Service Units, Facts and Figures

3

3.1 Scientific Service

The H.E.S.S. model (scale 1:100) in the Haus der Astronomie (on the Königstuhl) under the half-moon globe (formerly in the Gentner lab) with installations for the open day of MPIA/HdA on July 22, 2012 in which the MPIK participated.

Central IT Services

The IT group manages the central computer infrastructure of the MPIK, which provides central computing power and storage space for researchers. For this purpose several computer clusters and storage systems have been acquired during the last years. Most of this hardware is located in the new computer room, which was finished in the year 2010. In addition the central IT operates services like mail and web and administrates the institute network. Supporting users with the acquisition of desktop hardware and desktop software installations has become a growing activity over the last two years.

Because of increasing computing power needs from various MPIK research groups, a new Linux computer cluster has been installed in 2013. The cluster consists out of 160 dual processor nodes with a total of 2560 processor cores and 20 terabyte of system memory. Each cluster node is attached with a 10 Gigabit Ethernet (10 GbE) connection to the network. By using special high performance computing (HPC) optimized server systems, where four servers share a common two rack units high case with a redundant power supply, the whole cluster allocates only two 19 inch racks in the computer room. Very good energy efficiency is an additional advantage of the new systems.

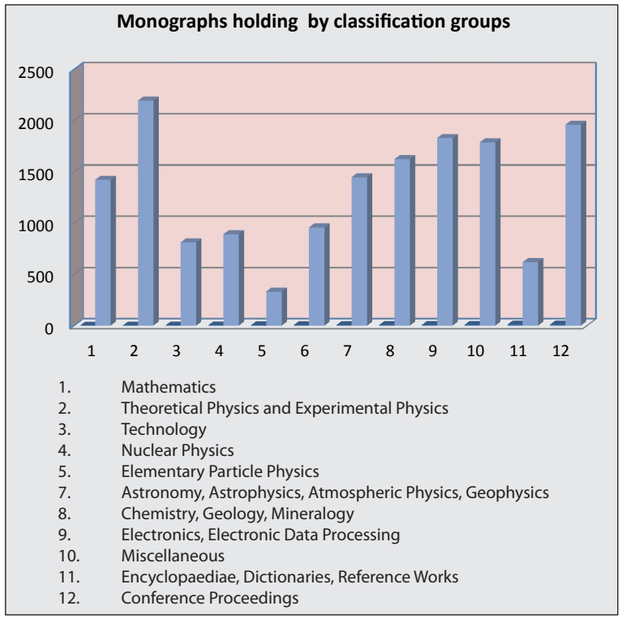
The cluster runs Scientific Linux 6 as operating system. The Sun Grid Engine is used for allocating computing resources to users and running batch jobs on the cluster. Parallel computing jobs are supported through the Message Passing Interface library MVAPICH2. Two new cluster head nodes are used for interactive work like program development and submitting jobs to the cluster batch queues.

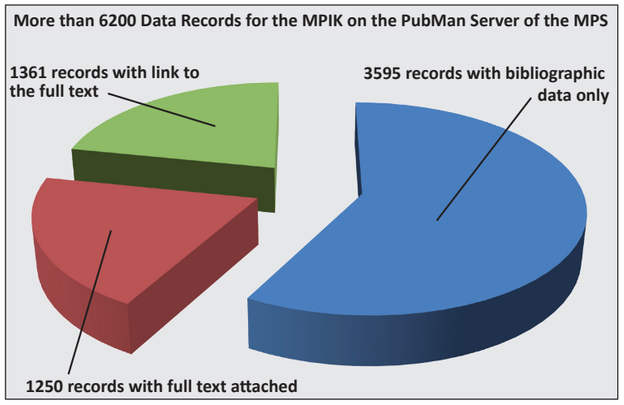
The installation of a third Lustre file system in 2012 with 10 GbE storage servers almost doubled the capacity of the parallel file systems to 2.3 petapyte. Together with additional new NFS file servers, the total file system capacity available for users at the end of 2013 is reaching 3 petabyte. To fully utilize the faster network speed of the new cluster all existing storage servers have also been upgraded to 10 GbE. The improved network speed results in a throughput of over 5 gigabyte/s for one Lustre file system while analyzing experimental data. The throughput being over 5 times faster compared to the old cluster dramatically reduced execution times for I/O intensive computing jobs.

With the commissioning of the new cluster in July 2013 the existing old clusters have been taken out of operation. Nevertheless, available computing power increased approximately by a factor of 3 at the same time reducing energy costs considerably.

The installation of a new virtual infrastructure in 2012 was a major upgrade for the central network services. The cluster, replacing six old servers and storage arrays, consists out of four servers and two ICSCI attached storage systems. It runs many critical central network services in a virtual environment. More than 40 virtual machines host services for web, web proxy, authentication, domain name services, licensing, etc. By the use of VMware vSphere 5 as virtualization software and vCenter Server as management software the time for administration could be reduced compared to the old virtual platform. At the same time availability for central network services has improved.

Frank Köck





Library

The library is a specialized library offering services primarily to scientists working at the institute. Scientists from outside are welcome, and usage is possible on appointment.

The collection of books increases continuously. By the end of 2013 our catalogue listed 24 745 monographs and conference reports. About 5500 bound journal volumes are available. In 2009 we became an e-only library for journal content. Access to electronic journals is predominantly covered by the Grundversorgung, i. e. the Max Planck Society ensures a permanent right to full-text access for more than 32 000 journal titles. Access to e-books is also primarily guaranteed via the Max Planck Society.

We manage the documentation of the publication output of the institute via our institutional publication repository PubMan (http://pub-man.mpdl.mpg.de). Our workflow allows researchers, secretaries, and the librarian to enter publication data and upload full texts. The librarian performs a final quality check. The intention of this electronic document server is among other purposes to increase the visibility of the intellectual output of the MPIK and to contribute to the world-wide virtual repository of high-quality scientific information. PubMan replaced eDoc in the beginning of 2011.

We also actively support various activities (catalogue enrichment, e-books, virtual library, open access, document ordering, electronic resource management) of the MPDL (Max Planck Digital Library).

Yet another task of particular importance is to find, analyze, and present bibliographic and citation information of scientists or institutions by using bibliographic data bases like SCOPUS or the Science Citation Index (SCI).

Gernot Vogt

Public Relations

The MPIK provides a variety of programs for the general public. The institute is attractive for groups of visitors, for which the public relations team offers guided tours. Mostly, a short introductory talk is followed by a tour to several labs, where sometimes explanations are given by specialists, and occasionally talks by members of the theory groups – depending on the interests and background of the visitors. In 2011-2013 we had 63 groups from schools, universities, other institutions or private with altogether about 890 persons.

In all three years of the reporting period, the MPIK participated in the "Girls' Day", a Germany-wide initiative to motivate girls for technical professions; every April, companies and institutions offer an action day for girls. Under the motto "the wondrous world of quanta", 30 girls (distributed in groups according to their school level) got insight into the professions of a physicist, an electronic technician or a precision mechanic. Supervised by mostly female staff, they performed experiments, saw original instruments and heard short talks about research projects.

The "Saturday Morning Physics" courses, addressing high-school students at the advanced classes and their teachers, typically attract about 100 persons and provide an insight into the research at the Institute or related topics by lectures, discussions and occasionally guided lab tours. A part of the lectures was given by external speakers. One out

of the overall 9 events in the reporting period was MPIK's contribution to the „Max-Planck-Tag" on November 11, 2011 (celebrating 100 years Kaiser-Wilhelm-Gesellschaft/Max Planck Society). The "Friday Morning Physics" comprised two talks and an interactive exhibition, which covered contributions from all divisions of the MPIK. In the afternoon, the general public was invited to see the exhibition and to hear 7 short talks by MPIK scientists.

Totally 60 press releases about outstanding scientific results have been released in the reporting period. They were all announced online via the MPIK website and in part via the central MPG website as well as via idw (Informationsdienst Wissenschaft, idw-online.de) and alpha galileo (www.alphagalileo.org). Prizes awarded to MPIK members and appointments of MPIK scientists were also announced on the MPIK web pages.

Girls'Day 2013: Waiting for particle tracks in the self-assembled cloud chamber.

In 2011, a completely new designed and revised edition of the Institute Booklet (in German and English) was published and the descriptions of MPIK's research fields and infrastructure on www.mpi-hd.mpg.de were adapted accordingly. Further, a number of revised or new flyers about individual research topics were edited in the reporting period. The series of "MPIK-NEWS" and "MPIK-NEWS intern" have been continued. All of the printed matter can also be downloaded as pdf files from the MPIK web pages.

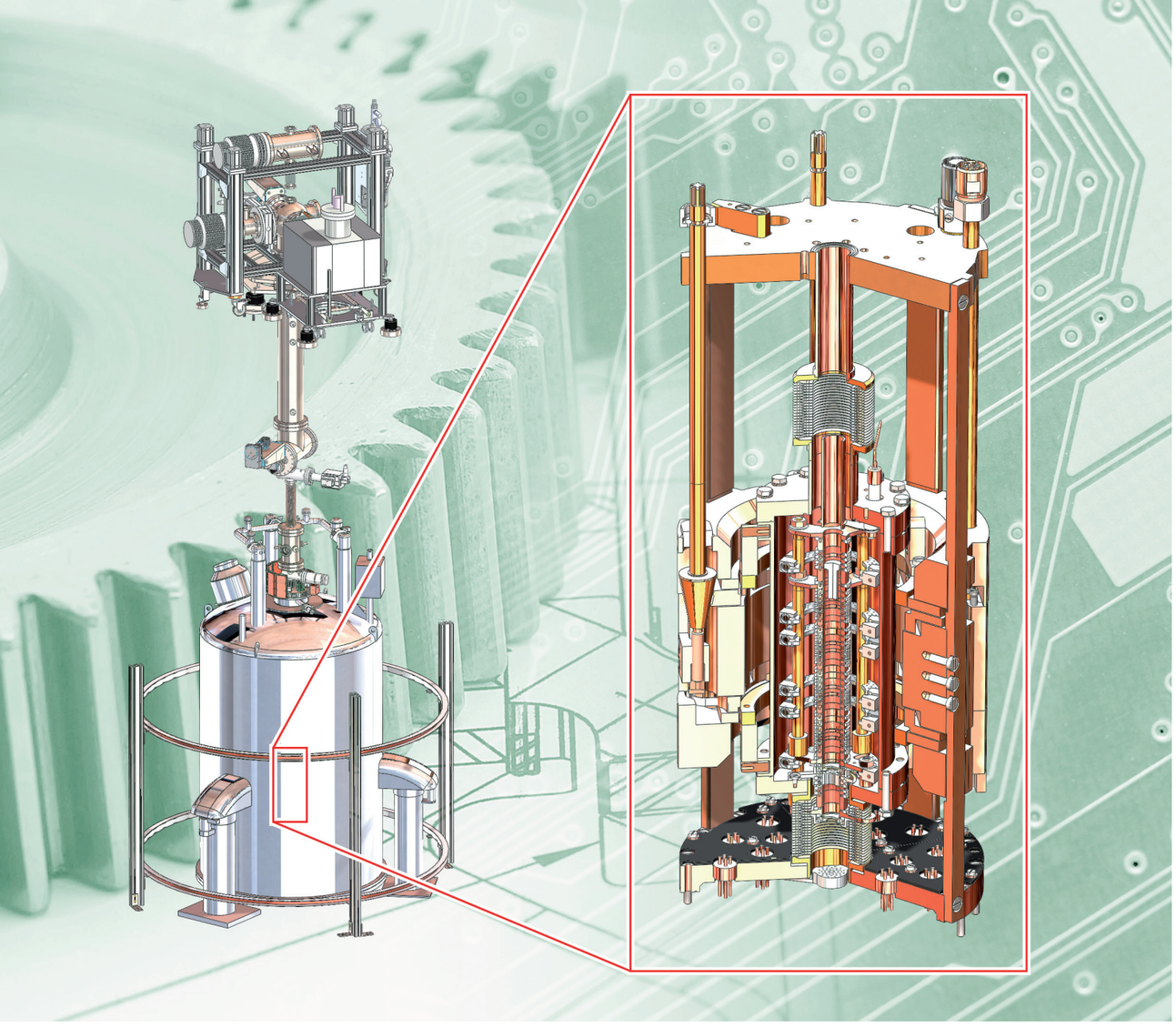
A novel concept has been developed for this Progress Report, which for the first time covers three years. Following a major reorganization of its content, the previous individual contributions have been cancelled. The present report contains solely extended overview articles, each with a title page and a list of the most important references; the annex is provided on CD only.

The showcase in the first floor of the Gentner Laboratory has been arranged combining past and present mass spectrometry research at the Institute: cosmic dust research, atmospheric physics and precision mass spectrometry using Penning traps. A number of original instruments or components and models are displayed.

In July 2012, the institute participated in the open day at the Max-Planck-Institut für Astronomie and Haus der Astronomie (HdA) on the Königstuhl in Heidelberg, presenting the H.E.S.S. project at the stationary 1:100 model, built in 2011 right to the opening of HdA, and the MPIK as a whole. The HdA, literally „House of Astronomy", is a unique centre for astronomy education and outreach in Heidelberg, operated by the Max Planck Society. The MPIK was also strongly involved in the open day at the H.E.S.S. site in Namibia and the inauguration ceremony of the H.E.S.S. II telescope in September 2012. Further, the MPIK represented the physics MPIs in Baden-Württemberg at the 61st Lindau Nobel Laureate Meeting 2012. And last but not least, scientists of the MPIK gave overall 18 public lectures at various external institutions, among them 5 talks at the HdA.

Title page of the Institute Booklet.

Bernold Feuerstein, Gertrud Hönes



3.2 Technical Units

Components of PENTATRAP, concertedly designed and manufactured by the engineering design office, the electronics and the precision mechanics shops of the Institute.

Electronics Shop

Throughout the years 2011 to 2013 many development projects have been carried out in the central electronics shop. Only glimpses will be given on the wealth of projects in oder to illustrate the variety of fields of work.

The Cherenkov Telescope Array (CTA) will employ many telescopes of 3 different sizes spread over an area of about 1 km^2 to reconstruct energy and direction of high-energy cosmic gamma rays (see Chapter 1.1). In a novel fully digital camera proposal („FlashCam“) the electrical pulses of the photomultiplier tubes (PMT) are continously digitized using commercial analogue to digital converters (ADC). In order to filter the interesting gamma-ray „snapshots“ out of the background light, the digitized data is analyzed in so-called field programmable gate arrays (FPGA). The interesting data can be readout via ethernet at very high data rate (≥3 GBytes/s) yielding a „snapshot-rate“ of a few 10s of kHz.

One key component of the FlashCam camera concept is the so-called motherboard featuring a low-cost Xilinx Spartan6™ FPGA, Gbit LAN connectivity and two slots for optional daughter cards. By adapting the firmware and plugging in specific daughter cards all different board types needed within a FlashCam camera can be setup. The FPGA-firmware has been designed as well as the motherboard, a 12 channel ADC daughter card, a DAC card. These boards are based on multilayer printed circuit boards (up to 14 layers) that require advanced design and assembly techniques. Several 10s of motherboards and ADC daughter cards have been manufactured and successfully brought into operation in 2013.

Due to its versatility the FlashCam motherboard/daughtercard system can be quite easily adapted to many other applications. For the beam position readout of the new cryogenic storage ring (CSR) one motherboard with one 12-channel ADC daughter card will be used. This application additionally makes use of a low-noise amplifier.

Another possible application could be the readoutout of the GERDA phase-II germanium detectors and PMTs. The PMT-bases of the phase-II active liquid argon szintillation veto had to be re-designed due to the extreme radiopurity requirements. Therefore, new types of components – foil capacitors instead of ceramics – had to be identified and qualified for the use inside liquid argon. Another large-scale project (STAREP) is the development of a computer-controlled voltage source system with 25 channels for ion traps like PENTATRAP. In order to fetch, store and manipulate single ions in such traps, the potentials inside the traps ranging from 0 V to 100 V have to be set precisely and kept extremly stable because voltage variations dilute the energy level measurement. Prototype versions of DAC-modules, controller, and voltage reference and supply have been connected to a trap in 2013.

STAREP as well as a steadily increasing number of other experiments at the MPIK employs LabView™ for experiment control and readout. The central electronics shop offers LabView hard- and software support and has developed many applications for the users.

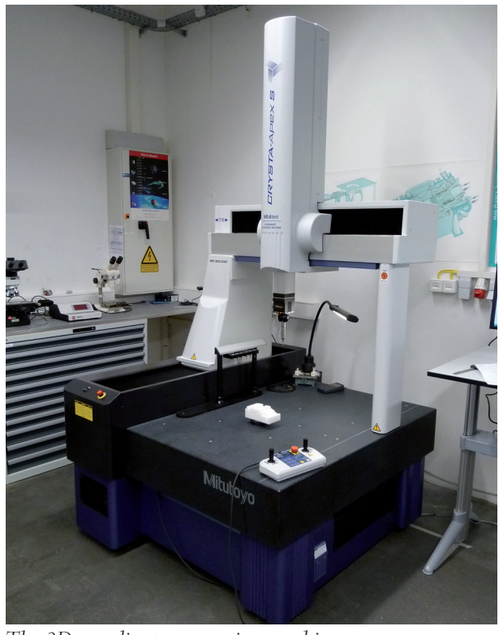
The central electronics shop has also given support at external locations. One big campaign was the installation of the H.E.S.S. II telescope drive control system at the site in Namibia. This system had been setup and tested at MPIK before and was brought into operation in spring 2012. Other external campaigns were the setup of the GERDA teststand at HADES in Belgium and the Double Chooz PMT installation in France.

Christian Bauer

Precision Mechanics Shop

During the reporting period from 2011 to 2013 a total of 27 000 working hours have been completed providing services for numerous research departments from manufacturing to the final assembly of experimental laboratory apparatus. The precision mechanics shop is staffed by 15 professionals who produce high-precision equipment tailored to the needs of the research groups by using CNC machines or even meticulously handcrafting certain parts. The machinists are thoroughly trained and educated as well as highly skilled and very knowledgeable. They periodically receive ongoing training through specific and intensive upgrade courses. New staff is usually recruited among the apprentices of the Institute's precision mechanics shop after their graduation. Right from the beginning of their vocational training these apprentices are required to become acquainted with regular tasks of the precision machine shop.

Panoramic view of the new workshop room equipped with the two CNC lathes (left CTX 320 and right CTX 800) and the CNC 5-axis milling machine DMU 80 Monoblock (center).



The 3D coordinate measuring machine.

Since the development of laboratory devices for science is highly complex, the management decided in 2011 to expand the CNC section by investing into CNC equipment. Two CNC lathes and a CNC 5-axis milling machine were purchased and installed in a purpose-built room. In addition a CAM system was implemented thus facilitating the programming of CNC machine tools. Using the CAM system, computer-generated design is fed directly into the manufacturing system of the CNC machines. This new approach resulted in creating a faster production process and in improving the quality.

In the interest of quality control a 3D coordinate measuring machine has been recently purchased. This machine permits the user to make automated measurements of high-precision workpieces in one setting. The results are output in the form of CAD data and may be checked and compared with the design data or with the 3D master model manufactured in the engineering design office. The results also enable the scientists to check the accuracy of their calculations thus helping them to decide whether adjusting or amending is needed.

Thorsten Spranz

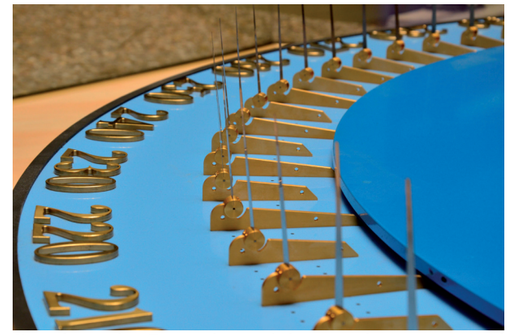
Apprenticeship Workshops

During the years 2011 through 2013 twenty-one apprentices of both the electronics shop and the precision mechanics shop have successfully completed their vocational and practical training. For five of them this led to a permanent job.

Based on excellent performance during the apprenticeship programme two apprentices received the apprentice award of the Max-Planck-Gesellschaft. In addition to that two apprentices came in first at a competition hosted by the district chamber of crafts and one apprentice even won first place at a competition hosted by the state chamber of crafts.

Both apprenticeship workshops, in close cooperation with the central shops did provide high quality assistance and service in the support of scientific projects and research.

The excellent collaboration of both apprenticeship workshops resulted in the restoration of the Foucault Pendulum located at the Astronomical Centre of the Helmholtz-Gymnasium in Heidelberg. In large parts the Pendulum has been newly designed, crafted and installed and equipped with a newly developed control system.



Details of the Foucault pendulum in the astronomical teaching centre of the Helmholtz Gymnasium.

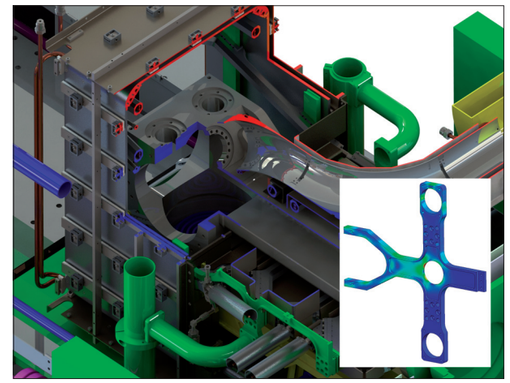
Stephan Flicker, Jochen Stephan

Engineering Design Office

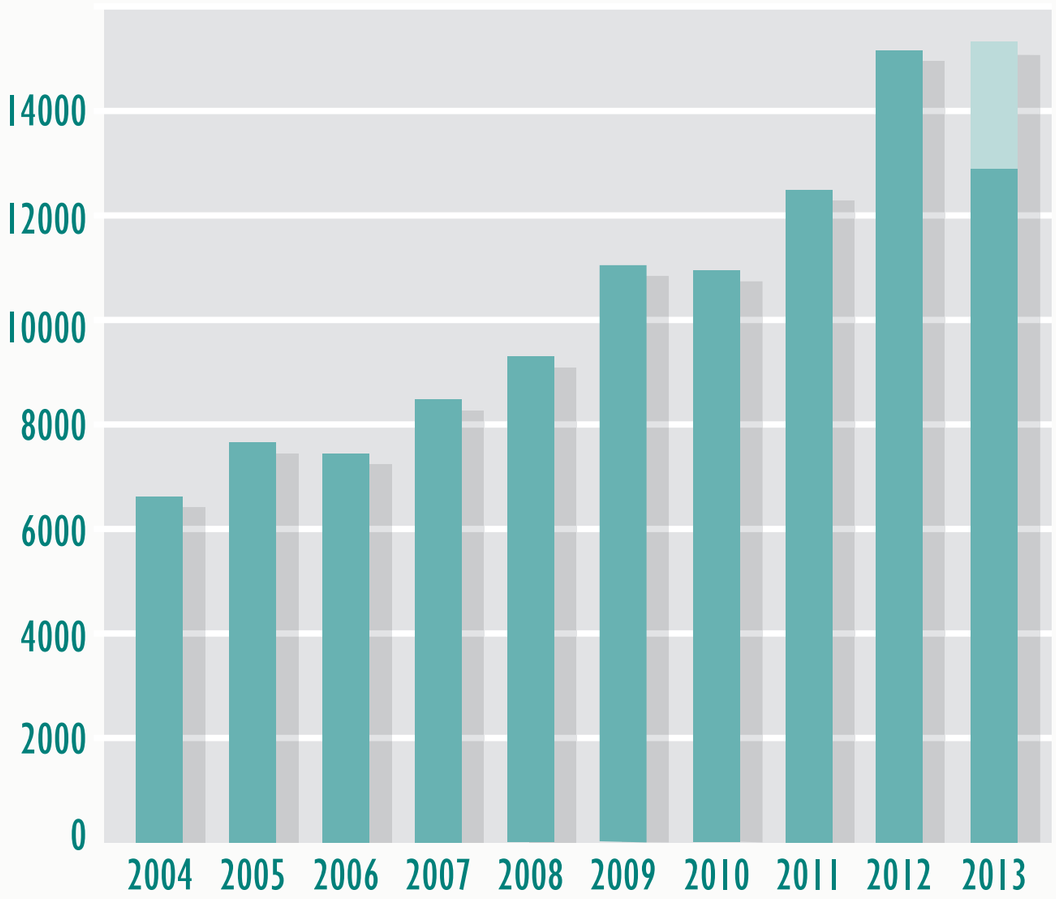
A large number of mechanical components for a diversity of projects of all the experimental divisions of the Institute have been constructed in the engineering design office. Major construction tasks that could be finalized in the reporting period were, among others, the projects CSR (Chapter 2.3), PENTATRAP (Chapter 2.1), H.E.S.S. II (Chapter 1.1), GERDA (Chapter 1.4), and GeMPI3 (Chapter 1.4).

3D assemblies and parts were modelled using the CAD software ‚SolidWorks' and ‚SolidWorks-Simulation' was the standard tool for calculations. Besides enineering drawings, also 3D models of the components were delivered to the workshops in order to optimize the programming of the manufacturing machines with the aid of compatible CAM software.

Thomas Weber



Details of the design study of the CSR electron cooler.



*) Source: ISI Web of Science™, November 2013

estimated

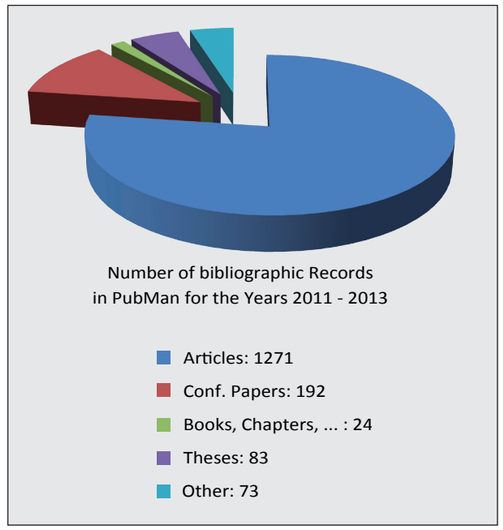
3.4 Statistics

Numbers of citations per year of papers by MPIK authors; from Web of Science together with an estimation for 2013.

Publications

The number of publications by MPIK scientists per year increased during the reporting period from around 300 in 2005 to 2010 now reaching 370–410. Out of the 1127 publication filed in Web of Science as of end of November 2013, the following numbers of papers were published in the most favoured journals:

Journal	Number of papers
Physical Review Letters	118
Physical Rewiew A	102
Physical Rewiew D	84
Journal of High Energy Physics	71
Physics Letters	66
Astrophysical Journal	61
Astronomy & Astrophysics	55
Monthy Notices of the Royal Astronomical Society	38
Journal of Physics Conference Series	35
European Physical Journal C	32
Nuclear Instruments Methods in Physics Research A	28
AIP Conference Proceedings	25
Physical Rewiew C	25
…	
Nature, Nature Methods, Nature Communications, Nature Photonics	16
Science	9



Theses

	2011	2012	2013
Bachelor theses	31	18	15
Master theses	2	19	26
Diploma theses	21	12	0
Dissertations	26	33	30
Habilitations	2	0	0

International Max Planck Research Schools

The MPIK is involved in three International Max Planck Research Schools (IMPRS). Two of them are organized by the institute, while the third one is coordinated by the MPI for Astronomy. The latter is an independent part of the Heidelberg Graduate School of Fundamental Physics (HGSFP) at the University of Heidelberg. The physics students of the two other IMPRS are also included in the HGSFP.

IMPRS-QD: quantum dynamics in physics, chemistry and biology
spokesperson: Christoph H. Keitel
coordinator: Antonino Di Piazza
institutions: MPIK, Heidelberg University, German Cancer Research Center, MPI for Medical Research, GSI Helmholtzzentrum für Schwerionenforschung (Darmstadt)

	2011	2012	2013
PhD students	42	38	37
female	9	8	8
from foreign countries	24	19	19
funded by IMPRS-QD	32	23	18
graduations	10	15	9

IMPRS-PTFS: precision tests of fundamental symmetries
spokespersons: Manfred Lindner and Klaus Blaum
coordinator: Werner Rodejohann
institutions: MPIK, Heidelberg University

	2011	2012	2013
PhD students	22	27	29
female	5	6	8
from foreign countries	9	12	10
funded by IMPRS-PTFS	15	17	17
graduations	1	3	3

IMPRS-HD: astronomy and cosmic physics @ MPIA
At the end of the reporting period, 6 PhD students (4 female, 5 from foreign countries) are working at the MPIK.

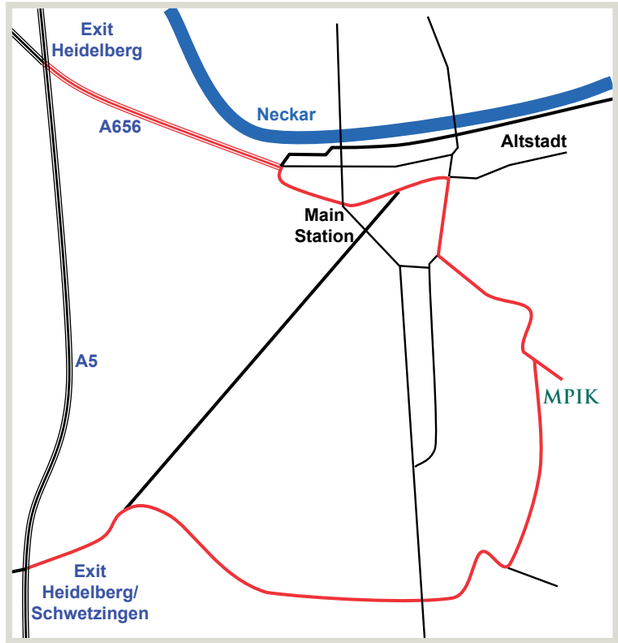
Institutional Collaborations

MPIK researchers participate in a large number of institutional collaborations, in part in a leading role – throughout the reporting period overall 69 projects. By far the biggest collaboration is CTA with presently 173 institutes from all over the world and led by Werner Hofmann. The second largest consortium is SPARC (108 institutes), followed by LHCb (66 institutes), FLAIR, NUSTAR (both 46 institutes), and H.E.S.S. (41 institutes). On the other hand, there are 35 collaborations with only one or two partner institutes.

Annex on CD

Complete lists of publications, invited talks, lectures and courses at universities, jointly organized conferences and workshops, habilitations, dissertations and theses, as well as institutional collaborations can be found on the accompanying CD.

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 via Mannheim or the Lufthansa Airport Shuttle to Heidelberg which arrives at Crowne Plaza hotel, Kurfürstenanlage 1. Continue with a taxi or bus 39 from station "Hans-Böckler-Straße" in Rohrbacher Straße.

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