million in third-party financial backing.

- Statistical physics of many-body systems and soft matter, the aim being to better understand complex systems and their phase transitions
- Numerical simulations, with links to the Institute of Mathematics and the Institute of Computer Science within the faculty
- Ultra-precise laser spectroscopy to analyze the fundamental symmetries of exotic matter and anti-matter in atoms, (anti-)protons, trapped ions, and cold neutrons
- Research on multiparticle entanglement for applications for quantum simulation, quantum communication and quantum computer involving the MOGON II super-computer
- Cooperation with the biological institutes of JGU, the Department of Chemistry and the University Medical Center Mainz

The Institute of Physics in Mainz has contributed to the development of new laser systems that are now used throughout the world.

The fact that the faculty's institutes are located close to each other and to the two Max Planck institutes and the Helmholtz Institute on campus results in research-relevant synergies. Close interdisciplinary collaborations enable new methodological approaches and research ideas to be developed and allows researchers to mutually benefit from state-of-the-art technical equipment.



JGU's research profile as a whole is characterized by the areas of particle and hadron physics, condensed matter physics and quantum physics and the various related collaborative research centers. The Institute of Physics and the Institute of Nuclear Physics have played a particularly prominent role in the university's success in Germany's Excellence Strategy program, most recently in the form of its Cluster of Excellence PRISMA$^+$ (Precision Physics, Fundamental Interactions and Structure of Matter). This has resulted in ideal conditions for cutting-edge research, for educating students and for promoting early-career researchers.

More information about PRISMA$^+$ can be found on pp. 20–23.

With regard to the upcoming Excellence Strategy competition, the Institute of Physics is playing a leading role in two interdisciplinary top-level research areas at JGU: M^{3}ODEL (Mainz Institute of Multiscale Modeling) is aiming to bring together research on multiscale modeling beyond the traditional boundaries of faculties and institutes so researchers can jointly benefit from this multidisciplinary environment. TopDyn focuses on the top-level research in topology; this is used to investigate specific properties of materials, including unusual magnetic structures, which may serve as information carriers in future data-storage devices.

More information about M^{3}ODEL and TopDyn can be found on pp. 48–49.

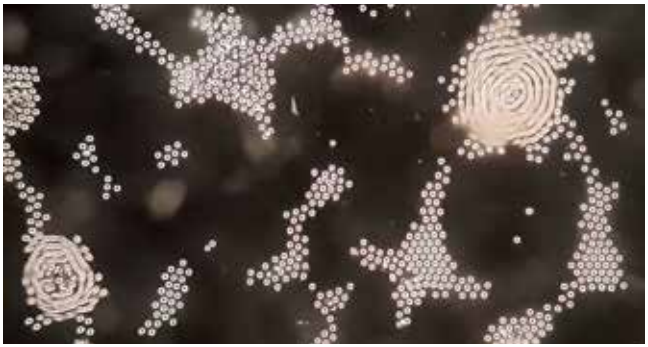
The Institute of Physics is integrated in a global and diverse research network. JGU's physicists are involved in research projects at numerous international research centers, for example at CERN in Geneva (Switzerland), at the Institut Laue-Langevin (ILL) in Grenoble (France) - a research center with the world's most powerful neutron source - and at the particle accelerator TRIUMF in Vancouver (Canada). Physicists from Mainz are even working in Antarctica at the high-energy neutrino observatory IceCube at the Amundsen-Scott South Pole Station. In addition, the institute maintains close contacts with many top research universities around the world. In turn, fellow scientists from all parts of the globe regularly visit Mainz to work and conduct research here.

ETAP – EXPERIMENTAL PARTICLE AND ASTROPARTICLE PHYSICS

The activities of the ETAP group focus on high energy physics, dark matter, neutrinos and detector development. ETAP physicists play a leading role in research projects at large international experimental facilities such as the Large Hadron Collider (CERN) in Switzerland, are participating in the construction of novel detectors such as ANNIE and DUNE (Fermilab) in the USA, and are investigating the properties of neutrinos in experiments at the Laboratori nazionali del Gran Sasso (LNGS) in Italy, at Jiangmen Underground Neutrino Observatory (JUNO) in China, and at the IceCube Neutrino Observatory at the South Pole.

Sebastian Böser, Volker Büscher, Frank Fiedler, Lucia Masetti, Uwe Oberlack, Matthias Schott, Stefan Tapprogge, Alfons Weber, Michael Wurm

www.etap.physik.uni-mainz.de

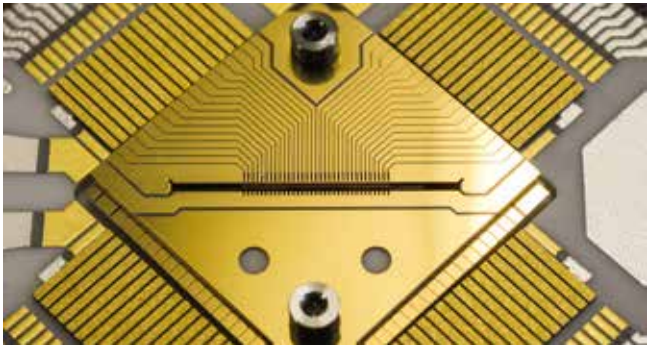


KOMET – CONDENSED MATTER PHYSICS

The focus of condensed matter physics research lies in the complex interactions of atoms in solids and liquids. The KOMET research group is a consortium of various theoretical and experimental teams in different disciplines and covers a very broad research spectrum, ranging from strongly-correlated electron systems, superconductivity, magnetism, spintronics, surface and soft-matter physics to biological and statistical physics. Theoretical physicists in the group model and predict the behavior of complex systems using different theoretical approaches including computer simulations.

Experimental side: *Katrin Amann-Winkel, Jure Demsar, Hans-Joachim Elmers, Gerhard Jakob, Martin Jourdan, Mathias Kläui, Thomas Palberg, Johannes Gerhard Schönhense, Angela Wittmann*
Theoretical side: *Peter van Dongen, Jamir Marino, Yuriy Mokrousov, Friederike Schmid, Jairo Sinova*

www.komet.physik.uni-mainz.de



QUANTUM – QUANTUM, ATOMIC & NEUTRON PHYSICS

The work of the QUANTUM group is directed at ultra-precise testing of fundamental symmetries of exotic matter or anti-matter in atoms, (anti-)protons, trapped ions, and cold neutrons. The group also investigates many-body entanglement with an eye to potential quantum-computing applications, quantum simulations and quantum communications.

Experimental side: *Dmitry Budker, Martin Fertl, Randolf Pohl, Ferdinand Schmidt-Kaler, Jochen Walz, Klaus Wendt, Patrick Windpassinger*
Theoretical side: *Peter van Loock*

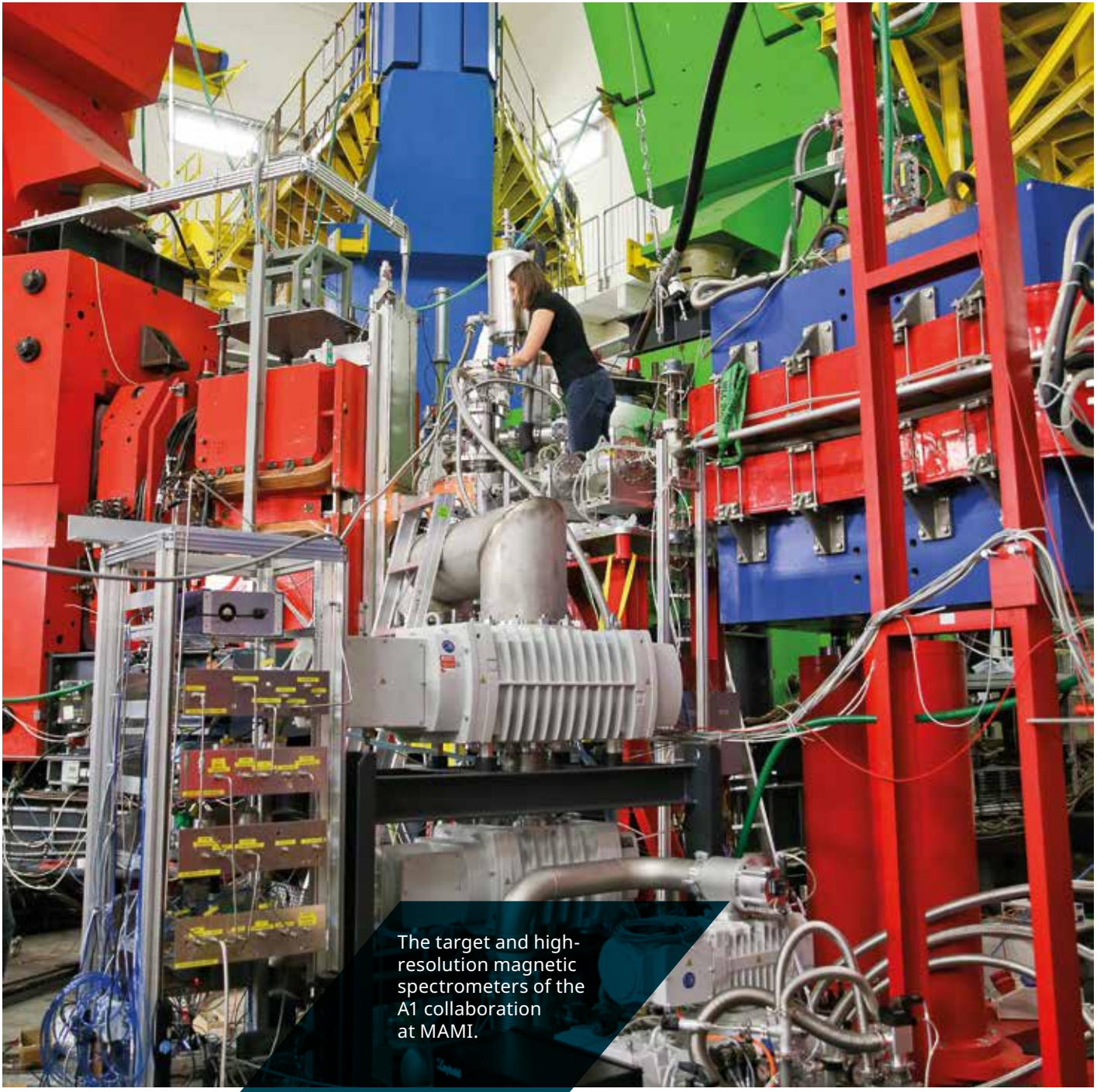
www.blogs.uni-mainz.de/fb08-iph-eng/scientific-working-groups

THEP – THEORETICAL HIGH ENERGY PHYSICS

The THEP group investigates various aspects of fundamental interactions in nature and the elementary constituents of matter: from perturbative quantum field theory for the strong and electroweak interactions of quarks and leptons to effective field theories, theories within noncommutative geometry, perturbative quantum gravity and string theory. It also investigates aspects relating to the extension of the Standard Model; for example, theories that could explain the existence of dark matter and the origin of particle masses. Approaches such as this are essential for understanding the results of experiments such as those conducted by the related ETAP research group; the close proximity of these groups in Mainz provides an excellent environment for collaboration. The extensive exchange with theoretical groups worldwide is enhanced, in particular, by the close relationship with the Mainz Institute for Theoretical Physics (MITP).

Julia Harz, Tobias Hurth, Hans Jockers, Joachim Kopp, Matthias Neubert, Martin Reuter, Pedro Schwaller, Hubert Spiesberger, Stefan Weinzierl

www.thep.physik.uni-mainz.de



The target and high-resolution magnetic spectrometers of the A1 collaboration at MAMI.

INSTITUTE OF
NUCLEAR PHYSICS

The research conducted at the Institute of Nuclear Physics seeks to explore the fundamental building blocks of matter while employing innovative precision measurements – in particular with the help of the university's own electron accelerator – to establish a 'new physics' that goes beyond the Standard Model of particle physics.

How large are atomic nuclei and what structural form do they take? How is the charge distributed within protons and neutrons, which were once considered to be elementary particles? What are the mechanisms by which these particles can be stimulated electromagnetically or even deformed, and how do their properties change when they are bound within an atomic nucleus? Physicists at the Institute of Nuclear Physics are investigating such and similar questions.

The heart of the experimental investigations lies in the Mainz Microtron (MAMI), an electron accelerator for energies up to 1.6 GeV. The excellent beam quality of MAMI enables researchers to conduct high-precision scattering experiments that focus on gaining insights into the details of the substructure of hadrons (that are composed of quarks and gluons) and hence to significantly contribute towards clarifying the inner workings of our universe. The institute is also involved in the exciting search for exotic particles, such as dark photons.

www.blogs.uni-mainz.de/fb08-nuclear-physics

200

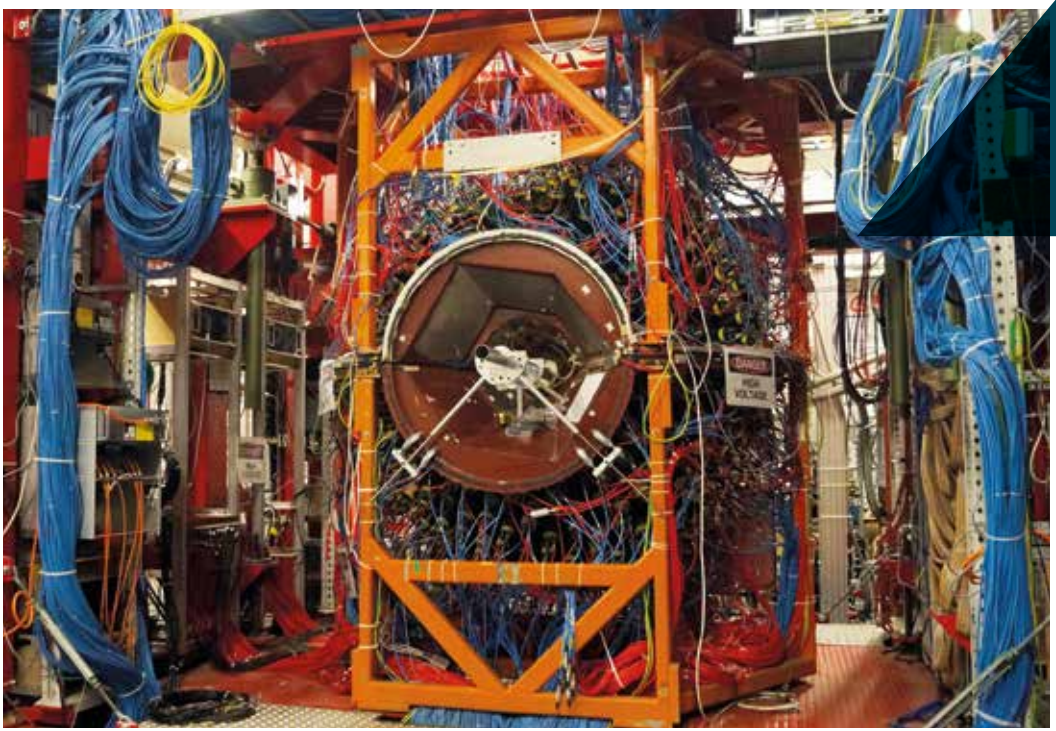
The spectrometers of the A1 collaboration are around 15 m in height, each weighing more than 200 tonnes.

More information on the new MESA accelerator can be found on pp. 20–23.

At present, the innovative Mainz Energy-Recovering Superconducting Accelerator (MESA) is being developed and constructed; this will be dedicated to undertaking precision tests of the Standard Model in the low-energy range. Its groundbreaking energy-recovery design will provide for energy-efficient electron acceleration, yielding very high beam intensities that will be available for research. The planned experiments will seek, in particular, to measure various fundamental parameters, such as the radius of the proton and the electroweak unification mixing angle with unprecedented precision at lower energies. Such parameters play an important role in determining the limits of validity of the established theory of elementary particles.

The close cooperation between experimental and theoretical groups is a special characteristic of the Institute of Nuclear Physics in Mainz. In such cooperative projects, experimentation, theoretical modeling and interpretation are closely intertwined. The overriding objective of the theoreticians is to probe the forces with which the components of the nucleus interact and – based on the underlying quantumchromodynamics (QCD) – to obtain a detailed description of low-energy phenomena associated with the strong interaction, for example, with the help of lattice gauge theories. The Institute of Nuclear Physics operates its own workshops (precision mechanics workshop, accelerator workshop, vacuum workshop, electronics workshop and detector laboratory) and is thus able to put together the equipment for the individual experiments and design individual components itself.

The $^{3}He/^{4}He$ dilution refrigerator that can generate very low temperatures down to 0.025 Kelvin



The Crystal Ball detector with superconducting polarization magnet to align proton spins.

The work of the individual research groups, in particular, in connection with the measurement experiments conducted using MAMI, involves scientists not just based in Mainz but also from all over the world, while the nuclear physicists are also contributing significantly to international experiments performed at external particle accelerators designed to address a wide range of topics – from charmonium spectroscopy and the search for exotic particles to the analysis of rare elementary particle decays.

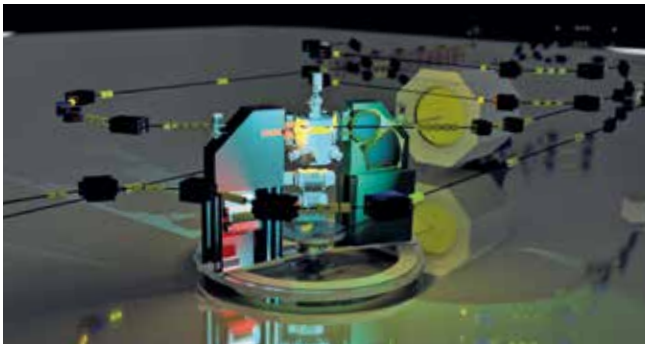
// Experimental Nuclear and Hadron Physics:
Patrick Achenbach, Kurt Aulenbacher, Winfried Barth, Niklaus Berger, Achim Denig, Wolfgang Gradl, Florian Hug, Eva-Maria Kabuß, Frank Maas, Harald Merkel, Atoosa Meseck, Michael Ostrick, Josef Pochodzalla, Concettina Sfienti

// Theoretical Hadron and Nuclear Physics:
Sonia Bacca, Pierre Capel, Jens Erler, Georg von Hippel, Harvey Meyer, Stefan Scherer, Marc Vanderhaeghen, Hartmut Wittig

EXPERIMENTS AT MAMI

The A1 collaboration conducts electron scattering experiments, the main aim being to study the spatial structure of atomic nuclei and hadrons. This involves bombarding a sample with the electron beam generated by the Mainz Microtron, and both the electrons scattered from the sample and any newly generated particles are detected using magnetic spectrometers. Such particles can also be studied in the experiments undertaken by the A2 collaboration using a secondary photon beam ('real photons'). The X1 research group is using the Mainz Microtron to develop novel extremely bright sources of radiation extending into the hard X-ray range and also explores their potential applications.

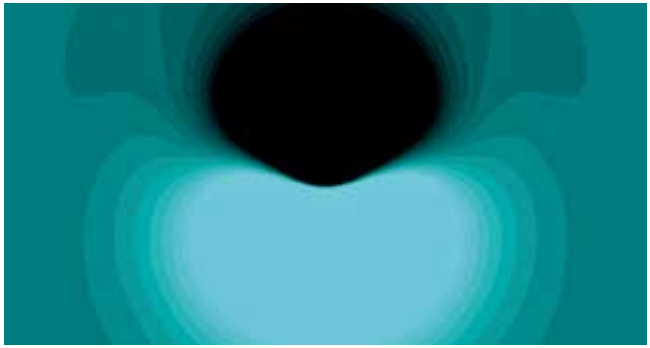
www.blogs.uni-mainz.de/fb08-nuclear-physics/experiments/experiments-at-mami



FUTURE EXPERIMENTS WITH MESA

The MAGIX experiment will employ a cryogenic supersonic gas jet target and high-resolution magnetic spectrometers for a variety of different high-precision electron scattering experiments, primarily to search for rare events and precisely measure nuclear observables in the low-energy range. Systematic optimization for low particle energies will even enable accurate cross-section measurements of key reactions in the field of nuclear astrophysics. In the experiment P2, parity-violating electron scattering will be employed to measure, in particular, the electroweak mixing angle with unprecedented accuracy at lower energies. The beam-dump experiment DarkMESA mounted behind P2, will be dedicated to searching for light dark matter.

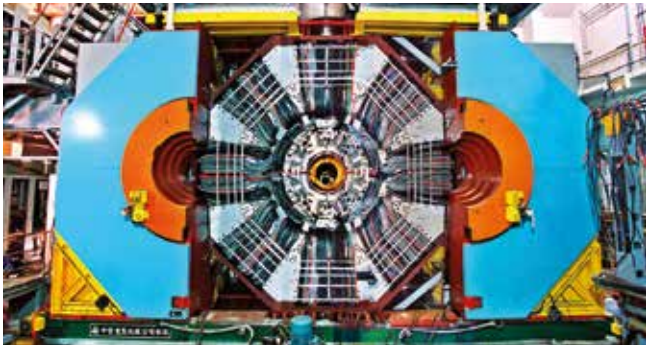
www.blogs.uni-mainz.de/fb08-nuclear-physics/experiments/experiments-at-mesa



THEORY GROUP

The Theory Group investigates the strong interaction at low and medium energies. A key area of their research is theoretical interpretation of experiments at the Mainz Microtron (MAMI) and at other accelerator facilities. In addition to analytical techniques such as effective field theories and dispersion theories, the researchers employ numerical simulations in the framework of lattice quantum chromodynamics (QCD).

wwwth.kph.uni-mainz.de



EXTERNAL EXPERIMENTS

Nuclear physicists based in Mainz are contributing to, inter alia, the COMPASS experiment at the world-renowned facility CERN in Geneva (Switzerland), the PANDA experiment at the European particle accelerator facility FAIR at the GSI Helmholtz Centre for Heavy Ion Research in Darmstadt, the BEPC II Beijing Electron-Positron Collider II (China), Belle II at the SuperKEKB accelerator in Tsukuba (Japan) and the Mu3e experiment at the Paul Scherrer Institute in Villigen (Switzerland), which has at its disposal one of the most intense muon beams in the world.

www.blogs.uni-mainz.de/fb08-nuclear-physics/experiments/external-experiments

A quadrupole magnet forming part of the international Muon g-2 experiment at Fermilab (USA), in which PRISMA$^+$ is involved.

CUTTING-EDGE RESEARCH AT JGU:

THE PRISMA+ CLUSTER OF EXCELLENCE

More than 300 scientists work in the PRISMA+ Cluster of Excellence. Their internationally acclaimed research is helping to provide important answers to crucial questions about the structure of matter and the fundamental forces of the universe.

PRISMA+ is the successor to the Precision Physics, Fundamental Interactions and Structure of Matter (PRISMA) Cluster of Excellence, which was established in 2019 and was successful in the previous Excellence Strategy competition and received funding from 2012 to 2018. The aim of PRISMA+ is to search for evidence of a 'new physics' beyond the established Standard Model of particle physics. Its approach is unique, since it combines innovative precision measurements – that will in future also be developed at the Mainz Energy-recovering Superconducting Accelerator (MESA), currently under construction – with leading contributions to large-scale international experiments and theoretical modeling. Its broad-aim experimental program is supplemented by modern and highly-innovative computational modeling in theoretical physics.

For many years, scientists in Mainz have benefited from the unique research infrastructure on the JGU campus, including the particle accelerator MAMI, while MESA will also become available in future; there is also the TRIGA Mainz research reactor used for both basic and applied research in nuclear chemistry. TRIGA serves as

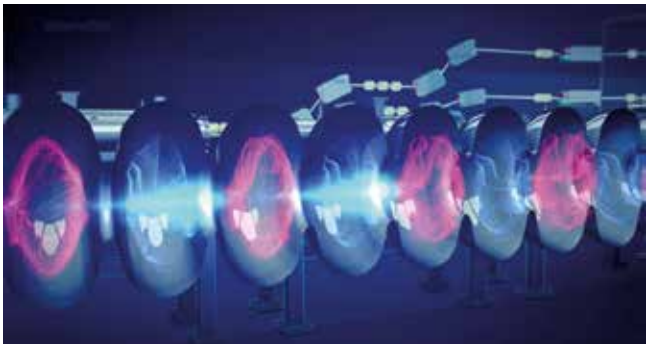
Participating institutes: Institute of Physics, JGU; Institute of Nuclear Physics, JGU; Department of Chemistry, JGU; Helmholtz Institute Mainz (HIM)

a high-quality source of ultracold neutrons. The PRISMA detector laboratory facilitates the exchange of experience and technology within PRISMA$^+$ by providing a shared research environment for the in-house development and construction of innovative detector components.

The Mainz Institute for Theoretical Physics (MITP) has established itself as a top international center for theoretical physics by hosting numerous workshops and a guest program for internationally prominent physicists. Residents of Mainz are familiar with the PRISMA$^+$ Cluster of Excellence primarily due to the public lecture series *Physics in the Theater* staged at the Mainz State Theater.

INFRASTRUCTURE FOR PRISMA$^+$: THE CENTER FOR FUNDAMENTAL PHYSICS (CFP)

The new Center for Fundamental Physics (CFP) research building will provide the necessary infrastructure for the expanded PRISMA$^+$ research program: It will make available the necessary space and infrastructure required for the operation of the MESA accelerator and its experimental facilities in an underground experimental hall (CFP I). It will also offer office and laboratory space – including special laboratories for detector development (CFP II). The building will cost approximately €75 million, with the federal government and the state of Rhineland-Palatinate each financing fifty percent of the costs.



NEXT-GENERATION PARTICLE ACCELERATOR: MESA

An extraordinary electron accelerator is being built on campus in the experimental halls of the new CFP I research building using the funding provided for PRISMA$^+$. With its innovative Energy Recovery Linac (ERL) operating mode, MESA will be highly energy efficient and, simultaneously, achieve an extremely high beam intensity that, otherwise, would require immense quantities of energy. This will allow a very large number of particles to be focused onto a tiny area of the target. In combination with excellent beam quality, MESA will provide optimal conditions for important precision experiments.

Research program

The PRISMA$^+$ research program unites some of the most interesting aspects of modern particle, astroparticle and hadron physics. The shared goal is to investigate fundamental forces and symmetries and the light they might throw on the existence of new particles, to discover the internal structure of ordinary (visible) matter, and to elucidate the nature of dark matter and its interactions with the visible sector.

More information:
www.prisma.uni-mainz.de

INTERNATIONAL THEORY CENTER: MAINZ INSTITUTE FOR THEORETICAL PHYSICS (MITP)

As an element within the cluster, MITP was formed to act as an international center promoting international networking and collaboration among different research disciplines in the field of theoretical physics. Since its founding in November 2012, it has become a prominent venue around the world for scientific exchange thanks to its comprehensive conference and seminar program.

MAINZ PHYSICS ACADEMY (MPA)

Within the Cluster of Excellence, the Mainz Physics Academy (MPA) constitutes the collective umbrella for all activities relating to graduate education and the promotion of early-career researchers. The two main hallmarks of the MPA are an 'Excellence Track' for highly qualified master's students and the 'MPA fellowship program' for outstanding doctoral candidates. The MPA offers summer schools and other extra-curricular offers, and a wide range of soft skills training sessions and workshops along with accompanying career development programs and networking events. Each year, a number of PhD fellowships are awarded, as well as scholarships for master's students.

The physics of clouds as a global phenomenon: Altocumulus lenticularis (disk-shaped) clouds over the Southern Alps in New Zealand.

INSTITUTE FOR

ATMOSPHERIC PHYSICS

The topic of climate change has brought the physics of the atmosphere into the heart of public discourse. Meteorological research explores the physical and chemical traits of the atmosphere, providing the understanding needed to comprehend the serious changes in our climate.

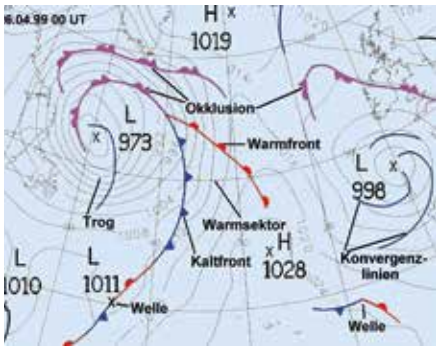
Atmospheric processes have been fundamental to all life on Earth since time immemorial. Hurricane-like storms and torrential rainfall, the melting of Arctic sea ice, drought disasters and air pollution represent just a few of the current issues that meteorologists address. An understanding of meteorology – how the Earth's atmosphere works – is essential in all these areas to comprehend how weather and weather phenomena arise. In addition to this, climate research focuses on the numerous interactions of trace gases exchanged between vegetation and the Earth's surface with the atmosphere and so ultimately strives to understand the entire Earth system on a long-term scale.

More information:
www.blogs.uni-mainz.de/fb08-ipa-en

In Mainz, seven research groups study a wide variety of interrelationships in daily weather patterns on climatologically relevant scales. Combining experimental methods and theoretical models, the institute's meteorologists are making a significant contribution to improving our understanding of atmospheric processes and are thus fostering a evidence-based discourse on climate change and its consequences.

The experimental research groups, often collaborating with both national and international partners, analyze trace gases and aerosol particles across the global atmosphere employing specific research aircrafts. Despite their significant impact on climate, the physical and chemical processes within clouds and their resultant effects remain inadequately understood.

Theoretical meteorologists in Mainz employ mathematical equations and computer models to unravel the mysteries of weather phenomena. Unlike experimental observations, such models provide the capability to simulate identical weather scenarios repeatedly, while systematically altering individual parameters. This allows scientists to deduce which variables are especially critical in understanding weather phenomena.



Weather, climate, and environmental protection are the major future topics being researched at the institute.

Read more about the weather in Mainz at www.atmoblog.de

CLOUD PHYSICS IN THE LAB: THE VERTICAL WIND TUNNEL

With the globally unique vertical wind tunnel, the scientists of the "Aerosol and Cloud Physics" group bring a piece of cloud into the laboratory. Cloud and precipitation particles can be studied in the wind tunnel laboratory, suspended in a vertical air flow under nearly atmospheric conditions. This enables the researchers to draw conclusions regarding the physical and chemical properties of these particles as well as their role in the formation of clouds, weather and climate.

Meteorologists working at the wind tunnel laboratory are collaborating closely with colleagues from the Particle Chemistry Department of the Max Planck Institute for Chemistry as well as teams from numerous German and international research institutions and universities. In contrast to many other cloud physics laboratories, the Mainz wind tunnel enables the study of properties and interactions of relatively large particles, such as raindrops and hailstones. Such information is essential to further improve weather prediction models and to interpret remote sensing data more accurately.

EXPERIMENTAL RESEARCH GROUPS

AIRBORNE MEASUREMENTS AND UTLS TRANSPORT PROCESSES

This research group combines measurements of trace gases such as CO_2 and ozone to study their transport and circulation within the atmosphere. This research focuses on the upper troposphere and lower stratosphere (UTLS). To infer circulation patterns from the measurements, data from weather and climate model simulations are analyzed in conjunction with the measurements.

Peter Hoor
utls.ipa.uni-mainz.de

ATMOSPHERIC TRACE GASES

The objective of this research group is to explore the impacts of clouds on atmospheric composition and climate, focusing particularly on the influence of aviation emissions. They adopt a holistic approach that combines measurements from aircraft, satellite observations, process studies, and global modeling. The findings from these studies can serve as a starting point for exploring methods to mitigate individual climate impacts caused by aviation.

Christiane Voigt
www.dlr.de/pa

AEROSOL AND CLOUD PHYSICS

This research group studies fundamental physical and chemical processes related to atmospheric aerosols, clouds and large hydrometeors. Their experimental research focuses on aircraft based field measurements as well as detailed laboratory studies, notably using the institute's vertical wind tunnel.

Stephan Borrmann
aerosols.ipa.uni-mainz.de

THEORETICAL METEOROLOGY

DYNAMIC METEOROLOGY

This research group focuses on the dynamics of the Earth's atmosphere, from the microscale to the planetary scale, and its significance in understanding weather and climate phenomena. The objective is to enhance the conceptual understanding of complex nonlinear dynamic phenomena and their interactions with physical processes. Such an understanding is crucial for improving weather forecasts and climate predictions.

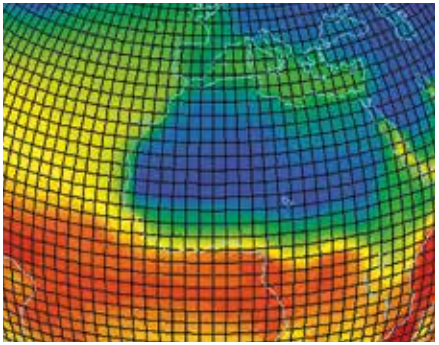
Volkmar Wirth
dynmet.ipa.uni-mainz.de

CLOUDS AND AEROSOLS

The Theoretical Cloud Physics research group explores the formation and development of clouds as well as the processes accountable for these phenomena. The Clouds, Aerosols, Dynamics research group studies the interaction between clouds and aerosol particles as well as atmospheric flow. One focus is determining how to represent these processes in mathematical models, ranging from the complexity of individual air parcels to comprehensive weather and climate models.

Peter Spichtinger
theoryofclouds.ipa.uni-mainz.de

Annette Miltenberger
clouds-aerosols-dynamics.ipa.uni-mainz.de



ENVIRONMENTAL MODELLING IN THE CLIMATE SYSTEM

This research group studies how chemical compounds within the Earth system impact air quality and climate as well as the processes responsible for the distribution of these trace compounds. It examines in detail the interplay of a wide variety of natural forces within our climate system.

Holger Tost
envmodel.ipa.uni-mainz.de

The language of mathematics forms the basis of all natural sciences and is understood internationally across all linguistic boundaries.

INSTITUTE OF
MATHEMATICS

The Institute of Mathematics conducts an exceptionally broad spectrum of research in all mathematical fields. The research ranges from abstract topics in number theory and algebraic geometry to analytical and statistical model building and numerical applications, e.g., in connection with computed tomography and hydrodynamics.

The German mathematician Georg Cantor observed that the essential nature of mathematics lies in its freedom, a statement that at first might seem paradoxical considering the strictly logical structure of mathematics. However, it is precisely this strict logic that engenders the freedom allowing mathematicians to detach themselves from concrete tasks – to abstract, to build bridges to other fields, and ultimately to generate innovative ideas and progress. It is in this spirit that 14 research groups in six areas at the Institute of Mathematics teach and conduct research on a wide range of mathematical issues. The institute in Mainz covers all the central fields of mathematics: algebra and geometry, topology, number theory, applied analysis and functional analysis, differential geometry, together with probability theory and numerical analysis. One of the special features of the institute is the perspective on the history of science provided by the History of Mathematics and the Natural Sciences research group. Specialized didactics completes the profile of the institute, which in addition to researching the theory of mathematical education, deals with teacher training and is comprehensively committed to the promotion of young research talents among pupils attending schools in Mainz.

www.math.uni-mainz.de

1998

Founding year of the 'Freunde der Mathematik' (Friends of Mathematics) alumni society, which acts, among other things, as a forum for former and future students freunde.mathematik.uni-mainz.de

The mathematicians in Mainz also participate in numerous international joint research projects. In the interdisciplinary JGU top-level research area Mainz Institute of Multiscale Modeling (M^3ODEL), they collaborate across disciplinary boundaries with colleagues from the natural sciences and computer science in the field of materials research. Cooperation with related disciplines has also resulted in significant participation in the DFG collaborative research center Multiscale Simulation Methods for Soft Matter Systems and the collaborative research center Waves to Weather. In addition, the Geometry and Arithmetic of Uniformized Structures (GAUS) collaborative research center has a satellite location in Mainz.

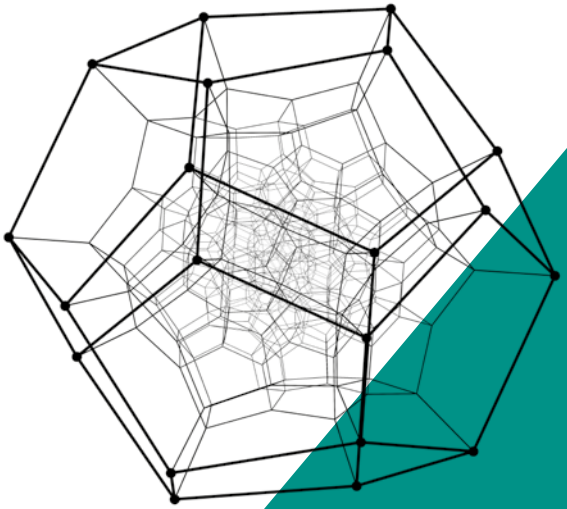
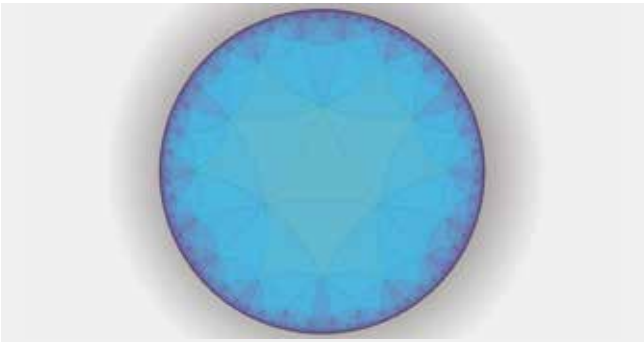


Image of a dodecaplex, similar to the hyperbolic tiling on the following page, developed in the advanced seminar 'Zahl und Bild' (Number and Image) given by Prof. Manuel Blickle.

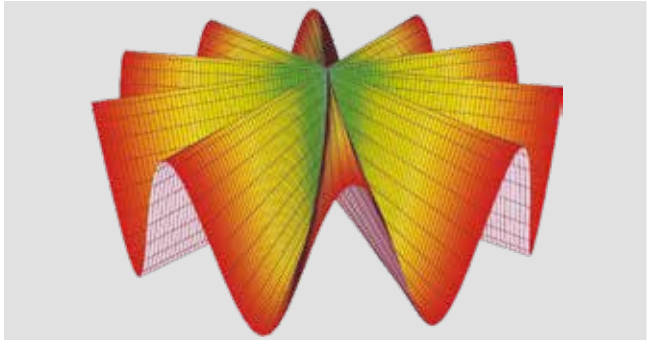


ALGEBRAIC GEOMETRY, TOPOLOGY AND NUMBER THEORY

The discipline algebraic geometry, topology and number theory brings together mathematicians in Mainz that have a particular interest in algebra in general and in algebraic geometry in particular. Groups conduct research in the fields of algebraic geometry, algebraic K-theory, Arakelov geometry, arithmetic geometry, computer algebra, group theory, higher category theory, complex analysis, topology and geometry, and number theory. A number of the researchers are also involved in the Geometry and Arithmetic of Uniformized Structures (GAUS) collaborative research center.

Tom Bachmann, Manuel Blickle, Theodorus de Jong, Manfred Lehn, Stefan Müller-Stach, Duco van Straten, Georg Tamme

www.agtn.math.uni-mainz.de



ANALYSIS

In the Analysis research area, problems of pure mathematics as well as those relating to physics, biology, and chemistry are investigated using methods based on the theory of ordinary and partial differential equations, differential geometry and functional analysis. The focus is thus also on the fields of functional analysis, mathematical biology and geometric analysis.

Lea Boßmann, Steffen Fröhlich, Vadim Kostrykin, Alan Rendall

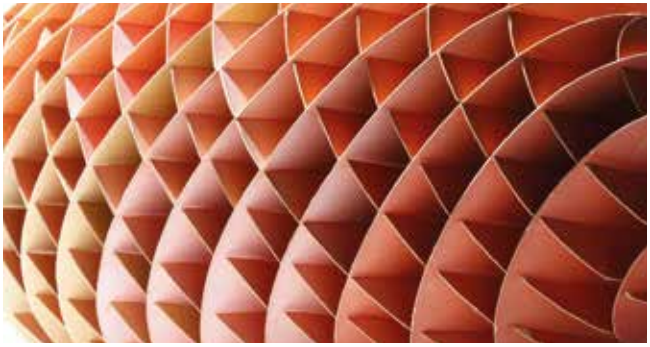
www.applied-analysis.math.uni-mainz.de
www.funktionalanalysis.mathematik.uni-mainz.de

SPECIALIZED DIDACTICS

The goal of the various courses is to develop knowledge and skills in the methodology of teaching mathematics as well as to consider specific approaches to the didactics of the subject and research-related issues. The principal focus of the subject of didactics of mathematics in Mainz is the history of mathematics and of the teaching of mathematics, and the role of language in the development of concepts employed in secondary education and the methodology of learning tasks.

Ysette Weiss

www.didaktik.mathematik.uni-mainz.de

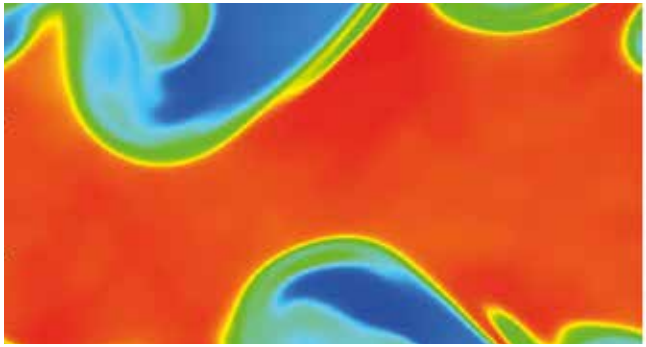


THE HISTORY OF MATHEMATICS AND THE NATURAL SCIENCES

How do our mathematical concepts and our ideas about the world develop? Where do our mathematical and scientific insights originate? The History of Mathematics and the Natural Sciences research group considers the exact sciences from a historical perspective and examines their development as an important component of human culture and education in our scientific-technological world.

Tilman Sauer

www.history.math.uni-mainz.de



NUMERICAL ANALYSIS

This research area covers the entire spectrum of numerical mathematics, from modeling to scientific computing. Dealt with are partial differential equations, in particular hyperbolic conservation equations, inverse problems and numerical linear algebra, adaptive discretization methods together with optimization problems. The work in this field has resulted in the development of practical applications in fluid dynamics, soft-matter physics, medicine and biology.

Martin Hanke-Bourgeois, Mária Lukáčová-Medvidová, Hendrik Ranocha
www.nummath.math.uni-mainz.de

PROBABILITY AND STATISTICS

In the probability and statistics research area, models based on the theory of probability are investigated together with their verification by means of statistics. The related research group focuses specifically on problems related to theoretical biology and statistical physics. The Mainz researchers work with random media, complicated combinatorics and partial differential equations with random noise.

Matthias Birkner, Lisa Hartung, Achim Klenke
www.probstat.math.uni-mainz.de


Computer science involves the systematic processing of information. As a central concept of almost all research disciplines, computer science is the key to all future progress.

INSTITUTE OF
COMPUTER SCIENCE

Computerized information processing has long been regarded as a standard practice in all areas of research. Due to its interdisciplinary character, the Institute of Computer Science at JGU is closely networked with various institutes; its research is directly applicable, in particular, in neighboring disciplines.

More than any other academic field, computer science has changed our world and society over recent years. The methods of computer science have become essential in both the social sciences and the natural sciences, for instance in biology, physics, medicine, and – in particular – in neurology. Data analysis and modeling techniques make it possible to investigate the fundamental aspects of a wide variety of issues in current research. As such, the research areas at the Institute of Computer Science are highly interdisciplinary.

One focus is on data science, an immensely important area for both research and practice, which combines big data and machine learning techniques. It is here that the computer scientists in Mainz can benefit from their experience; they have long utilized such applications to identify novel events recorded in the data on particle collisions collected at particle accelerators such as CERN and to detect disease patterns in DNA sequences. The most recent applications are much broader-based; in addition to the natural sciences, there are links to almost all other fields, such as the life sciences, humanities and cultural studies.

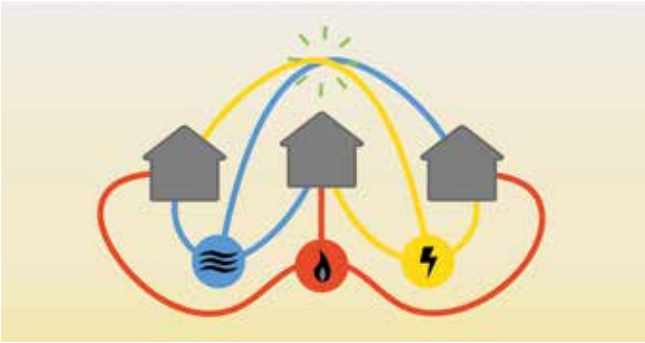
Reflecting the growing importance of computer science, there is a wide range of, often recently established, young research groups. The range of cutting-edge

10

The Institute of Computer Science now houses ten research groups, making it the fastest-growing institute in the faculty.

www.cs.uni-mainz.de

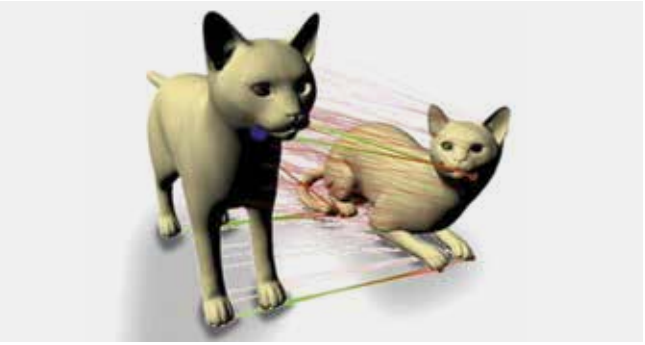
research topics in Mainz includes big data, efficient algorithms, bioinformatics, high-performance computing, computer graphics, machine learning, information systems and program analysis. In step with the increasing importance of computer science and the growing need for well-trained teachers, there is also a research group for specialized didactics at the institute. JGU's very own MOGON II supercomputer was ranked the 65th fastest computer in the world when it was commissioned in 2017. One way this has been used since the 2020 COVID-19 pandemic outbreak has been to perform the complex computations required to develop drugs to combat the SARS-CoV-2 coronavirus. With the commissioning of the new MOGON NHR Süd-West high performance computer at JGU in spring 2023, the German National High Performance Computing Alliance (NHR) has made further important progress towards establishing a powerful, modern research infrastructure that will



ALGORITHMICS

The central research field of the Algorithmics research group is the development of efficient algorithms for problems related to combinatorial optimization. The correctness and theoretical analysis of algorithms are vital to algorithm design. The field of algorithm engineering involves their practical implementation, optimization and experimental evaluation, frequently in connection with problems arising from interdisciplinary projects.

Ernst Althaus
www.algorithmics.informatik.uni-mainz.de



COMPUTER GRAPHICS AND VISUAL COMPUTING

The Computational Geometry and Visual Computing research group investigates the theoretical basis for efficient geometric algorithms and data structures and uses them in practical applications to create visualizations and to simulate motion sequences. Research in the domain at the intersection between computer graphics (synthesis of images of virtual objects) and computer vision (pattern recognition in data from the real world) is undertaken by the Visual Computing research group.

Elmar Schömer, Michael Wand
www.cg.informatik.uni-mainz.de
www.visualcomputing.informatik.uni-mainz.de

promote high-performance computing throughout Germany. In the future, research groups from all over Germany will be able to apply for computing time in the focal areas of high energy physics, condensed matter physics and the life sciences.

Computer scientists in Mainz are actively involved in several joint research projects, most notably the interdisciplinary Mainz Institute of Multiscale Modeling (M^3ODEL) collaboration, the goal of which is to facilitate and connect computational and model-oriented research across campuses. This sort of approach is traditional in Mainz and has already enormously enriched and promoted research in a wide variety of disciplines.

DATA MINING AND ARTIFICIAL INTELLIGENCE

The Data Mining research group focuses on the field of data mining and machine learning (ML). It develops methods to analyze large and complex quantities of data and adapts these methods for use in the life sciences and other areas (including computational sustainability, energy, transport and social networks). The Artificial Intelligence research group investigates methods for automated natural-language processing using ML techniques.

Stefan Kramer, Katharina von der Wense
www.datamining.informatik.uni-mainz.de

COMPUTER SCIENCE DIDACTICS

The core task of specialized didactics of computer science is to convey the concepts, models and ideas of computer science in a structured manner appropriate to general education, in particular in the context of teacher-training degree courses. The topic of "digitization in schools" involves important intersections with all other disciplines. A further important aspiration is to convey the concepts of computer science to the general public, for example by means of participatory exhibitions and lectures geared to a general audience.

Jens Gallenbacher
di.uni-mainz.de

HIGH PERFORMANCE COMPUTING AND EFFICIENT COMPUTING AND STORAGE

The High Performance Computing (HPC) research group focuses on the design, implementation, and evaluation of scalable tools using state-of-the-art high-performance computing technologies. The development of methods and tools is often the result of collaboration with interdisciplinary partners. HPC is currently advancing into the realm of exascale computing, and in particular supports data-driven applications. This development will make it necessary to design not only computing power, but also storage capacity and memory bandwidth in a scalable manner. The focus of the Efficient Computing and Storage research group is on scalable storage and computing systems, and it is developing protocols and architectures capable of integrating new storage technologies into (parallel) file systems and data deduplication and backup environments.

Bertil Schmidt, André Brinkmann
www.hpc.informatik.uni-mainz.de
research.zdv.uni-mainz.de

INFORMATION SYSTEMS

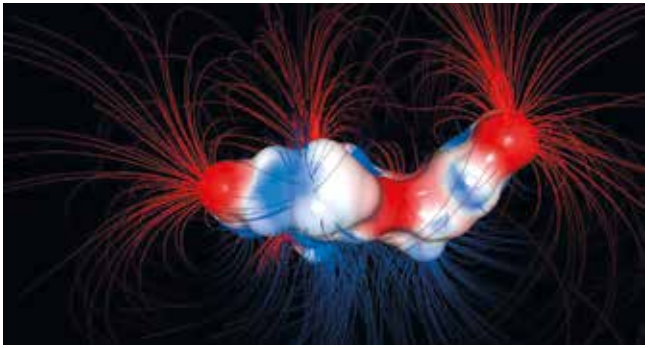
The Information Systems research group focuses on the design and implementation of novel methods and systems to efficiently manage, process, analyze and interpret data. This involves adapting established database management concepts to modern hardware and software environments, designing unconventional processing models (e.g., blockchains), and transactional and analytical processing of very large, and potentially differently structured, datasets (OLTP/OLAP).

Felix Schuhknecht
infosys.informatik.uni-mainz.de

PROGRAMMING LANGUAGES

Sustainably reliable software systems are a cornerstone of our society. The Programming Languages working group develops methods and technologies to simplify the programming and maintenance of correct, secure and performant software systems. The research group's core skills are in the theory, design, development, and application of novel abstractions, programming techniques and programming languages that can be used to realize reliable software systems.

Sebastian Erdweg
www.pl.informatik.uni-mainz.de



SCIENTIFIC COMPUTING AND BIOINFORMATICS

The focus of the Scientific Computing and Bio- informatics research group is on the development and application of cutting-edge bioinformatics methods and program packages, mostly in close collaboration with academic and industrial partners. Their applications range from computer-aided diagnosis and prognosis to rational drug design for new medicines.

Andreas Hildebrandt
www.bio.informatik.uni-mainz.de

EXTERNAL COLLABORATIVE RESEARCH PROGRAMS

The faculty cooperates closely with various research institutions in the area of fundamental research. Scientists at the participating institutes benefit from this productive cooperation in numerous pioneering projects.

Since 2017, the HIM in Mainz has provided an environment for creative exchange between the sciences.

HELMHOLTZ INSTITUTE MAINZ

The Helmholtz Institute Mainz (HIM) is an institutional collaboration between Johannes Gutenberg University Mainz and the GSI Helmholtz Center for Heavy Ion Research in Darmstadt, combining university academia with the scientific capabilities of an internationally renowned accelerator center. The institute's chief focus is currently the FAIR accelerator complex, which is being built in Darmstadt. In the near future, the Facility for Antiproton and Ion Research will provide the capability to conduct novel and globally unique experiments in nuclear and hadron physics. The researchers at HIM are investigating the strong interaction from different perspectives. The strong interaction is the one of the four fundamental forces of nature, which causes quarks to bond together, ensuring the cohesion of neutrons and protons. The researchers study short-lived mesons composed of quarks, analyze the structure of the proton, and are seeking to determine the composition of dark matter. They search for new, hypothetical particles beyond the Standard Model and generate new theoretical conceptual models. Also on the agenda are the properties of super-heavy atomic nuclei and the development of pioneering accelerator technologies.

www.hi-mainz.de

MAX PLANCK INSTITUTE FOR CHEMISTRY

The current research at the Max Planck Institute for Chemistry (MPI-C) is seeking to develop an integral understanding of chemical processes in the Earth system, particularly in the atmosphere and biosphere. The researchers are investigating a wide range of interactions between air, water, soil, life and climate throughout the Earth's history up to the present day. One of their main goals is to discover how air pollution, including reactive trace gases and aerosols, affects the atmosphere, biosphere, climate and health.

www.mpic.de/2285/en

MAX PLANCK INSTITUTE FOR POLYMER RESEARCH

The Max Planck Institute for Polymer Research (MPI-P) is one of the leading international research centers in the field of soft matter. "Control soft matter to create function" is the shared objective of the institute. By focusing on soft matter and macromolecular materials, the MPI-P is investigating a broad interdisciplinary range of topics; these include nanocapsules and nanodiamonds for medical diagnostic and therapeutic purposes, organic materials for use in novel solar cells and light-emitting diodes, and coatings for surfaces to make these particularly resistant to soiling.

www.mpip-mainz.mpg.de/en/home

FRAUNHOFER INSTITUTE FOR MICROENGINEERING AND MICROSYSTEMS

Researchers at the Fraunhofer Institute for Microengineering and Microsystems (IMM) work to translate scientific advances into innovations in the fields of chemistry, energy and diagnostics. The IMM is an integral component of the research and development landscape in Germany and a recognized partner in microsystems technology-based projects well beyond the borders of Europe.

www.imm.fraunhofer.de/en.html

COLLABORATIVE RESEARCH CENTERS

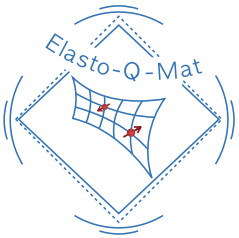
The collaborative research centers (CRCs) of the German Research Foundation (DFG) enable researchers to work on comprehensive research-projects by pooling a university's existing resources. They are intended to operate for up to twelve years. CRC/Transregios are collaborative research centers the sites of which are distributed across several universities and that jointly apply to be recognized as such.

THE SUBJECTS OF APPLICATIONS BY JGU

CRC/TRANSREGIO 146: MULTISCALE SIMULATION METHODS FOR SOFT MATTER SYSTEMS

Speaker university:
Johannes Gutenberg University Mainz
Multiscale modeling is one aspect that will help promote computational materials science. In this CRC, physicists, chemists, applied mathematicians and computer scientists are working to solve key challenges such as how to address strong heterogeneities and non-equilibrium, for example in biological systems. The group uses the computing power of MOGON NHR Süd-West for its simulations.

trr146.uni-mainz.de



CRC/TRANSREGIO 165: WAVES TO WEATHER

Speaker university:
Ludwig-Maximilians-Universität München (LMU)

In this CRC, meteorologists, mathematicians, statisticians, computer scientists and experts in visualization are jointly investigating the limits of weather forecasting, the aim being to improve the quality of weather forecasts.

www.wavestoweather.de

CRC/TRANSREGIO 173: SPIN+X: SPIN IN ITS COLLECTIVE ENVIRONMENT

Speaker university:
The University of Kaiserslautern-Landau (RPTU)

In the CRC Spin+X, researchers from the fields of physics, chemistry and engineering investigate the properties of spin. Although not yet comprehensively understood, the spin phenomena are already critically important for modern technological applications such as data storage and magnetic sensing. From fundamental physics to functional processes and applications, the CRC encompasses the entire value chain.

rptu.de/en/sfb-trr-173-spin-x

CRC/TRANSREGIO 288: ELASTIC TUNING AND RESPONSE OF ELECTRONIC QUANTUM PHASES OF MATTER (ELASTO-Q-MAT)

Speaker university:
Goethe University Frankfurt

The ELASTO-Q-MAT initiative aims to understand and implement new physical phenomena of solids that emerge from the particularly close correlation between the elastic properties of a material and its electronic quantum phases. To achieve this, the researchers investigate how different types of electronic order influence elastic tuning and elastic response in representative classes of quantum materials that are characterized by high sensitivity of their properties to intrinsic stresses or extrinsic pressures.

transregio288.org/index.html

THE SUBJECTS OF APPLICATIONS BY JGU

CRC/TRANSREGIO 301: THE TROPOPAUSE REGION IN A CHANGING ATMOSPHERE

Speaker university:
Johannes Gutenberg University Mainz
The composition of the atmosphere in the region of the tropopause plays a key role in the energy balance of the atmosphere and in the Earth's climate. The CRC investigates precisely which processes in this region are relevant to the climate and what feedback mechanisms exist between such processes. It employs laboratory and field measurements together with model simulations, the aim being to enhance our understanding of the fundamental processes in this difficult-to-access region. This will allow climate models to be improved and uncertainties in climate projections to be reduced.

tpchange.de

CRD/TRANSREGIO 306: QUANTUM COOPERATIVITY OF LIGHT AND MATTER

Speaker university:
Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU)
The goal of the Quantum Cooperativity of Light and Matter (QuCoLiMa) CRC is to study the quantum collective behavior of physical systems at the interface between quantum optics and condensed matter. Scientists from JGU and its partner universities FAU and Saarbrücken are seeking to understand how cooperative behavior in the quantum realm arises and how it can be controlled.

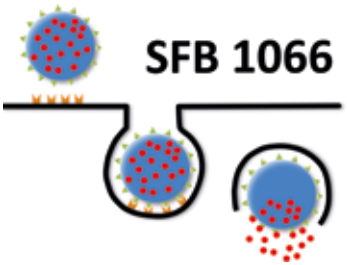
www.qucolima.de

CRC/TRANSREGIO 319: RMAP: RNA MODIFICATION AND PROCESSING

Speaker university:
Johannes Gutenberg University Mainz
Pharmacologists, biochemists, biologists, computer scientists and medical scientists are collaborating in this CRC to investigate the interaction between RNA modifications and processing. They are aiming to gain new insights into how our bodies synthesize proteins. The COVID-19 pandemic has increased awareness in the general public that the hereditary material of some viruses is RNA. In human cells, RNA is responsible for transporting genetic information and translating it into proteins. This CRC is investigating which specific modifications and processes play a role in these mechanisms.

rmap.uni-mainz.de

PARTICIPATION BY JGU



CRC 1066: NANODIMENSIONAL POLYMER THERAPEUTICS FOR TUMOR THERAPY

Speaker university:
Johannes Gutenberg University Mainz
Chemists, pharmacologists, biologists, physicists and medical scientists are working together in this collaborative research center to develop novel, multifunctional nanoparticulate drug carriers that can be used in the immunotherapy of malignant melanomas.
sfb1066.de/en

Recently launched

CRC 1551: POLYMER CONCEPTS IN CELLULAR FUNCTION

Speaker university:
Johannes Gutenberg University Mainz

CRC/TRANSREGIO 326: GEOMETRY AND ARITHMETIC OF UNIFORMIZED STRUCTURES (GAUS)

Speaker university:
Goethe University Frankfurt/Main
The research undertaken by this CRC is the mathematical exploration of complicated geometric and arithmetic spaces with the help of uniformization. The researchers aim to identify fundamental connections, for example, with regard to moduli spaces, automorphous forms, Galois representations and cohomological structures.
crc326gaus.de

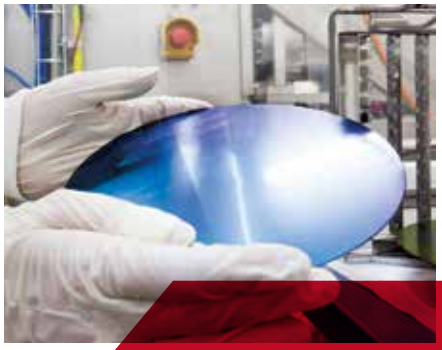
CRC 1245: ATOMIC NUCLEI: FROM FUNDAMENTAL INTERACTIONS TO STRUCTURE AND STARS

Speaker university:
Technical University Darmstadt
More than 100 scientists are working in this CRC to systematically describe atomic nuclei across the entire nuclide chart on the basis of effective field theories of the strong interaction and by conducting key experiments at international research facilities in Japan, the USA and in Darmstadt. The scientists in Mainz are contributing their expertise in the field of theoretical nuclear physics.
sfb1245.tu-darmstadt.de

In addition to collaborative research centers, the faculty is home to numerous other externally funded research projects: www.blogs.uni-mainz.de/fb08-pmc/research

TOP-LEVEL RESEARCH AREAS

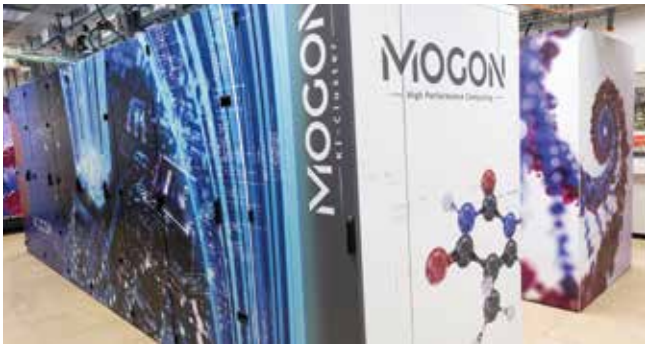
The top-level research areas at JGU, which are funded by the Research Initiative of the State of Rhineland-Palatinate, bring together internationally established research groups that have already demonstrated excellence in research. This provides them with a realistic chance of being successful in Germany's Excellence Strategy program during the second competition phase.



TOPDYN – DYNAMICS AND TOPOLOGY

The TopDyn Research Center brings together two of the most exciting research areas in an interdisciplinary manner, namely dynamics and topology. Topology is a central concept in many areas of science, from cosmology through superfluidity to metallurgy. The topology of a system is characterized by a topological charge that is extensively protected against external disturbances, thereby rendering the states of the system particularly stable. Certain applications, in particular, require especially stable states that, for example, can be shielded from noise and other disturbances by virtue of their topology. In addition, the ability to switch states – where dynamics is key – is a necessity. These issues are studied collectively in TopDyn in connection with a number of particularly important selected systems, such as topological electronics, spintronics and quantum computing. In this research center, mathematicians, chemists and physicists are collaborating to investigate topology and dynamics, in particular at the interface between the classical and quantum regimes, and to develop functionalities for potential applications.

topdyn.uni-mainz.de



MAINZ INSTITUTE OF MULTISCALE MODELING (M³ODEL)

The interdisciplinary Institute of Multiscale Modeling in Mainz brings together experts from fields as diverse as physics, chemistry, molecular biology, mathematics and computer science who share a common vision: to develop robust, efficient, and reliable computer models and to enable quantitative prediction of properties arising from the interaction of multiple scales. Numerical methods and data-driven modeling have become indispensable tools in various natural and life sciences with an ever-intensifying focus on processes across multiple scales that require new and innovative approaches.

model.uni-mainz.de

FACULTY 08

PROFESSORS

INSTITUTE OF PHYSICS

// Experimental Particle and Astroparticle Physics (ETAP): Sebastian Böser, Volker Büscher, Frank Fiedler, Lucia Masetti, Uwe Oberlack, Matthias Schott, Stefan Tapprogge, Alfons Weber, Michael Wurm **// Condensed Matter Physics (KOMET) – Experimental side:** Katrin Amann-Winkel, Jure Demsar, Hans-Joachim Elmers, Gerhard Jakob, Martin Jourdan, Mathias Kläui, Thomas Palberg, Johannes Gerhard Schönhense, Angela Wittmann **Theoretical side:** Peter van Dongen, Jamir Marino, Yuriy Mokrousov, Friederike Schmid, Jairo Sinova **// Quantum, Atomic and Neutron Physics (QUANTUM) – Experimentalists:** Dmitry Budker, Martin Fertl, Randolf Pohl, Ferdinand Schmidt-Kaler, Jochen Walz, Klaus Wendt, Patrick Windpassinger; **Theoreticians:** Peter van Loock **// Theoretical high-energy physics (THEP):** Julia Harz, Tobias Hurth, Hans Jockers, Joachim Kopp, Matthias Neubert, Martin Reuter, Pedro Schwaller, Hubert Spiesberger, Stefan Weinzierl

INSTITUTE OF NUCLEAR PHYSICS

// Experimental nuclear and hadron physics: Patrick Achenbach, Kurt Aulenbacher, Winfried Barth, Niklaus Berger, Achim Denig, Wolfgang Gradl, Harald Merkel, Florian Hug, Eva-Maria Kabuß, Frank Maas, Atoosa Meseck, Michael Ostrick, Josef Pochodzalla, Concettina Sfienti
// Theoretical nuclear and hadron physics: Sonia Bacca, Pierre Capel, Jens Erler, Georg von Hippel, Harvey Meyer, Stefan Scherer, Marc Vanderhaeghen, Hartmut Wittig

INSTITUTE FOR ATMOSPHERIC PHYSICS

// Experimental side: Stephan Borrmann, Peter Hoor, Christiane Voigt
// Theoretical side: Annette Miltenberger, Peter Spichtinger, Holger Tost, Volkmar Wirth

INSTITUTE OF MATHEMATICS

// Algebraic geometry, topology and number theoreticians: Tom Bachmann, Manuel Blickle, Theodorus de Jong, Manfred Lehn, Stefan Müller-Stach, Duco van Straten, Georg Tamme **// Analysis:** Lea Boßmann, Steffen Fröhlich, Vadim Kostrykin, Alan Rendall **// Specialized Didactics:** Ysette Weiss **// History of mathematics and the natural sciences:** Tilman Sauer **// Numerical mathematics:** Martin Hanke-Bourgeois, Maria Lukáčová-Medvidová, Hendrik Ranocha **// Probability and Statistics:** Matthias Birkner, Lisa Hartung, Achim Klenke

INSTITUTE OF COMPUTER SCIENCE

// Algorithmics: Ernst Althaus **// Algorithmic geometry and computer graphics:** Elmar Schömer **// Data management:** Panagiotis Bouros **// Data mining and artificial Intelligence:** Stefan Kramer, Katharina von der Wense, **// computer science didactics:** Jens Gallenbacher **// Efficient computing and storage systems:** André Brinkmann **// High-performance computing:** Bertil Schmidt **// Information systems:** Felix Schuhknecht **// Programming languages:** Sebastian Erdweg **// Scientific computing and bioinformatics:** Andreas Hildebrandt **// Visual computing:** Michael Wand

STUDY PROGRAMS

BASIC DEGREE PROGRAMS

Bachelor of Science
- Physics
- Applied Physics, Majoring in Computer Science
- Meteorology
- Environmental Sciences, Majoring in Atmospheric and Climate Science
- Mathematics
- Computer Science

Bachelor of Education
- Physics
- Mathematics
- Computer Science

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EXTENSION PROGRAMS

Master of Science
- Physics
- Meteorology
- International Master in Atmospheric Sciences
- Mathematics
- Computational Sciences
- Applied Bioinformatics
- Computer Science with Minor in Physics, Mathematics or Biology
- Computer Science and Economics

Master of Education
- Physics
- Mathematics
- Computer Science

Supplementary Teacher Training Examination
- Physics
- Mathematics
- Computer Science

Excellence Track Certificate
(Extension of the M. Sc. Physics)

FACTS AND FIGURES

5
institutes

23
degree programs

€22.7
million
in third-party funding

73
professors

2.545
students

383
doctoral candidates

462
academic staff members

341
university degrees
(bachelor's/master's)

69
doctorates awarded

180
administrative-technical staff
members

The figures on personnel, degrees and third-party funding are taken from the JGU document *Facts and Figures 2021. he.uni-mainz.de/daten*

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