3

Infra-structure

3.1 Scientific and Technical Infrastructure

Aerial view of the Institute's campus in spring. In the background the city of Heidelberg.

Campus

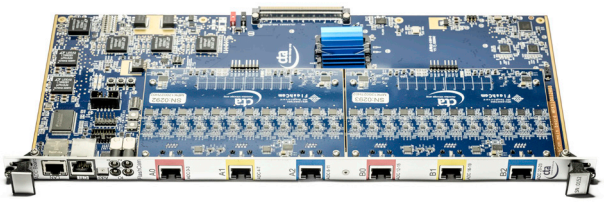
The institute campus is situated in the forest 200 m above the city of Heidelberg. The main buildings are the Walther Bothe and the Wolfgang Gentner Laboratories with office and laboratory space. The library building with a lecture hall and a seminar room suitable for small conferences lies at the centre of the campus. Other significant buildings are the experimental hall complex, the electronic and mechanical workshop buildings, the kindergarten and guest houses. The neighbour to the south is the European Molecular Biology Laboratory (EMBL). See page 58 for a map of the site.

Central IT Services

The central IT infrastructure provides computing power and storage space. A Linux cluster and several special-purpose servers with about 6500 processor cores are available for processing batch jobs. Data is stored on hard disks with a total capacity of over 13 Petabytes. For fast access, most of the data space is organized as a parallel file system. A central tape library is used as a backup system to assure data safety and as a long-term archive. All servers and file systems are attached with up to 100 Gigabit Ethernet connections to the network. The cluster mainly serves for data storage, data analysis and simulations in gamma-ray astronomy as well as for time-consuming calculations in theoretical quantum dynamics. Further, the IT group operates mail and web servers, supports users with desktop hardware and software, and maintains the technical infrastructure in the lecture hall and seminar rooms.

Four water-cooled racks containing the 272 servers of the two clusters.

Electronics



Main board for FlashCam with FPGA and two plugged-on analogue-to-digital converter boards.

Electronics to control experiments and for data acquisition are developed and produced in the central electronics shop and the apprentices' shop, since in many cases the experimental requirements cannot be fulfilled by commercial devices. A new electronic circuit design is transferred to the layout of a respective board, which is then usually produced externally and tested before its integration into an experiment. The central electronics group has specialist expertise in areas of critical importance to the institute, for example in the high voltage systems needed for ion traps, and the digitisation systems needed to capture the data from many experiments. Maintenance and repair of electronic devices is also performed. Some of the electronic technicians are permanently engaged in specific experiments.

Precision Mechanics and Engineering Design

CNC 5-axis milling machine.

Both the central precision mechanics shop and the apprentices' shop are equipped with modern CNC-controlled as well as conventional milling and turning machines. Further, a number of welding and soldering techniques are applied to produce vacuum components. Among the treated materials are steel, copper, titanium, tantalum, molybdenum as well as ceramics and plastics. The precision of the workpieces is checked with a high-resolution 3D measuring device. Several specialized mechanics shops are in charge of some large-scale experiments.

Many of the components for scientific instruments that are built in the mechanics shops are developed in the engineering design office based on a 3D-CAD system. It delivers three-dimensional views that can be rotated on the screen, technical drawings for the manufacturing process, data to directly control the CNC machines and lists of the required materials. The software package includes a numerical simulation tool to test the components beforehand.

FlashCam @ H.E.S.S.: new camera for CT5

Concluding the development, prototyping and system integration phase, a pre-series "FlashCam" fully digital camera for Cherenkov telescopes has made its way into a data taking astroparticle physics experiment, see Section 1.1. The electronics workshop has been heavily involved in the development of the FlashCam readout system and all the subsequent stages towards the installation at the experiment. The modular and scalable FlashCam readout system is based on a motherboard featuring a low-cost logic IC (field programmable gate array, FPGA) providing a large number of fast digital I/O ports and the corresponding short-term data buffers and logic processing. From an external server, the FPGA can be accessed through a 1 Gbit LAN interface. Combining the motherboards with application-specific daughter boards (ADC, DAC, trigger, clock distribution), a fully featured readout system for the 1764 photomultiplier tubes of the FlashCam camera can be set up.

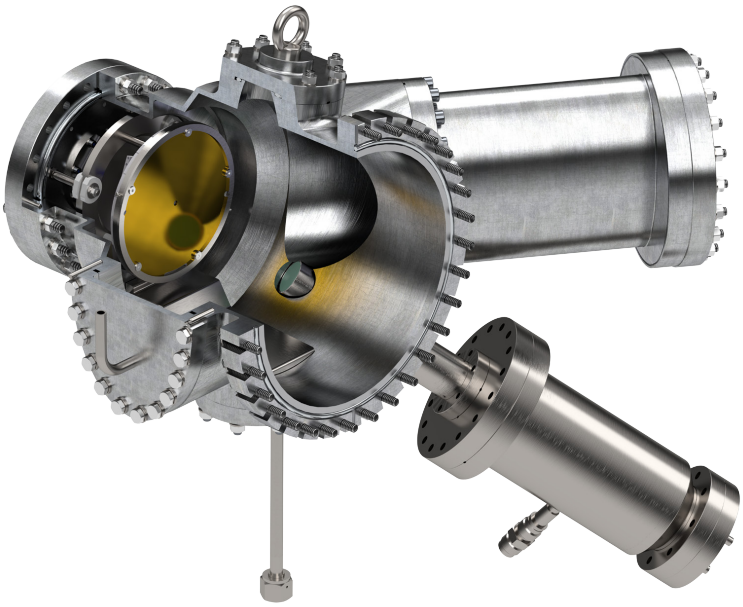
Due to its high versatility, this system is already being used in totally different experiments as well: the "outrigger array" of the HAWC gamma-ray observatory in Mexico, medical imaging research at the Heidelberg Ion Beam Therapy Center HIT, germanium and active veto readout of the double-beta decay experiment LEGEND at LNGS in Italy, to name just a few.

The picture shows the re-installation of the delicate light sensors into the FlashCam camera body after transport to Namibia. Subsequently, some initial electrical tests were performed and the camera was finally mounted into the large central telescope and integrated into the H.E.S.S. data acquisition system. Only a few days later, the FlashCam camera successfully recorded its first high-resolution image of the crab nebula.

Components for the calibration and monitoring system (CMS) of KATRIN

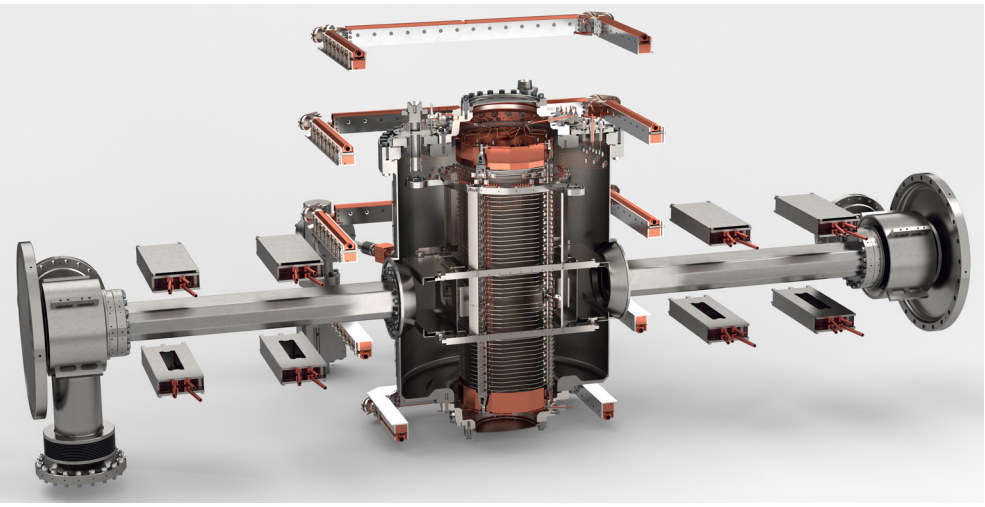
For the Karlsruhe Tritium Neutrino Experiment (KATRIN), a so-called rear-wall chamber has been designed and produced at MPIK. Amongst other things, this chamber contains sensors for monitoring the source activity and a highly sensitive gold-plated electrode which defines the potential of the tritium source. The specific challenge of this piece was to mill it from a forged block of stainless steel 316L rather than realise it as a welded assembly.

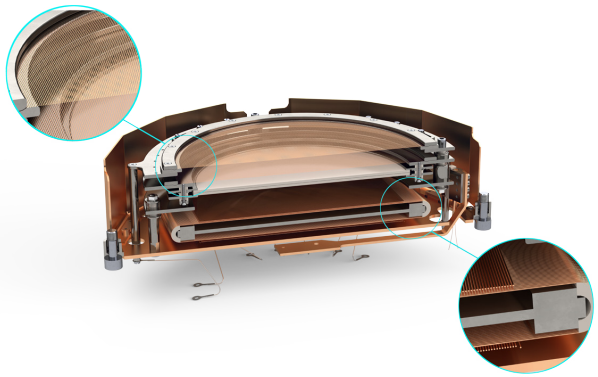
In addition to the chamber, the engineering design office and precision mechanics shop were involved in the development and manufacturing of many further components for this part of KATRIN. As an example, this included the implementation of the UV lighting mount including optical path and focusing, the magnetic field shielding, and an adjustment device.



The CSR reaction microscope: setup and multi-channel plate detector

The worldwide first cryogenic reaction microscope, the CSR-REMI, was designed for the cryogenic storage ring CSR and is presently under construction. The complete design and the production of most of the vacuum chambers as well as the mechanical components have been done in MPIK's engineering design office and precision mechanics shop. Besides the vacuum chambers, the production comprises the spectrometer electrode arrays, the large-area multi-channel plate detectors, coils for generating magnetic fields and a large number of thermal shields. Due to the requirements of operation at cryogenic temperatures of about 10 K and the need to use low-permeability materials, the components have been precision fabricated preferentially from stainless steel 1.4435 BN2, titanium, AlMg4.5Mn and high-purity copper. Nearly all parts have been high-temperature vacuum annealed. Following extensive tests, titanium-ceramics hard-solder connections could be produced successfully. Electron-beam welding and construction of prototypes were also required.





Scientific Information Service

View into the MPIK library.

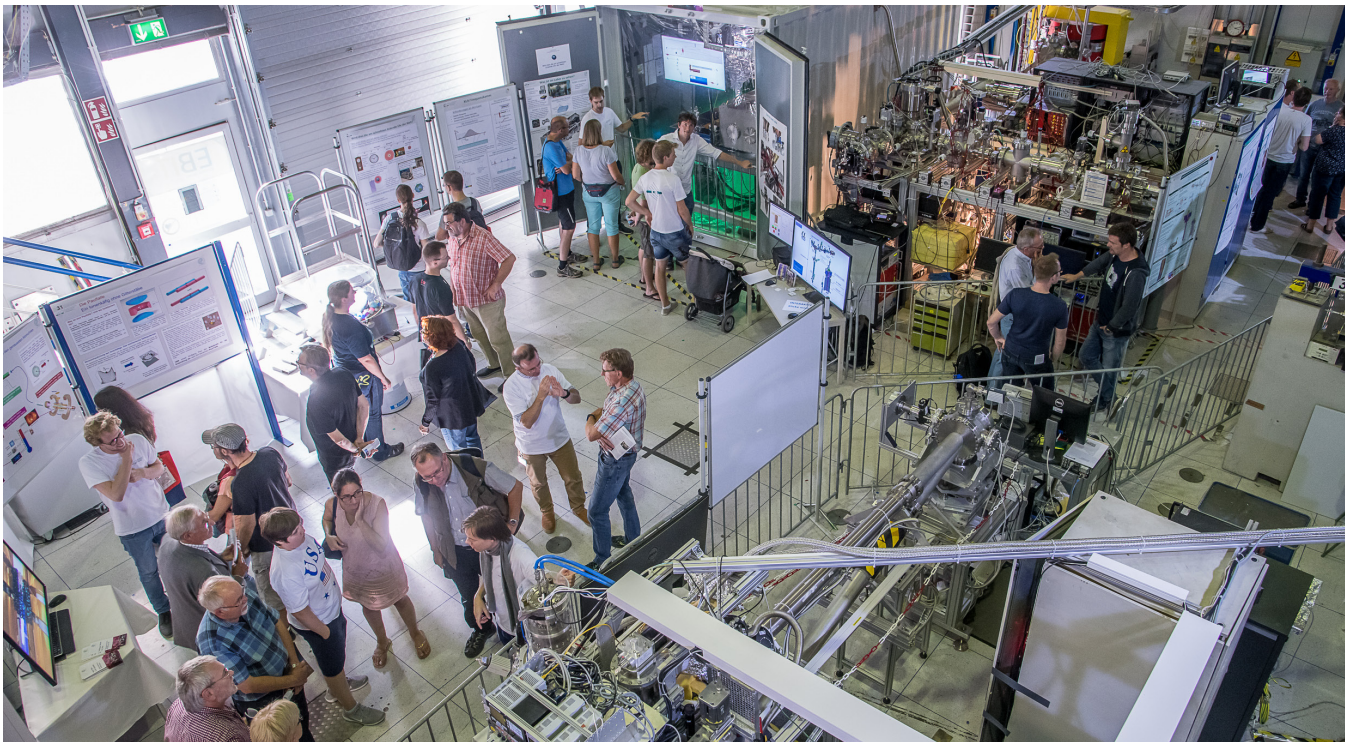
The Institute's library presently holds about 26 200 monographs, book series, conference proceedings, theses prepared at the MPIK and about 6 200 journal volumes. Via the Max Planck Society, the library provides access to e-books, online dictionaries, databases and more than 40 000 e-journals. MPIK actively participates in the Max Planck Society's open access activities via the Max Planck digital library. The publication management system PuRe offers the opportunity to publish papers and supplementary material and to prepare individual publication lists.

Public Relations

It is a high priority of the MPIK that major research results are communicated well beyond the scientific community, to the public at large. A dedicated publication relations team writes press releases about selected results which are published via the Institute's homepage and internet services. Detailed information about the research at the Institute is kept up to date both online and as printed matter. Groups of visitors are welcome for guided institute tours; for school students, we provide the "Saturday morning physics" courses.

Open Day in September 2018

On the occasion of its 60th birthday, the MPIK performed an open day on September 16, 2018. The weather conditions were ideal, and more than 3000 visitors came to the institute to see the 69 stations and talk to MPIK's scientists and technicians. The visitors were enthusiastic and mostly stayed for many hours. The stations comprised demonstration and hands-on experiments, laboratory visits, displayed objects, posters and talks.



Publication Statistics

The publication output of the Institute is documented via the Max Planck wide publication repository PuRe (https://pure.mpg.de/), which presently contains about 8000 datasets related to the MPIK. 1165 entries have been added in the years 2017-2019, of which 700 contain the full text and 345 provide a link to the full text of the publication.

While the total number of publications has fluctuated over the years, the yearly number of citations to all publications ever published by MPIK scientists continues to increase.

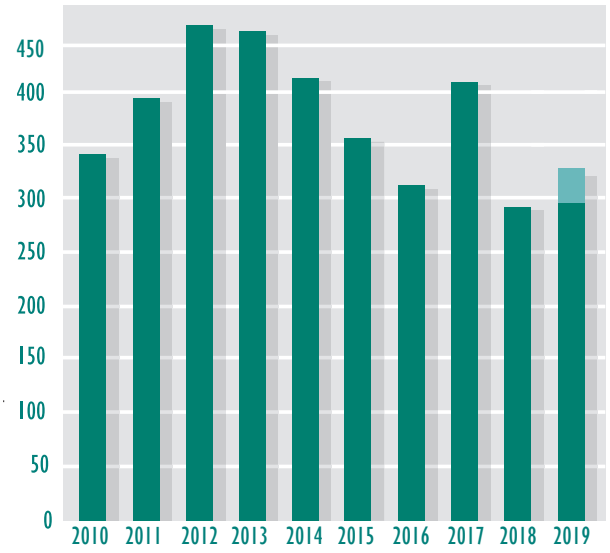
In the years 2017-2019, overall 48 papers were regarded as being of interest for the general public and therefore accompanied by a press release.

The following table lists the most favoured journals during the years 2017 to 2019 together with the numbers of papers published therein. The second table indicates the number of theses of various types completed at MPIK over the three years.

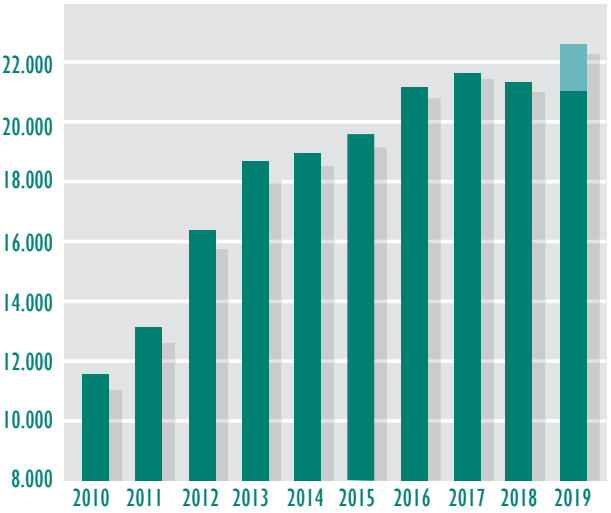
Journal	Papers
Physical Review Letters	87
Physical Review D	80
Physical Review A	68
Astronomy & Astrophysics	54
Journal of High Energy Physics	54
Physical Review C	45
AIP Conference Proceedings	41
European Physical Journal C	33
Monthly Notices of the Royal Astronomical Society	31
Nature, Nature Photonics, Nature Physics, Nature Communications	27
Science	7

	2017	2018	2019
Bachelor theses	18	11	16
Master theses	20	8	13
Dissertations	14	19	19
Habilitations	0	0	1

Published Items in Each Year



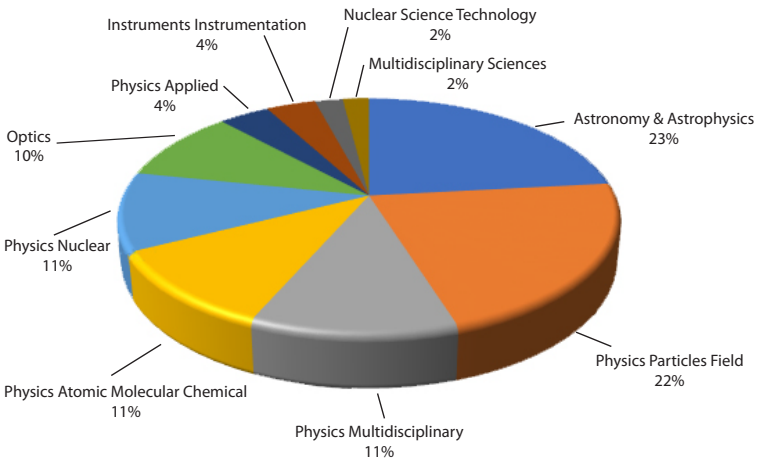
Citations in Each Year

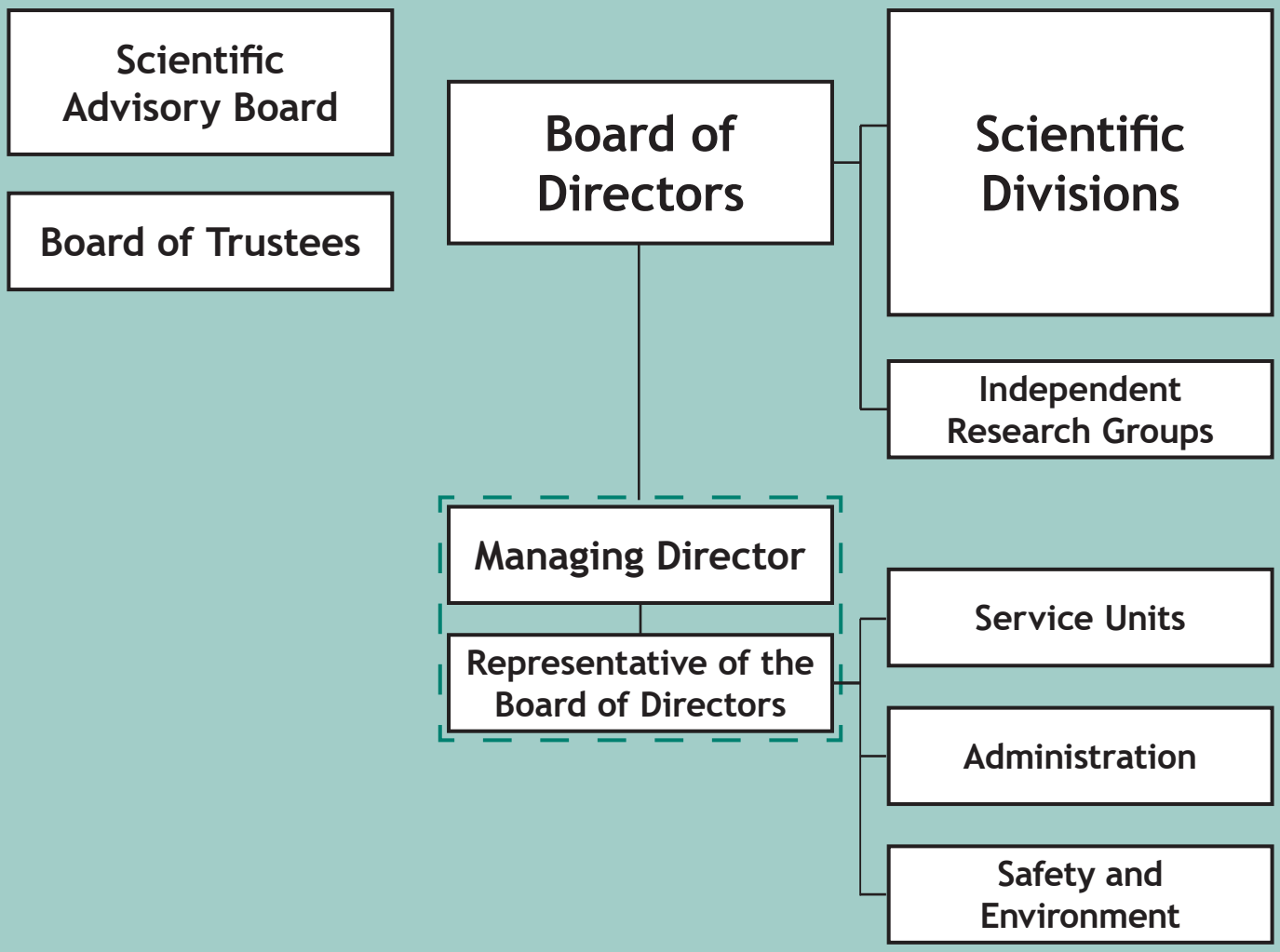


Source: ISI Web of Science™, December 2019

estimated

Distribution of the publications by Web of Science™ categories





3.2 Personnel

Organisational diagram of the Institute.

Prizes awarded to MPIK Members

Prof. Dr. Klaus Blaum: External Member of the Physics Class of the Royal Swedish Academy of Sciences; ERC Advanced Grant
Prof. Dr. Till Kirsten: Enrico Fermi Prize of the Italian Physical Society
PD Dr. Adriana Pálffy-Buß: Hertha-Sponer-Preis der Deutschen Physikalischen Gesellschaft 2019; Röntgen-Preis der Justus-Liebig-Universität Gießen 2019
Dr. Kilian Heeg: ESRF Young Scientist Award 2018; Carl Zeiss Award for Young Researchers 2018; IBAME Young Scientist Award 2017
Dr. Andreas Mooser: IUPAP Young Scientist Prize in Atomic, Molecular and Optical Physics 2019
Dr. Lisa Schmöger: Otto-Hahn-Medaille der MPG and Otto Hahn Award 2018
Dr. Jonas Gunst: Otto-Hahn-Medaille der MPG 2017
Dr. Ludwig Rauch: Ruprecht-Karls-Preis der Stiftung Universität Heidelberg

Appointments of MPIK Scientists

PD Dr. Jörg Evers: Außerplanmäßiger Professor at Heidelberg University
Dr. Carlos Esteban Yaguna Toro: Professor in Physics at Pedagogical and Technological University of Colombia, Tunja, Colombia
Dr. Sunil Kumar Sudhakaran: Assistant Professor at Indian Institute of Science Education and Research, Tirupati, India
Dr. Farinaldo da Silva Queiroz: Junior Professor with tenure track at International Institute of Physics, Natal, Brasilia and International Centre for Theoretical Physics dof the South American Institute for Fundamental Research, São Paulo, Brasilia
Meng Wen: Associate Professor at Hubei University
Yue-Yue Chen: Tenure-track Full Professor at Shanghai Normal University
Jian-Xing Li: Tenure-track Full Professor at Xi'an Jiaotong University

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Prof. Dr. Hans-Arwed Weidenmüller

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Dr. Holger Kreckel, subsequent to ERC Starting Grant
Dr. Brian Reville, from 01.05. 2019

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Dr. Hardy Simgen
Dr. Anatoly Smolnikov
Dr. Sven Sturm
Dr. Richard J. Tuffs
Dr. Felix Werner
Dr. Richard White
Prof. Dr. Andreas Wolf

A complete list of people working at the MPIK may be found in the electronic annex.

International Max Planck Research Schools

The MPIK is involved in three International Max Planck Research Schools (IMPRS). Two of them are coordinated by the institute, while the third one is coordinated by the MPI for Astronomy (MPIA). The IMPRS are part of the Heidelberg Graduate School for Physics (HGSFP) at the University of Heidelberg.

IMPRS-QD: quantum dynamics in physics, chemistry and biology
Spokesperson: Christoph H. Keitel
Coordinator: Jörg Evers
Institutions: MPIK, Heidelberg University, German Cancer Research Center, MPI for Medical Research, GSI Helmholtzzentrum für Schwerionenforschung (Darmstadt)

	2017	2018	2019
PhD students	45	41	47
female	6	10	11
from foreign countries	26	24	28
funded by IMPRS-QD	11	10	11
graduations	6	16	10

IMPRS-PTFS: precision tests of fundamental symmetries
Spokespersons: Manfred Lindner and Klaus Blaum
Coordinator: Werner Rodejohann
Institutions: MPIK, Heidelberg University

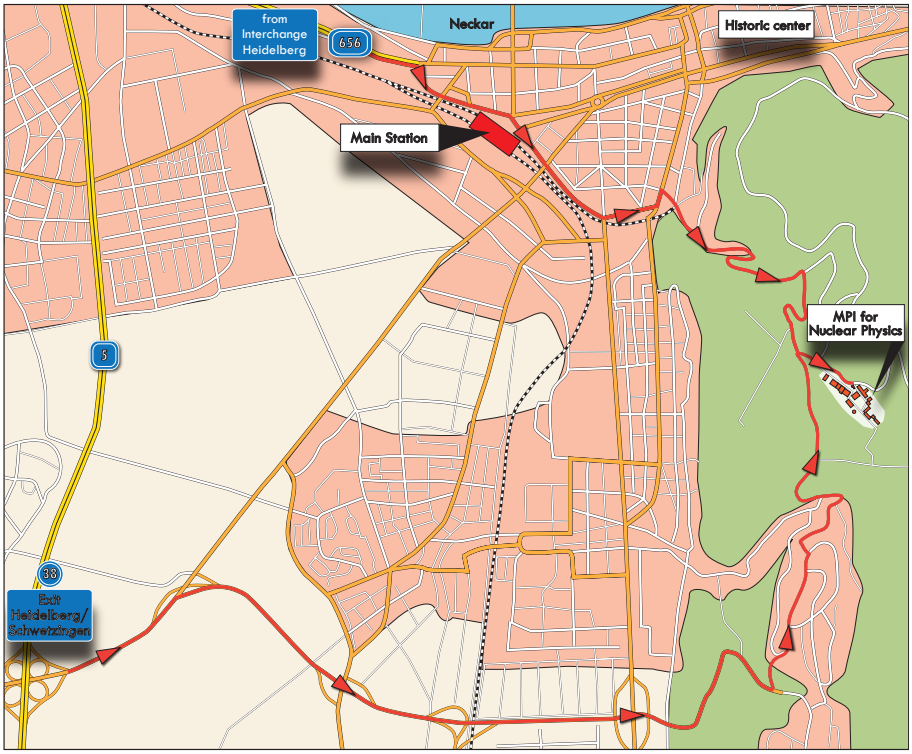
	2017	2018	2019
PhD students	25	23	21
female	4	5	7
from foreign countries	7	7	6
funded by IMPRS-PTFS	14	6	7
graduations	4	6	8

IMPRS-HD: astronomy and cosmic physics @ MPIA
During the reporting period, 15 PhD students (of which 4 female, 6 from foreign countries, 2 funded by IMPRS-HD, 7 graduations) were working at the MPIK.

Electronic Annex

The electronic annex provides lists of personnel, publications, theses, invited talks at conferences and symposia or at other institutes, teaching activities, jointly organised conferences and workshops, as well as institutional collaborations. Both the annex and the report itself can be downloaded from MPIK's web pages:
www.mpi-hd.mpg.de/mpi/en/public-relations/reports-and-information-material

How to reach the Institute



By car: Autobahn A5 from the north until Autobahnkreuz Heidelberg, turn to A656 (from Mannheim) direction Heidelberg; at the end of the Autobahn turn right (direction "Zentrum, Altstadt, Schloss"), keep straight ahead at the main station and follow Kurfürstenanlage until Adenauerplatz (hotel Crowne Plaza), turn right into Rohrbacher Straße, after about 1 km turn left into Steigerweg, and follow the direction signs to Max-Planck-Institut für Kernphysik about 2.5 km uphill.

From the south leave A5 at the exit Heidelberg/Schwetzingen, turn on B535 direction Heidelberg/Leimen, then right direction Leimen and keep straight ahead for about 4.5 km (at last uphill) to the Aral station, there turn left to Boxberg and follow the direction signs to Max-Planck-Institut für Kernphysik.

By train: Arriving at the main station Heidelberg Hauptbahnhof which can be reached either directly by long-distance trains or via Mannheim and S-Bahn, take a taxi to the institute, or tram or bus to Bismarckplatz, change to bus 39 direction Königstuhl until stop "MPI Kernphysik" (about 15 min).

By plane: Airport Frankfurt/Main; take either an express train (ICE, IC) at Flughafen Fernbahnhof or the Lufthansa Airport Shuttle to Heidelberg which arrives at Crowne Plaza hotel, Kurfürstenanlage 1. Continue with a taxi or bus 39.

By taxi: Taxis are available outside the main station or can be called: +49 6221 302030. Please tell the taxi driver MPI für Kernphysik, Saupfercheckweg, as there are three other MPIs in Heidelberg.

Site Map of the MPIK