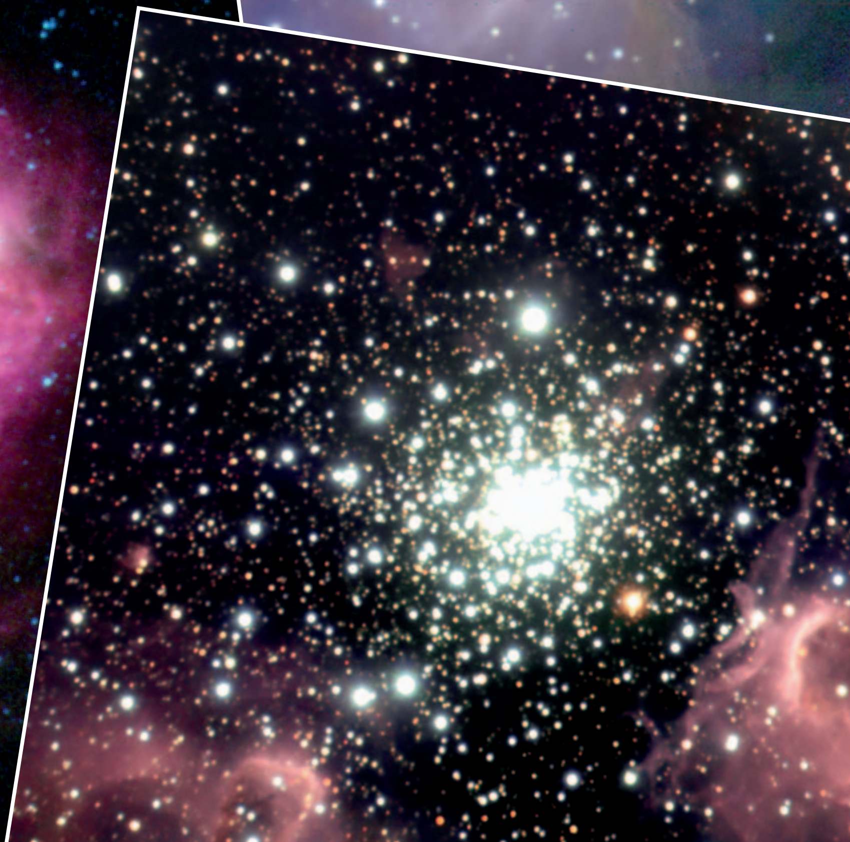
Max Planck Institute for Astronomy

Heidelberg-Königstuhl

Annual Report 2012



Cover Picture:
Top: Luci near-infrared JHK color-composite of W3 Main. *Bottom left:* Color composite of Spitzer data of the embedded cluster RCW 34 and its surrounding bubble (blue: 3.6 micron, green: 4.5 micron, red: 8 micron). *Bottom right:* Near-infrared JHK color composite of starburst cluster NGC 3603 and immediate surroundings.
For details on the topic "Massive Star Formation in different environments" see Chapter III.1 (page 41)

Credits: Top and bottom left: Arjan Bik, MPIA; bottom right: Bernhard R. Brandl, Sterrewacht Leiden

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Max Planck Institute for Astronomy

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Preface

This Annual Report describes the scientific activities at the Max Planck Institute for Astronomy (MPIA) in Heidelberg. It is intended for our colleagues worldwide as well as for the interested public.

In addition to presentations of recent scientific results, we also report in more depth on a few selected research areas at MPIA and on some of our ambitious instrumentation projects. Furthermore, some other activities and highlights of the life at our institute are presented.

This year has brought a rich scientific harvest on topics ranging from the structure of the universe to stars and exoplanets. There was also excellent, steady progress on crucial, observing facilities and regular science observations.

For our Center for Astronomy Education and Outreach, the Haus der Astronomie, 2012 was the first full year of regular operation in the new, galaxy shaped building. And this striking building was clearly one of the magnets for attention during our open house day in July with thousands of visitors on the MPIA campus.

We hope that this annual report, edited by Klaus Jäger, Markus Pössel and Axel M. Quetz, will give the reader a flavour of the research, work and life at our institute and we would like to thank all authors who have contributed to this issue.

Thomas Henning, Hans-Walter Rix

Heidelberg, November 2013

I. General

I.1 Scientific Goals

Astrophysical Research at the Max Planck Institute for Astronomy (MPIA, see Fig. I.1.1) is aimed at exploring and understanding the nature and evolution of planets, stars, galaxies and the universe as a whole. This is pursued through the development and operation of telescopes and their instrumentation, by designing, executing and analysing observing programs and surveys, and by connecting the physical nature of the observed phenomena through theoretical studies and numerical simulations. The MPIA focuses its observational capabilities on the optical and infrared spectral regions, taking a leading role in both groundbased and space-based instrumentation.

Scientific research at MPIA is organized within two research departments: Planet and Star Formation and Galaxies and Cosmology.

In addition to the staff in these departments, the Institute hosted in 2012 five Independent Research Groups (two Emmy Noether groups supported by the German Science Foundation DFG, and two groups supported by the Max Planck Society, MPS, and one group supported by the MPS and the Humboldt Foundation).

Over the course of the year 2012, there were a total of about 65 postdoctoral stipend holders, about 86 PhD students, and 15 diploma and master's students and student assistants working at the institute.

Strong ties exist between MPIA and the University of Heidelberg, with its Center for Astronomy (ZAH), both in research and teaching, for example through the International Max Planck Research School (IMPRS) for Astronomy and Cosmic Physics.

The main research fields of the two departments are complementary in both scientific and practical terms. Obviously, star formation is a critical aspect of the formation and evolution of galaxies, and the instrumen-

Fig. I.1.1: A spectacular view of the MPIA campus with the main building (left of center), the "Haus der Astronomie" with its spiral shape and the Elsässer Laboratory with its two telescope domes to the right. On the top left of the image a part of the Landessternwarte can be seen.

Credit: Sebastian Egner

tation capabilities required by both departments share strong commonalities: e.g. requirements for high spatial resolution, powerful survey capabilities, and the importance of access to the infrared and millimeter spectral regions.

Galaxies and Cosmology

The "Realm of Galaxies"

Shortly after the Big Bang, the Universe was rather "simple" and nearly homogeneous. Now it is beautifully complex, with rich "hierarchical" structure over a wide range of physical scales: from the filamentary distribution of galaxies on large scales (the "cosmic web") to galaxies themselves, down to clusters of stars, individual stars, and their planets. The formation of this wealth of structure appears to be driven by gravitational instabilities, but to make things 'work' these instabilities must arise in good part from a dominant, but yet to be identified, dark matter component.

The galaxies we observe in the present-day universe represent a central layer in this hierarchical order, each consisting of millions to billions of stars, gas, and dust, all embedded in halos of dark matter. As Edwin Hubble already realized 80 years ago, these "island universes" do not show the full variety of morphology (or visual appearance) and structures that seem physically possible. On the one hand, the variety of galaxies seems vast: galaxies as an object class span ten orders of magnitude in their stellar masses, and the rate of new star formation varies similarly; the physical sizes of different galaxies still vary by a factor of 100. While some galaxies apparently do not have a black hole at their centers, in other galaxies this central black hole has the mass of more than one billion suns. On the other hand, observations have shown, particularly in the last 15 years, that only a small fraction of the possible combinations of the characteristic galactic quantities (stellar masses and ages, size, central black hole, etc.) are actually realized in the universe. Virtually all physical properties strongly correlate with all other properties: massive galaxies are large; massive galaxies contain virtually no young stars; the central black hole contains a constant mass fraction of the spherical star distribution ten million times its size. While spiral galaxies are the most common galaxy type, no such galaxy is among the most massive ones.

This means that the "realm of galaxies", as Hubble called it, shows a high degree of order. How this order developed from the random mass fluctuations existing after the Big Bang is a fundamental question of galaxy formation and a central issue of cosmology.

There are three broad lines of explanation for the limited variety in the zoo of galaxies: Either, observed galaxies represent the only stable configurations. Alternatively, the cosmological initial conditions only permit the formation of the galaxies we see. Or, the overall process of galaxy formation results in a limited set of outcomes because it is very much self-regulating.

What questions would we like to answer?

Many of the projects that the MPIA researchers are pursuing ultimately address when and where these three mechanisms play a role. Some of the specific questions being discussed by researchers in this department are:

- During which cosmological epoch did most of the stars form?
- Is cosmic star formation now coming to its end? Why has the star formation rate declined over the last six billion years?
- Which galaxies reside in which dark matter halos?
- How did the central black holes in galaxies form and grow?
- Why is it possible to predict the properties of the small-sized central black hole from the overall size of a galaxy?
- Which processes determine the structure and morphology of galaxies and when do these processes occur?
- What is the state of the interstellar medium, the raw material from which new stars form?
- What is the state of the intergalactic medium, in the space between galaxies, where most of the atoms in the univere reside?
- Can the various observations be understood ab initio within a comprehensive model?
- How did the Milky Way, our Rosetta Stone of galaxy evolution, form?

What do we do to find the answers?

The approaches used at the MPIA to tackle these questions comprise three aspects: the detailed study of galaxies in the present-day Universe; the direct study of galaxies at earlier cosmic epochs through the observation of distant (high-redshift) objects; and the comparison of observations with physical models. The observational capabilities for the field require survey telescopes, large telescopes for sheer photon collecting power on faint sources, and particular techniques such as Adaptive Optics and Interferometry to achieve high spatial resolution. Comprehensive studies of galaxy evolution require observations from the X-rays to the radio wavelengths.

The MPIA has been an important partner in several of the surveys that have brought, or promise to bring, breakthroughs in these areas: the PanStarrs-1 survey which has successfully started in 2010; the Sloan Digital Sky Survey (SDSS) and Segue for the Milky Way and Local Group; complemented since 2008 by the LBC cameras at the LBT; the 2.2 m telescope on La Silla has enabled the Combo-17 galaxy evolution survey; the VLT and the LBT are used to follow-up this survey work; the Irac and

Mips instruments on the Spitzer Space Telescope; and the Pacs Instrument of the Herschel mission to study star formation and the interstellar medium, complemented by the VLA, the Plateau de Bure Interferometer, Apex and soon Alma at radio and sub-millimeter wavelengths. The Galaxies and Cosmology department truly carries out multi-wavelength astrophysics.

Planet and Star Formation

The link between stars and galaxies

The formation of stars is a fundamental process in the Universe, shaping the structure of entire galaxies and determining their chemical state. The formation of individual stars can be best studied in nearby molecular clouds. The study of star formation in other galaxies allows us to understand this process under physical conditions which can be very different from those in the Milky Way. Our studies of star formation in the Magellanic Clouds allow an investigation of the effect of metallicity on the star formation process, which is certainly an important factor in understanding star formation in the early Universe. Stars are born in the dense and cold cores of molecular clouds, which become gravitationally unstable and, in general, fragment to form binaries and multiple stellar systems. The role of magnetic fields

Fig. I.1.2: Watching a tiny galaxy grow – the dwarf galaxy NGC 4449 (*top left*) and the even tinier galaxy it is about to gobble up (*bottom right*).

Credit: R. Jay GaBany (Blackbird Observatory) in collaboration with David Martínez-Delgado (MPIA)

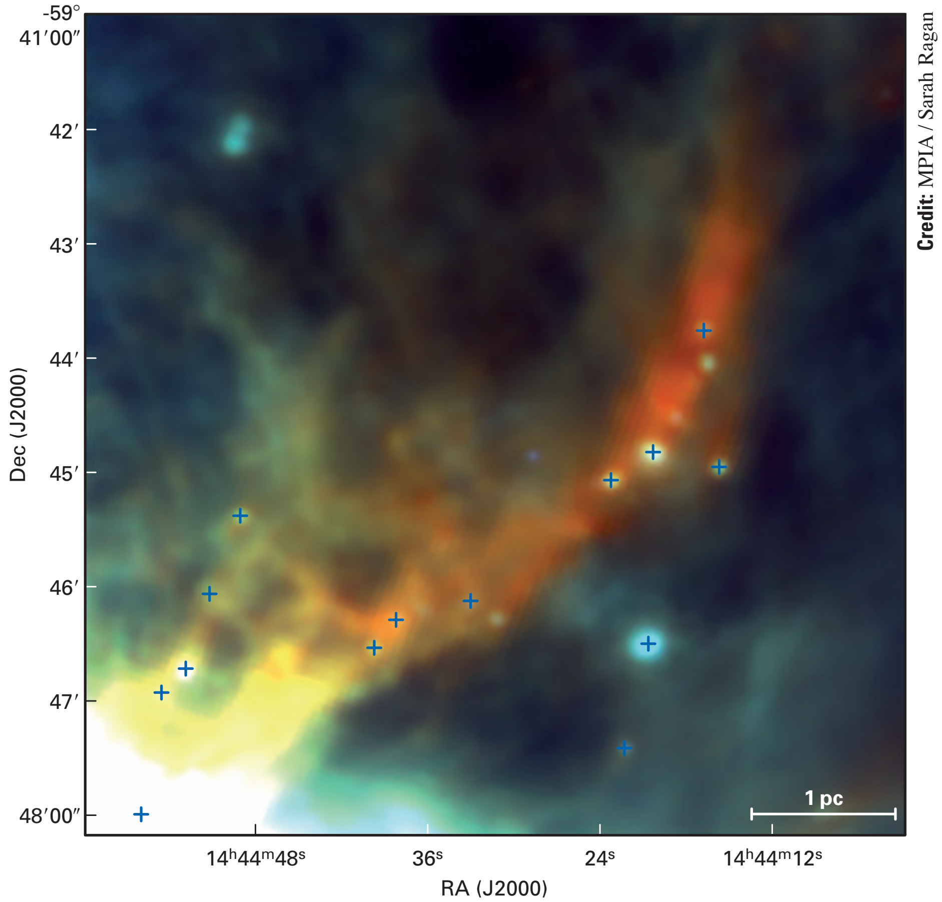


Fig. I.1.3: A false-color image of the molecular cloud IRDC316.72+0.07. Each "+" symbol indicates the presence of a protostellar core: a region that has started to collapse, but has not yet formed a new-born star. This is the first time these early stages of star formation have been observed. The image shows far-infrared data taken with the PACS instrument aboard the HERSCHEL Space Telescope (70 µm [blue], 100 µm [green], and 160 µm [red]. See also chapter II.2. for details.

or turbulence in controlling the onset of star formation remains one of the open key questions. This question is immediately related to the shape of the initial (sub-)stellar mass function in different environments. Dynamical interactions in multiple systems may be a crucial factor for the formation of Brown Dwarfs. Massive star formation takes place in clusters, leading to complex star-forming regions. The rapid evolution of massive protostars and the associated energetic phenomena provide an enormous challenge in identifying the formation path of massive stars.

Looking behind the curtain…

The earliest phases of star formation are obscured by enormous amounts of dust and gas and can only be detected by sensitive far-infrared and (sub-) millimeter observations. At later evolutionary stages, the objects "glow" at near- and mid-infrared wavelengths, and finally become visible at optical wavelengths. Our observing programs cover a wide range of wavelengths with a special emphasis on infrared and (sub-) millimeter observations.

The formation of planets and planetary systems is a natural by-product of low-mass star formation. Because of angular momentum conservation, accretion of matter onto the central protostar happens predominantly through a circumstellar disk. Disks around T Tauri stars are the natural birthplaces of planetary systems, resembling the solar nebula 4.5 Gyr ago. During the active accretion phase, bipolar molecular outflows and ionized jets are produced, which in turn play an important role in the evolution of star-disk systems. We are presently starting to use protoplanetary disks as laboratories for understanding the formation of our own solar system and the diversity of other planetary systems detected so far.

The research of the Planet and Star Formation department is focused on the understanding of the earliest phases of stars, in both the low and high stellar mass regime. Observations with space observatories such as SPITZER, HST and HERSCHEL, as well as ground-based infrared and (sub-) millimeter telescopes, allow the detection and characterization of massive protostars and their subsequent evolution. The vigorous use of submillimeter facilities is preparing the department for the Atacama Large Millimeter Array (ALMA), which will soon commence operation.

The investigation of Brown Dwarfs, which were first detected in 1995, is another important research topic. How do Brown Dwarfs form? Are young substellar objects also surrounded by disks? What is the binarity fraction and the exact mass of these objects? What is the composition of their atmospheres? These are among the burning questions which are attacked by MPIA scientists.

The formation of planetary systems and the search for other planets

With the detection of the first extrasolar planets, the study of planet formation in protoplanetary disks entered a new phase of explosive growth. The department is well-positioned to play an important role in these studies, with a combination of infrared and sub–millimeter observations, numerical (magneto-)hydrodynamical simulations, and radiative transfer studies. Imaging with the Hubble Space Telescope and the wealth of data from the Spitzer Telescope and since 2009 from Herschel is providing new insights into the earliest stages of planet formation. Improved spatial resolution from our adaptive optics program, infrared interferometry with large telescopes and long baselines, and the use of millimeter interferometers provide insights into the disk structure and the evolution on spatial scales relevant to planet formation. Gas evolution in disks is studied by high-resolution infrared spectroscopy and the accretion behaviour by multi-object spectroscopy.

We have started new observing programs to search for extrasolar planets through direct imaging, the transit technique, and astrometry. With the Spectral Differential Imaging facility (SDI) at the VLT, we provided a new mode for high-contrast imaging with the adaptive optics instrument Naco. This system presently outperforms any other similar device in the world and was paving the way for the development of Eso's Sphere instrument, where MPIA is Co-PI institute. The department actively participates in the planet search program Seeds with the Subaru telescope on Mauna Kea (Hawaii).

The theoretical program of the PSF department focuses on complex numerical simulations of protoplanetary disk evolution, including the interplay between radiation, dynamics, chemistry, and grain evolution. The study of the formation of massive stars constitutes another topic for theoretical studies. Multidimensional radiative transfer codes, both for molecular lines and the dust continuum, have been developed in the department. These theoretical studies are also well integrated with the various observational key projects.

The understanding of many of the microphysical processes and the composition of dust and gas requires dedicated laboratory studies. Such a laboratory astrophysics unit is part of the Planet and Star Formation department, and is located at the Institute for Solid-State Physics of the University of Jena. This group investigates the spectroscopic properties of nanoparticles, as well as molecules, especially PAH's, in the gas phase.

I.2 Observatories, Telescopes, and Instruments

MPIA has been a key driver and partner in the construction and operation of two large ground-based observatories – the Centro Astronomico Hispano Aleman in Spain and the Lange Binocular Telescope in Arizona.

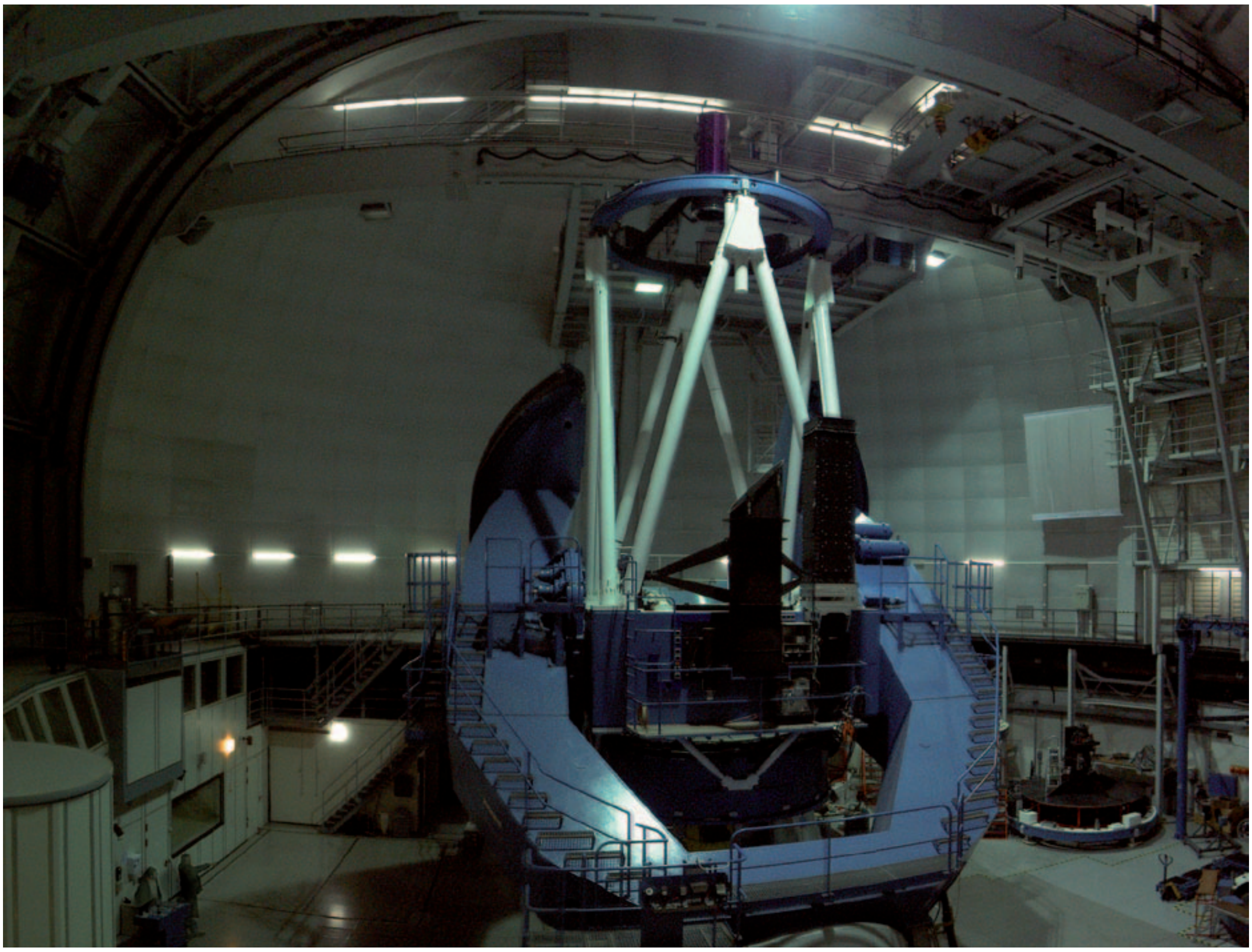
Centro Astronomico Hispano Aleman (CAHA)

During the 1970s and 1980s the construction of the Calar Alto Observatory with its 2.2 m and 3.5 m telescopes had been the central focus of the MPIA. Since 2004 the observatory is jointly operated as Centro Astronomico Hispano Aleman (CAHA) by the Max Planck Society, represented by the MPIA, and the Consejo Superior de Investigaciones Científicas (CSIC), represented by the Instituto de Astrofísica de Andalucía (IAA), as an organization of Spanish law.

Large Binocular Telescope (LBT)

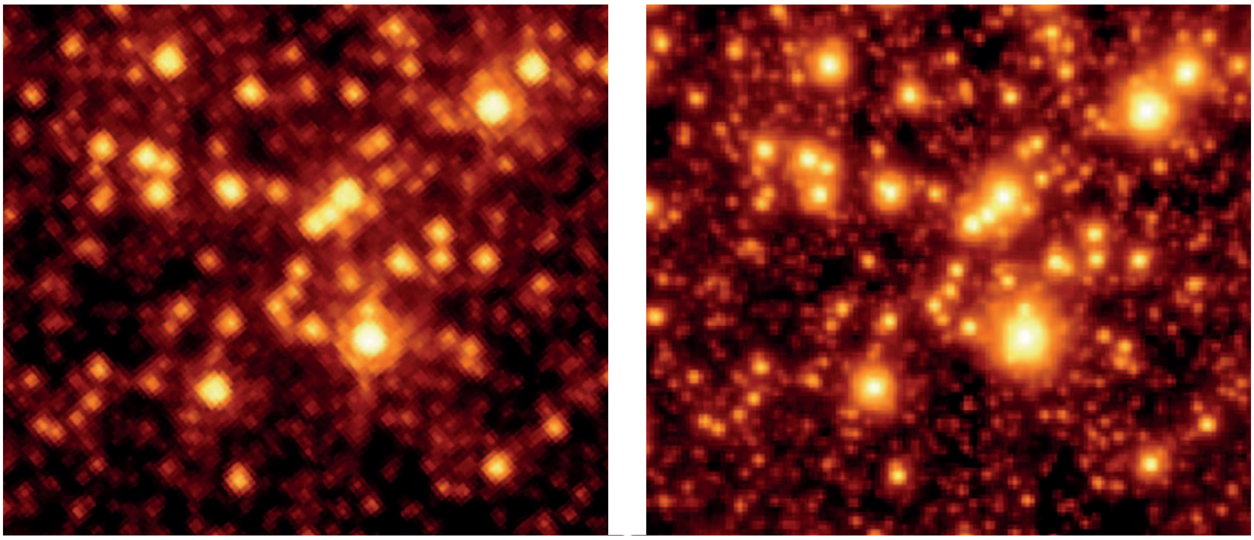
Since 1997, the MPIA has been the coordinating institute for the German participation in the Large Binocular Telescope (LBT) on Mt. Graham near Tucson, Arizona. By the end of 2007, the second prime-focus camera was installed which is now used for regular science programs. The year 2008 has seen the installation and the beginning of the commissioning of the first of the two LUCI instruments, jointly built by the Landessternwarte of the Center for Astronomy of Heidelberg University (ZAH), the MPIA, and the MPE. Additional contributions were also made by the Ruhr University Bochum and the Fachhochschule Mannheim. Science demonstration observations with this near-infrared multi-object spectrometer have commenced in December 2009 and at the beginning of 2010 the first excellent spectra and images have been published. Furthermore, the first adaptive secondary mirror for the LBT started its operation in 2010 and hence the first "sharper than HUBBLE"

Fig. I.2.1: View into the dome of the 3.5 m-Telescope at CAHA.



Credit: Boris Häusler

Credit: LBTO



near infrared LBT-images (see above) could be released. The MPIA also uses its 2.2 m telescope on La Silla, Chile, operated by the European Southern Observatory (Eso). As of April 1st 2009 in a new agreement between the MPG and Eso, the amount of time available at this telescope for MPG researchers has been increased from 25 to 75 percent.

Fig. I.2.2: One of the first test images (*right*) taken with the adaptive optics at the Large Binocular Telescope as compared to an image of the same region by the Hubble Space Telescope. The better resolution of the LBT image is clearly visible. Both images of a region in the globular cluster M 92 are taken at 1.6 µm (near-infrared) wavelenght.

Ground Based and Space Based Observatories

The MPIA has a prominent and successful tradition of developing and building instruments for ground-based and space-based astronomical observations. Such observations are, almost by necessity, complementary. Ground-based telescopes usually have larger mirrors and therefore more light-gathering power than space telescopes. By using cutting-edge techniques such as adaptive optics and interferometry – which the MPIA has played a leading role in developing – they can also achieve higher angular resolution. Space telescopes, on the other hand, are the only way to carry out observations in wavelength regions where our atmosphere absorbs the radiation or generates a bright background, as is the case, for example, in wide regions of the infrared spectral regime.

Since the pioneering days of infrared astronomy in the 1970s, the MPIA has been a leading instrument developer for this field of astronomy. In particular, the construction and implementation of Isophot aboard Iso, the first Infrared Space Observatory of the European Space Agency Esa, was led by the MPIA. From 1996 to 1998, it acquired excellent data, particularly in the previously inaccessible far-infrared range. The knowledge gained with Iso was the basis for MPIA's prominent role in ongoing space projects such as the Herschel Space Observatory and the James Webb Space Telescope (JWST). Astronomers at the MPIA are also actively participating in legacy science programs with the Spitzer Infrared Observatory.

At the end of 2009 Herschel has provided the first data obtained within a number of key science programs with MPIA participation. During 2010 and within the regular operation, the first scientific papers based on excellent Herschel data have been published in a dedicated Astronomy & Astrophysics special issue. And thanks to a trouble-free operation, Herschel provides us until now with excellent data.

Worldwide Collaborations

The new generation of instruments for 8 m class telescopes and space missions are too large and expensive to be built by a single group, such as the MPIA. At present, the Institute is therefore participating in, or leading a number of international collaborations for building scientific instruments for new large telescopes, thereby gaining access to the world's most important observatories. An example in the southern hemisphere is the Eso Very Large Telescope (VLT) in Chile, with its four 8 m telescopes that can be linked to form a powerful interferometer. In the northern hemisphere, MPIA is participating in the Large Binocular Telescope (LBT) in Arizona. This extraordinary telescope is equipped with two mirrors of 8.4 m diameter each, fixed on a common mount, making it the world's largest single telescope. With the current routine scientific use of the two prime focus cameras and the near-infrared multi-object spectrograph Luci-1 in December 2009, the LBT has become a productive world-class observatory.

In 2007, MPIA became the University of Hawaii's largest Partner in the international Pan-Starrs1 (PS1) project, which grants full access rights to the data from a 1.8 m wide-field telescope on Haleakala/Maui (Hawaii) with a new 1.4 Gigapixel camera – the largest digital camera ever built. Since 2010, PS1 provided MPIA scientists with regular survey data.

These collaborations enable MPIA astronomers to observe the northern and the southern sky with first class telescopes. At the same time the MPIA is participating in studies for the instrumentation of next-generation large telescopes, the so-called Extremely Large Telescopes (ELTs).

Instrumentation for Ground-based Astronomy

The currrent activities of the MPIA in the area of ground-based instrumentation concentrate on interferometric instruments for the Eso VLT Interferometer (VLTI), high-fidelity imaging instruments for the LBT and the VLT, and survey instruments for Calar Alto. The MPIA is also involved in studies for future instruments for the European ELT (E-ELT).

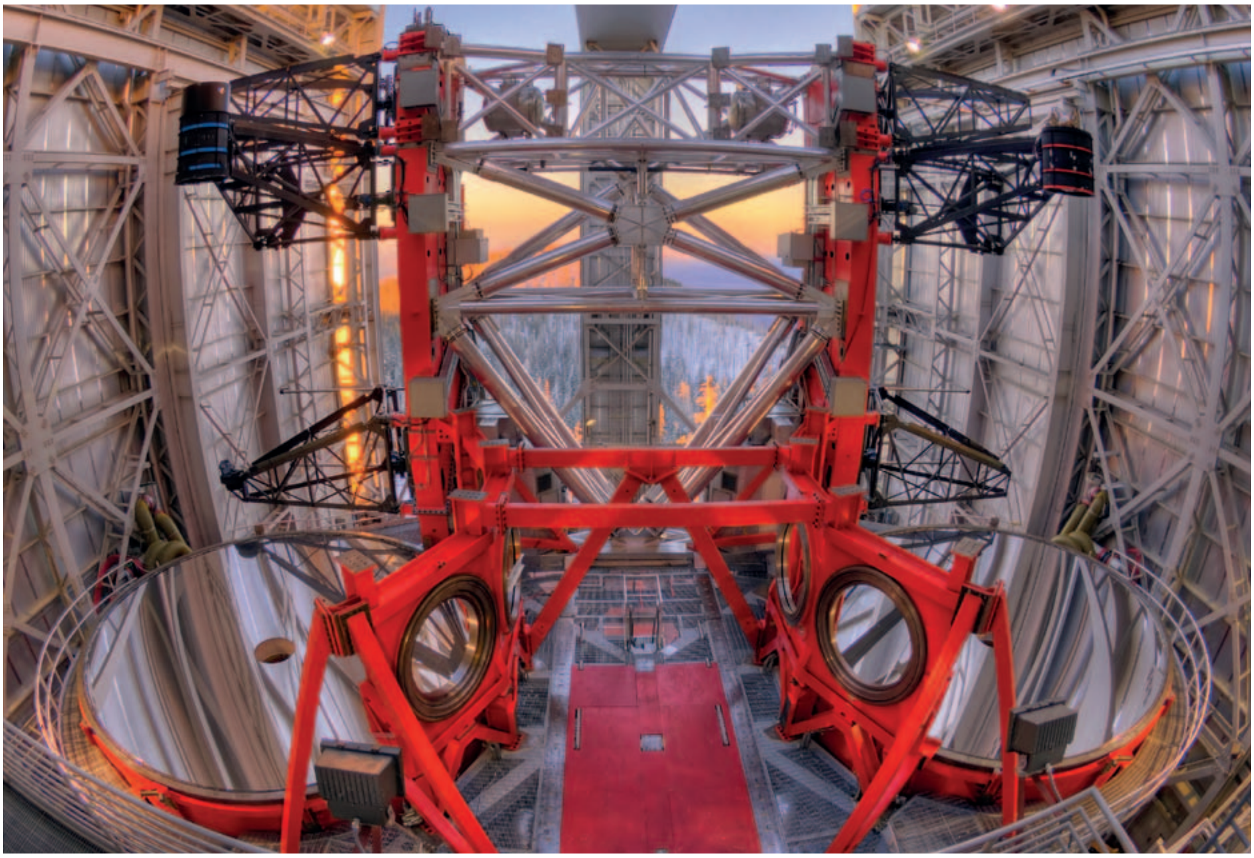
VLTI instrumentation

In September 2008, the differential delay lines for the dual-feed VLTI system Prima were installed on Cerro Paranal, Chile. These units were built by the MPIA together with Geneva Observatory and the Landessternwarte Heidelberg. Prima is now in its active commissioning phase. In the related science project Espri, the differential delay lines will be used in the combined K-band light with two 1.8 m VLT Auxiliary Telescopes, in order to measure the separation of a stellar target from a reference star with micro-arcsecond precision. The goal is the dynamical determination of the masses of extrasolar planets by precise astrometric measurements of the orbital reflex-motions of planetary host stars.

MPIA is participating in the second-generation VLTI projects Matisse and Gravity. Matisse is a successor of the very successful Midi instrument built by the MPIA which has been in operation on Paranal since September 2003. The Matisse consortium consists of nine institutes led by the Observatoire de la Côte d'Azur. Matisse will combine the light from all four VLT 8.2 m telescopes in the mid-infrared for high spatial resolution image reconstruction on angular scales of 10 – 20 milliarcseconds. The scientific applications range from studies of Active Galactic Nuclei (AGN) to the formation of planetary systems and of massive stars, and the study of circumstellar environments.

Gravity is the successor of Prima. Like Matisse it will combine four VLT 8.2 m telescopes, but in the

Fig. I.2.3: Fisheye image with high dynamic range of the Large Binocular Telescope.



Credit: Marc-Andre Besel, Wiphu Rujopakarn / LBTO near-infrared. The Gravity consortium is led by MPE Garching; the partners include MPIA, l'Observatoire de Paris, and the University of Cologne. Assisted by a high-performance adaptive optics system, Gravity will provide precision narrow-angle astrometry and phase referenced imaging of faint objects over a field of view of 2″. This will permit astronomers to study motions to within a few times the event horizon size of the massive black hole in the Galactic Center, and potentially test General Relativity in its strong field limit. Other applications are the direct detection of intermediate mass black holes in the Galaxy, dynamical mass determinations of extrasolar planets, the origin of protostellar jets, and the imaging of stars and gas in obscured regions of AGNs, star forming regions, or protoplanetary disks.

High-resolution cameras

After its integration at MPIA, Luci 1, the first of two identical mid-infrared cryogenic imaging cameras and multi-object spectrographs for the LBT, was shipped to Mt. Graham in August 2008, followed by phases of installation and commissioning. This instrument built together with the Landessternwarte Heidelberg, the MPE Garching, the University of Bochum, and the Fachhochschule for Technology and Design in Mannheim, has become ready for scientific exploitation in December 2009. It provides a $4' \times 4'$ field-of-view in seeing limited mode. At the beginning of 2010 the first excellent spectra and images have been published. With the adaptive secondary mirrors (the first one was installed at the LBT in 2010), diffraction-limited performance can be expected for the two Luci instruments over a field of about $0\rlap{.}'5 \times 0\rlap{.}'5$ (see figure I.2.2 on page 12). Adaptive optics will also permit users to achieve spectral resolving powers of several tens of thousands. Scientific applications for the multi-mode Luci instruments are many, including studies of star formation in nearby galaxies.

The by far largest instrumentation project at the MPIA is the near-infrared beam combiner Linc-Nirvana for the LBT, which presently is being assembled at the institute. As the PI institute, the MPIA leads a consortium with the Italian Observatories (Inaf), the MPIfR Bonn, and the University of Cologne. Linc-Nirvana is currently undertaking integration and testing at the MPIA as the various subsystems provided by the different project partners are being delivered. By coherent combination of the two LBT primary mirrors via Fizeau interferometry, Linc-Nirvana should provide diffraction-limited imaging over a $10\rlap{.}''5 \times 10\rlap{.}''5$ field of view in the 1 – 2.4 μm

Fig. I.2.4: The Very Large Telescope (VLT) site in the Atacama Desert in Chile at sunrise.

Credit: Eso

regime, with the spatial resolution of a 23 m telescope. Multi-conjugated adaptive optics with up to 20 natural guide stars will ensure large sky coverage. Due to the panoramic high-resolution imaging and astrometric capabilities of LINC-NIRVANA, scientific applications range from supernova cosmology, galaxy formation, and extragalactic stellar populations and star formation, to extrasolar planets, stellar multiplicity, the structure of circumstellar disks, and the imaging of solar-system planets and their atmospheres.

As Co-PI institute in a consortium with the Laboratoire d'Astrophysique de l'Observatoire in Grenoble, the Laboratoire d'Astrophysique in Marseille, ETH Zürich and the University of Amsterdam, the MPIA coleads the development of SPHERE, a VLT instrument specialized for the imaging of Jupiter-like extrasolar planets. To overcome the huge brightness contrast between the planet and its host star, SPHERE will use eXtreme Adaptive Optics (Xao), coronography, and three differential imaging-capable focal plane subinstruments that will, respectively, employ polarimetry in the visual, dual imagery in the near-infrared, and integral field J-band spectroscopy.

Survey instrumentation

A workhorse for MPIAs survey efforts in the near infrared at Calar Alto is the OMEGA2000 near-infrared imager, in operation at the prime focus of the 3.5 m telescope since 2003. It provides a field of view of $15.'5 \times 15.'4$, and z to K-band sensitivity.

The successor of OMEGA2000 will be PANIC, the Panoramic Near-infrared Camera, which is a wide-field general purpose instrument for the Calar Alto 2.2 m telescope. PANIC is a joint development of the MPIA and the Instituto de Astrofísica de Andalucía. With four Hawaii2-RG detectors, it will provide a field of view of $30' \times 30'$. Surveys of extragalactic, galactic, and solar system objects will be possible as well. Some of the numerous possible science cases are gamma-ray burst hosts, supernovae, distance scales, high-redshift quasars, accretion disks, post AGB-stars, and X-ray binary counterparts.

MPIA has also build LAIWO, the Large Area Imager for the Wise Observatory (Israel). It is an optical camera that was re-installed at the observatory's 1 m telescope in fall 2008. A mosaic of four CCD detectors with $4\,K \times 4\,K$ pixels each provides a field of view of one square degree. The main scientific application is the photometric search for transiting extra-solar planets of Jupiter size.

The HAT-South project is a network of 24 small-sized automated telescopes with the goal to survey a large number of nearby stars to search for transiting extrasolar planets. These telescopes are located at three sites: Las Campanas in Chile, the H.E.S.S. site in Namibia, and Siding Springs in Australia. MPIA is responsible for the site preparation and operations of the Namibian node. The survey is expected to detect about 25 planets per year. The Hat-South project is a collaboration between Harvard, the Australian National University, and MPIA.

Instruments for next generation telescopes

In 2010, an ESO commission led by MPIA already finished the search for the site of the planned 39 m E-ELT. It will be the mountain Cerro Armazones in Chile's Atacama Desert (after intensive studies of various suitable places in the world including Spain, Argentina, and Tibet).

In preparation for the future with this awesome telescope, MPIA has participated in two studies for instruments: METIS and MICADO. The METIS concept is a thermal/mid-infrared imager and spectrograph whose wavelength coverage will range from 3–14 microns. A wide rage of selectable resolving powers is planned. Adaptive optics will permit diffraction-limited observations. Science cases are conditions in the early solar system, formation and evolution of protoplanetary disks, studies of the galactic center and of the luminous centers of nearby galaxies, high-redshift AGNs and high-redshift gamma ray bursts.

In December 2008, several concepts of the MICADO study were evaluated and down-selected for a phase A study. MICADO is a near-infrared imaging camera with multi-conjugated adaptive optics that will provide a spatial resolution exceeding that of the James Webb Space Telescope (JWST) by a factor of 6 to 7. It will have a sensitivity down to 29 mag in bandpasses from I to K. Applications range from young stellar objects in our galaxy to star formation in high-redshift galaxies. The achievable astrometric precision will further advance studies of stellar orbits around the black hole in the galactic center and of the proper motions of globular clusters in the galactic halo. With MICADO, detailed mapping will be possible on scales as small as 80 pc of the structure, the stellar populations, and the interstellar dust distribution in galaxies with redshifts $z < 1$.

Instrumentation for Space-based Astronomy

Europe's far infrared and submillimetre space observatory HERSCHEL has started its four year long mission with a picture-perfect launch aboard an ARIANE-5 rocket on 14th May 2009. The MPIA has been one of the major partners in the development of the PACS instrument which enables imaging and spectroscopy in the wavelength range from 60 to 210 mm with unprecedented sensitivity and spatial resolution. The MPIA has been responsible for delivering the PACS focal plane chopper and for characterizing the large Ge:Ga spectrometer cameras and their –270 °C readout electronics.

After successful delivery and check-out of the PACS hardware contributions, MPIA has been heavily involved in many PACS Instrument Control Center tasks.

Credit: Eso / L. Calçada

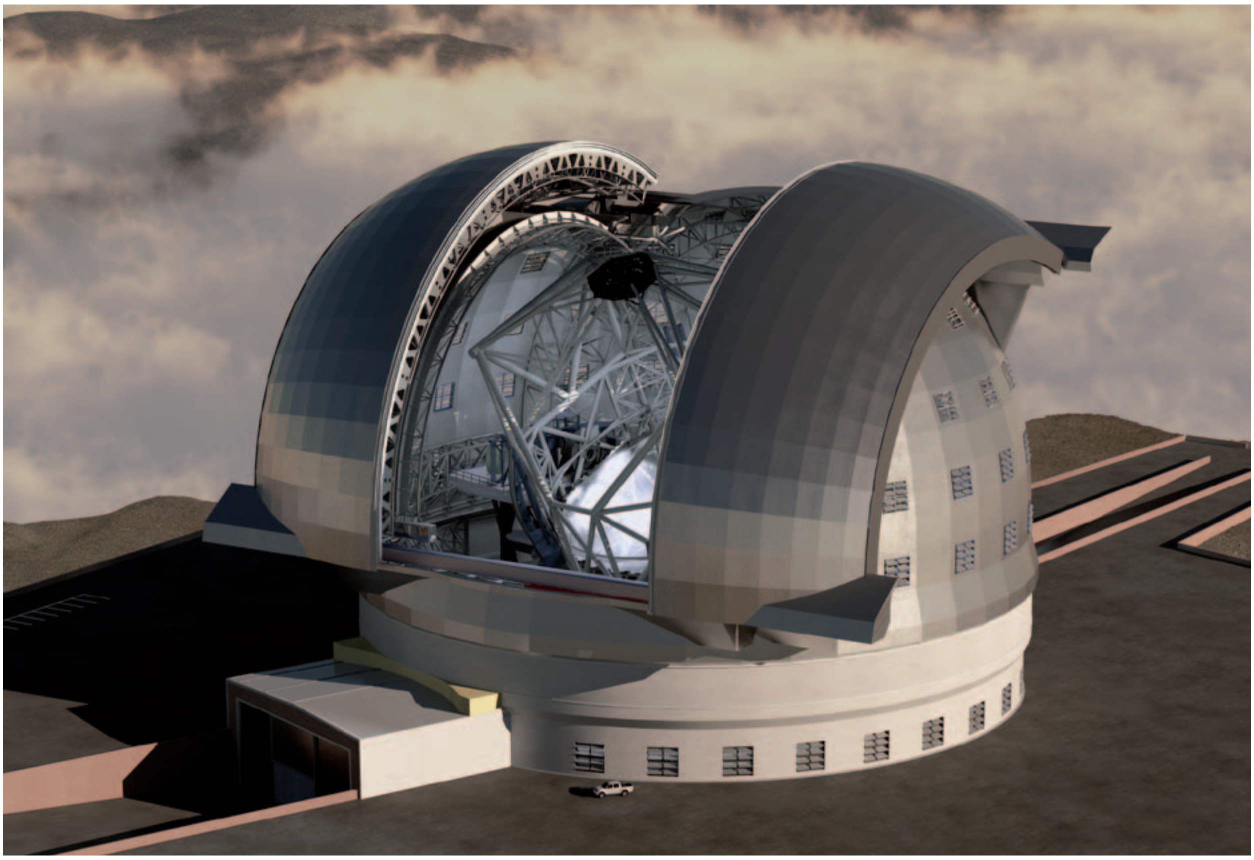


Fig. I.2.5: Artist impression of the European Extremely Large Telescope (E-ELT).

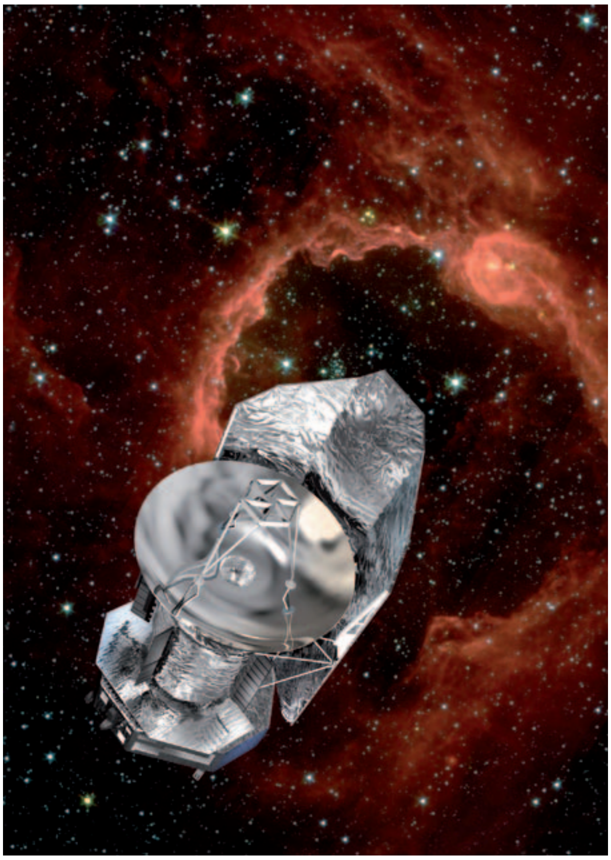
The Instrument Control Centre (ICC), located at the PI institute MPE in Garching, has the responsibility for operations, calibration and data reduction of the Pacs instrument. MPIA is one of four institutes of the Pacs consortium which are main manpower contributors to the Pacs ICC. MPIA has coordinated a large number of tasks for the calibration of the Pacs instrument and has been responsible for establishing the Pacs performance verification phase plan and the central Pacs calibration document. In particular, the MPIA team has exclusively carried out the detailed mission planning of all Pacs performance verification phase operational days, utilizing dedicated software tools, and has delivered the observational data bases to the Herschel Science Center at Esac in Villafranca (Spain) and the Mission Operations Center at EsoC in Darmstadt (Germany). The MPIA team had build up a corresponding calibration plan for Herschel's routine phase and also ensured the optimum inflight setup of the Ge:Ga spectrometer detector arrays following a procedure developed in the MPIA space laboratory (see chapter III.1 of the annual report 2010 for details about Herschel and some of the excellent scientific data obtained in the first year of the regular mission).

The MPIA is the leading institute in Germany for the development of instrumentation for the James Webb Space Telescope (JWST, Fig. I.2.7), to be launched in this decade as the successor to the Hubble Space Telescope.

JWST will be equipped with a folding primary mirror with a diameter of 6.5 m and four science instruments. As a member of a European consortium, MPIA is responsible for the development of the cryogenic wheel mechanisms required for precise and reliable positioning of the optical components in JWST's mid-infrared instrument Miri and is also leading the electrical system engineering of this instrument. Miri is designed for the wavelength range from 5 to 28 micron, and consists of a high-resolution imager and a spectrometer of medium resolving power.

In 2009 the flight model of the filter wheel mechanism was delivered for integration into the imager section of the Miri instrument. Now, Miri is the first completed JWST science instrument. It has successfully passed all incoming acceptance tests and is currently being integrated into the Isim (Integrated Science Instrument Module) at Goddard Space Flight Centre. The MPIA also provides critical components for the second JWST instrument mainly developed in Europe, the near-infrared multi-object spectrograph NirSpec This contribution, as well as our participation in the NirSpec science team, will provide the astronomers at MPIA with further excellent opportunities for powerful infrared observations. For the development of the precision optics of Miri and NirSpec, the MPIA has closely co-operated with Carl Zeiss

Credit: Esa

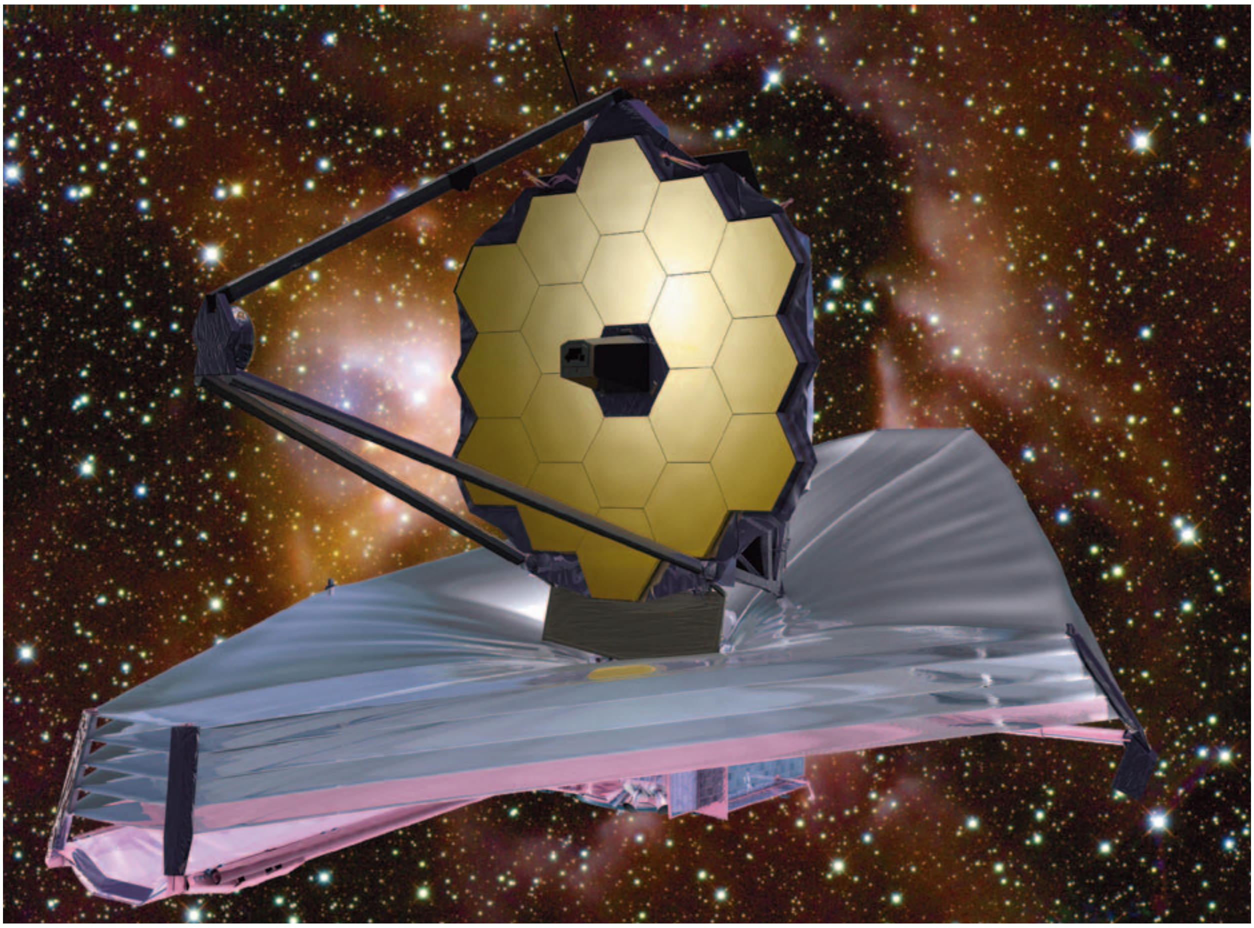


Optronics, Oberkochen, and Astrium GmbH, Ottobrunn and Friedrichshafen. With the end of 2010, all tasks regarding the cryogenic mechanisms were successfully finished and they were integrated into Miri and NirSpec.

The Institute is also leading a major data analysis aspect of Esa's Gaia project, a space observatory scheduled for launch in 2013. Gaia will be the successor to the Hipparcos astrometry satellite, exceeding the latter's sensitivity by several orders of magnitude. The satellite will measure positions, magnitudes, and radial velocities of one billion stars, in addition to numerous galaxies, quasars and asteroids. The telescope will provide photometric data in 15 spectral bands as well as spectra in a selected spectral range. Unlike Hipparcos, Gaia does not need to be provided with an input catalogue, but will measure systematically all accessible objects. Automatic object classification will thus be of major importance for data analysis. Concepts for coping with this demanding task are being developed at the MPIA (supported by a grant from DLR).

Fig. I.2.6: (*left*) The Herschel Space Observatory.

Fig. I.2.7: (*bottom*) Design model of the James Webb Space Telescope (JWST), with its large segmented primary mirror and characteristic sun shield.



Credit: Nasa

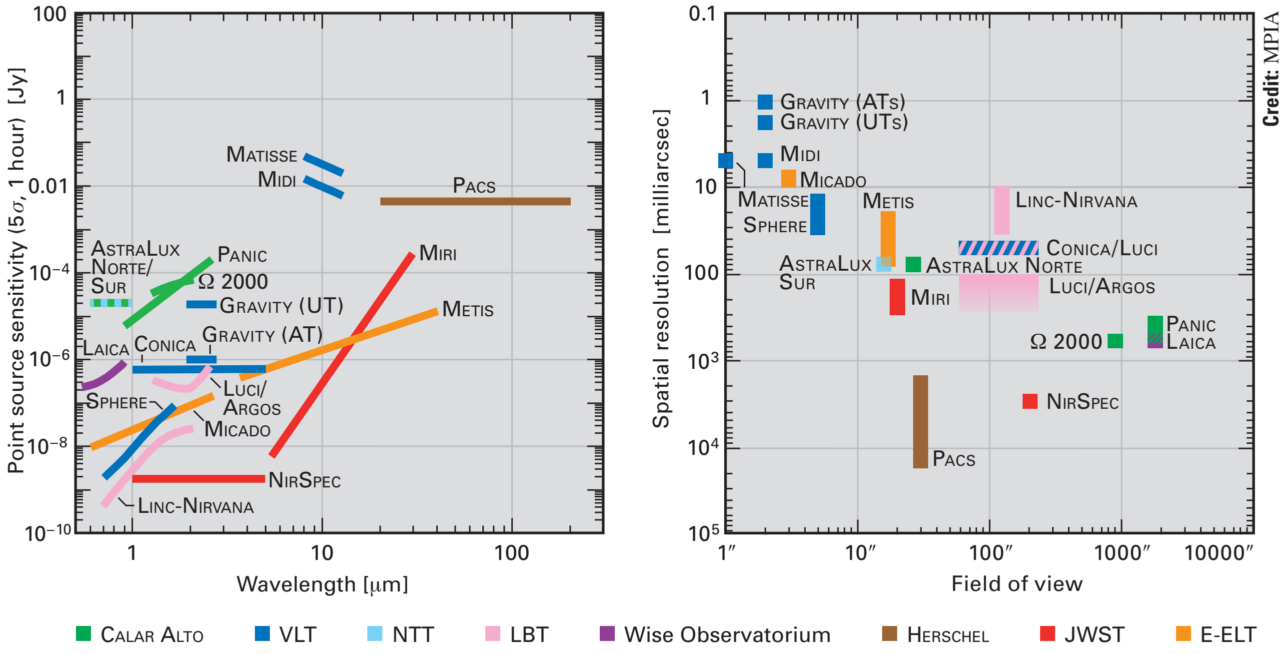


Fig. 1.2.7: Capabilities of MPIA's major instruments. *Left:* sensitivity as a function of wavelength. *Right:* spatial resolution as a function of field of view.

Involvement in Mission Studies within the Esa Cosmic Vision Program

Euclid has the goal of mapping the geometry of the dark Universe by studying the distance-redshift relationship and the evolution of cosmic structures. To this end, the shapes and redshifts of galaxies and galaxy clusters will be measured out to redshifts $z \sim 2$, that is, to a look-back time of 10 billion years, thereby covering the entire period over which dark energy played a significant role in accelerating the expansion of the Universe. The observing strategy of Euclid will be based on baryonic acoustic oscillations measurements and weak gravitational lensing, two complementary methods to probe dark energy. The Euclid survey will produce 20 000 square degrees visible and near-infrared images of the extragalactic sky at a spatial resolution of 0.030 arcsec. It will also yield medium resolution ($R = 400$) spectra of about a third of all galaxies brighter than 22 mag in the same survey area. During October 2011, Euclid was selected as one of two missions to be carried out. A possible launch date could be 2017 or 2018.

EChO is another Esa Cosmic Vision mission currently in competition for the M3 launch opportunity. It will be the first dedicated mission to investigate the atmospheres of exoplanets. EChO will provide simultaneous multi-wavelength spectroscopic observations at medium resolution and with very long exposure times. The observatory will analyse the structure of the atmospheres, the abundances of the major molecules (oxygen and carbon) or magnetospheric signatures. For this purpose, EChO will focus on transiting expoplanets to benefit, e.g., from the starlight passing through the limb of the planet's atmosphere. Regarding the scientific and the technical background, MPIA made important contributions for the initial mission proposal. MPIA has also led a international study consortium to perform a assessment study of EChO's science instrument leading to a proposal for the EChO science instrument provision which was submitted to Esa in November 2012. During this study the institute has worked closely together with Astrium (Friedrichshafen / Ottobrunn) and was financially supported by DLR.

Finally, Spica, the Space Infrared Telescope for Cosmology and Astrophysics, is another astronomy mission of Esa's Cosmic Vision in which MPIA is participating in the study phase. The mission is planned to be the next space astronomy mission after Herschel observing in the far infrared and to be launched probably in 2019. It will feature a cold 3.2 m telescope providing up two orders of magnitude sensitivity advantage, mostly for spectroscopic observations, over existing far-infrared facilities. Spica is led by the Japanese Space Agency Jaxa. Europe has proposed to participate with a Spica Far Infrared Instrument called Safari, the telescope mirror, and support of the ground segment. Currently, the European contribution to the observatory is in an extended assessment phase, keeping it in line with the status of the project at Jaxa.

I.3 National and International Collaborations

The MPIA is strategically well-placed: Heidelberg has become one of Germany's foremost centers of astronomical research. Cooperation with the High-energy Astrophysics Department of the MPI for Nuclear Physics (MPIK), the new Heidelberg Institute for Theoretical Studies (HITS), and with the institutes of the Center for Astronomy Heidelberg (ZAH), established in 2005, is manifold: the ZAH consists of the Landessternwarte, the Astronomisches Recheninstitut, and the Institut für Theoretische Astrophysik at the University. Also, the "International Max Planck Research School" for Astronomy and Cosmic Physics (IMPRS, see Section I.4) is run jointly by the Max Planck Institutes and the University.

Nationally, MPIA has extensive cooperations with the MPI for Extraterrestrial Physics in Garching and the MPI for Radio Astronomy in Bonn, as well as with numerous other German institutes, whose locations are shown in Fig. I.3.1.

The establishment of the German Center for Interferometry (Frontiers of Interferometry in Germany, or FrInGe, located at the MPIA, also emphasizes the Institute's prominent role in Germany in this innovative astronomical technique. The goal is to coordinate efforts made by German institutes in this field and to accomo-

Fig. I.3.1: Position of the partner institutes of the MPIA in Germany.

Credit: Mountain High Maps / MPIA graphic date the interests of the German astronomical community in the European Interferometric Initiative. Another specific goal is the preparation of the next generation of interferometric instruments. This includes the preparation of second-generation instruments for VLTI, such as Matisse and Gravity.

FrInGe, together with other interferometric centers in Europe, is partaking in the establishment of the European Interferometry Initiative. The long-term perspective is to establish a European interferometric center for the optical and infrared wavelength region. In addition to MPIA, the following institutes are participating in FrInGe:

the Leibniz Institute for Astrophysics in Potsdam (AIP), the Astrophysical Institute of Jena University, the Kiepenheuer Institute for Solar Physics in Freiburg, the MPI for Extraterrestrial Physics in Garching, the MPI for Radio Astronomy in Bonn, the University of Hamburg, the I. Physical Institute of Cologne University, and the Universities of Kiel and Munich.

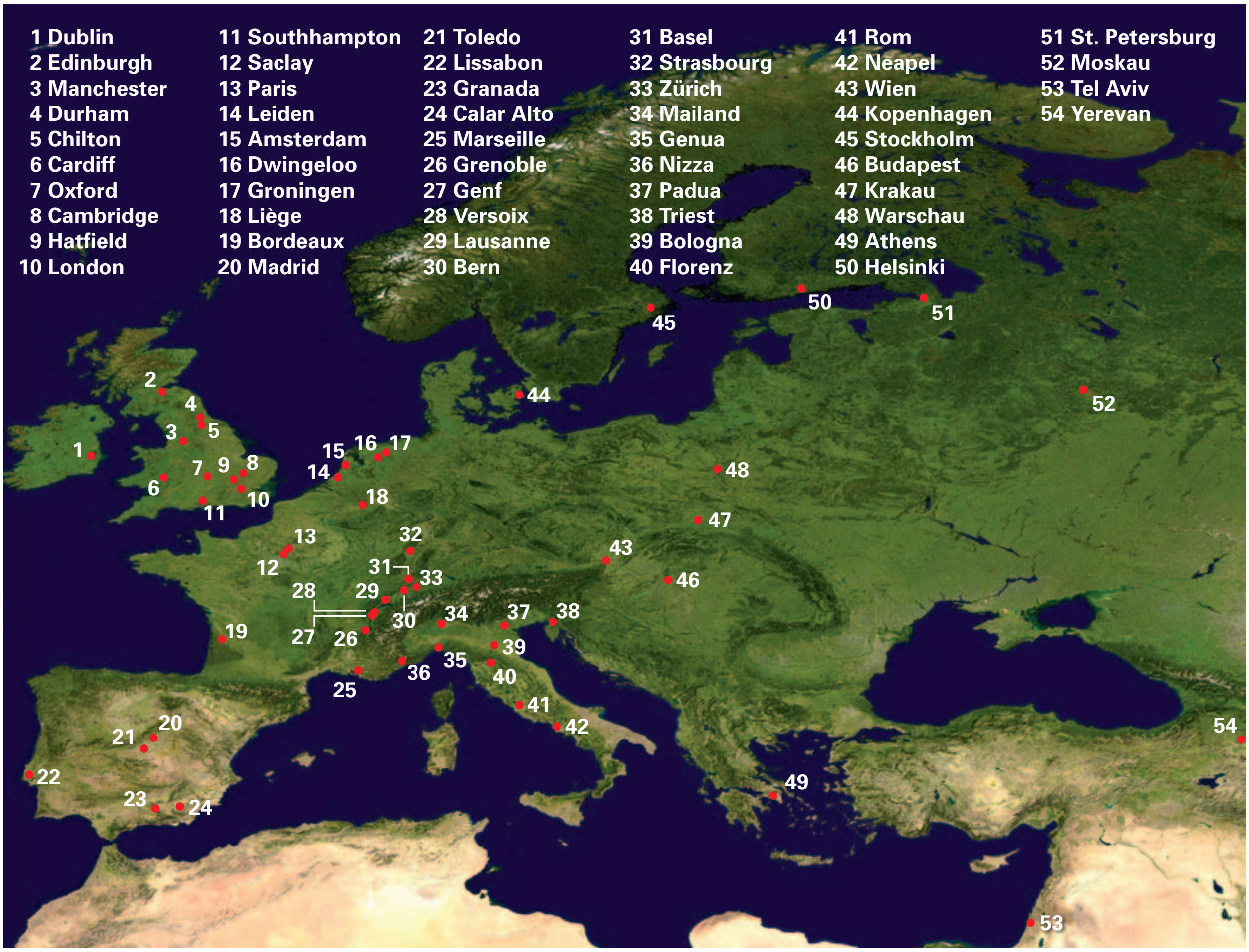
The MPIA is participating in a number of EU-networks and worldwide collaborations, in part as project leader. These include:

Opticon: A network of all operators of major telescopes in Europe, financed by the European Union. Its main goal is to optimize use of scientific technical infrastructure, in order to increase scientific results and reduce costs. Opticon's other main goal is to coordinate technology development for the next generation of ground-based telescopes.

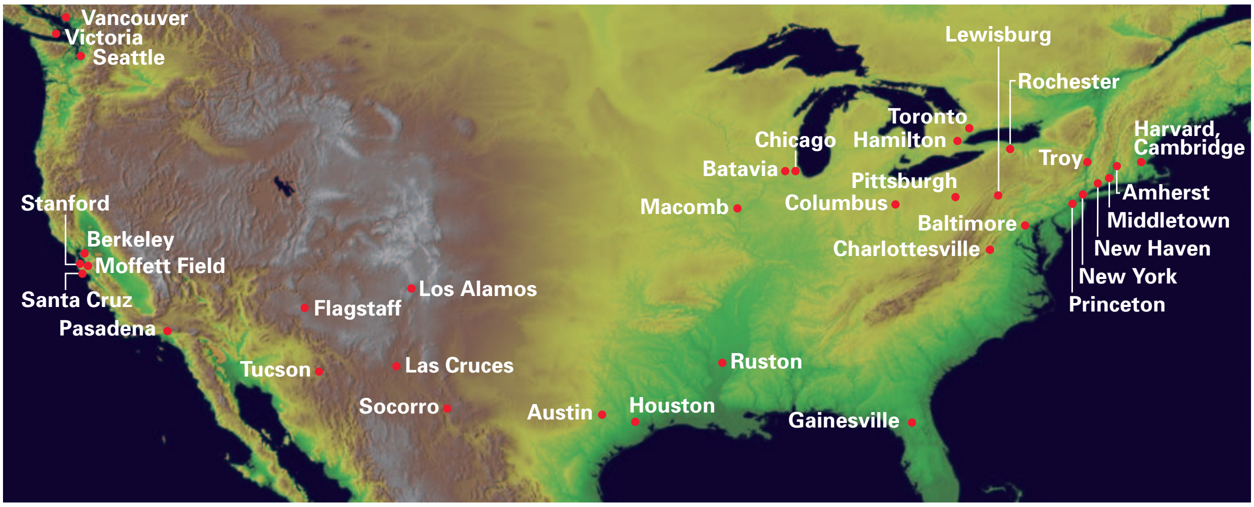
Espri (Exoplanet Search with Prima): This project aims at carrying out the first systematic astrometric planet search with a measurement accuracy of 10–20 microarcseconds. For this purpose, we have built, in collaboration with Eso, the Landessternwarte Heidelberg, and the Geneva Observatory in Switzerland, differential delay lines for the Prima facility at the VLTI. Our consortium is also developing the astrometric data reduction software.

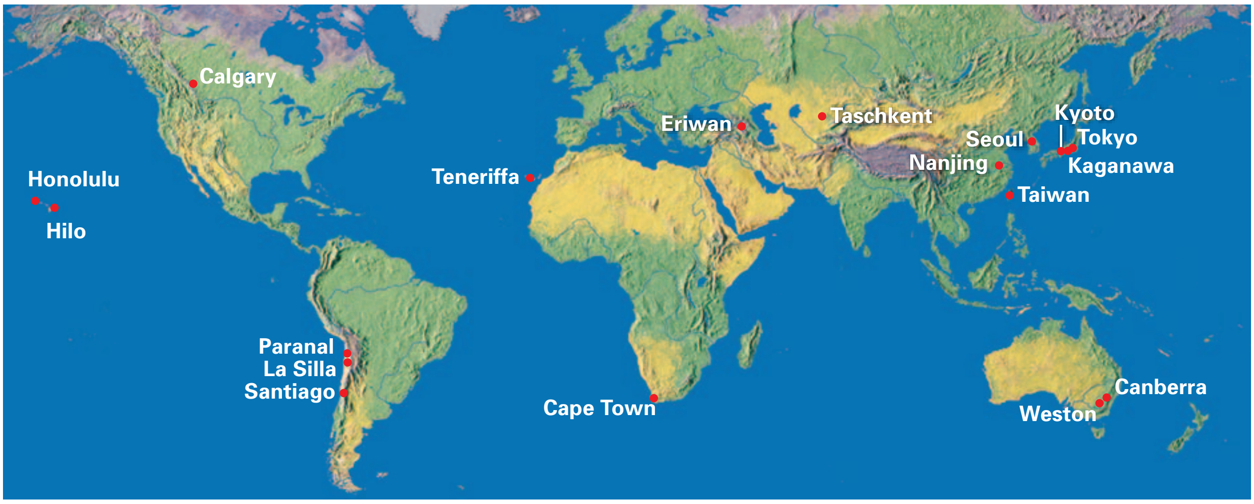
Cid: The "Chemistry In Disks" project is a joint collaboration with Bordeaux, Jena and Iram (Grenoble). The major goal of Cid is the study of physical structure and chemical composition of protoplanetary disks at various evolutionary stages. We focus on a sample of nearby bright protoplanetary disks orbiting low-mass (T-Tauri) and intermediate-mass (Herbig Ae) stars. For that, we employ multimolecule, multi-line observations with the Plateau de Bure interferometer and the Iram 30 m antenna, followed by comprehensive data analysis and theoretical modeling.

Fig. I.3.2: Position of MPIA's international partner institutes. See also on the facing page.



Credit: Nasa "Blue Marble" / MPIA graphic





Credit for both figures: Nasa "Blue Marble" / MPIA graphic

Seeds: This is an imaging survey using the Subaru telescope at Mauna Kea. The main goal is to search for giant planets and protoplanetary/debris disks around 500 nearby stars of solar type or other more massive young stars. This is a collaboration between Naoj, Princeton and MPIA.

The MPIA is part of a DFG-funded research network ("Forschergruppe") on the first stages of planet formation. This network involves the University of Tübingen (chair), the MPIA (co-chair), the Institute for Geology and Geophysics in Heidelberg (co-chair), the Kirchhoff Institute for Physics in Heidelberg, the Institute for Theoretical Astrophysics in Heidelberg, the Institute for Planetology in Münster and the Institute for Geophysics and Extraterrestrial Physics in Braunschweig. It combines laboratory astrophysics with theoretical astrophysics and astronomical observations in order to gain a better understanding of how the first planetary embryos are formed out of the circumstellar dust surrounding a young star. The network funds 10 PhD students, most of which started in early 2007. The project is currently within it's 2^{nd} funding period (from January 2010 until December 2012).

Sisco (Spectroscopic and Imaging Surveys for Cosmology): This EU network is dedicated to the study of galaxy evolution with the help of sky surveys. The Institute has made pivotal contributions to this network through Cadis, Combo-17, and the Gems surveys. Additional partners are: University of Durham, Institute for Astronomy in Edinburgh, University of Oxford, University of Groningen, Osservatorio Astronomico Capodimonte in Naples, and Eso in Garching.

Elixir, an EU network dedicated to exploit the unprecedented capabilities of the NirSpec instrument on the JWST space mission.

SDSS, the Sloan Digital Sky Survey, has revolutionized wide-field surveying at optical wavelengths. It is the most extensive imaging and spectroscopy sky survey to date, imaging about a quarter of the entire sky in five filters. The final catalogue provides positions, magnitudes, and colors of an estimated one hundred million celestial objects as well as redshifts of about one million galaxies and quasars. The observations are made with a 2.5 m telescope specially built for this purpose at Apache Point Observatory, New Mexico. The project is conducted by an international consortium of US, Japanese and German institutes. The MPIA was the first of what is now twelve European partner institutes in SDSS and the only one to participate since the inception of surveying. In exchange for material and financial contributions to the SDSS, a team of scientists at the MPIA receives full access to the data. In 2005, the "original" SDSS was completed, and an extension, SDSS-II/Segue, focusing on Milky Way structure, was completed in mid 2008.

MPIA is a partner in Pan-Starrs1 (PS1), the most ambitious sky survey project since the SDSS, as part of the Pan-Starrs1 Science Consortium (PS1SC), using a dedicated 1.8 m telescope and the record-breaking 1.4 Gigapixel Camera (GPC1) with a 7-square-degree field of view. PS1SC is an international collaboration, involving the University of Hawaii, the MPE, Johns Hopkins University, the Harvard-Smithsonian Center for Astrophysics/Las Cumbres Observatory Global Telescope, the Universities of Durham, Edinburgh and Belfast, and Taiwan's National Central University. It will operates the PS1 telescope during 2009 – 2012 to carry out multiple time-domain imaging surveys in its g, r, i, z, y filter set: the "3pi" survey of all of the sky visible from its location on Haleakala (Hawaii), a medium-deep supernova survey, as well as a dedicated survey of the Andromeda galaxy and a search for transiting planets. Including this planet search, MPIA scientists are leading four out of twelve key science projects within PS1SC, covering in addition the search for the most distant quasars and the coolest stars, as well as a comprehensive study of the Local Group's structure.

Within the Herschel Space Observatory project, MPIA is the largest Co-I institute in the PACS instrument consortium, which consists of partners from 6 European countries. Herschel was successfully launched on May 14th, 2009. The institute leads two Herschel guaranteed Time Key Programs on "The earliest phases of star formation" and "The Dusty Young Universe: Photometry and Spectroscopy of Quasars at $z < 2$" and participates in nine other Herschel Open and Guaranteed Time Key Programs. All these observing programs are large international collaborations.

I.4 Educational and Public Outreach and the "Haus der Astronomie"

Training the next generation of scientists and communicating astronomy to the public has a longstandig tradition on the Königstuhl. The "Haus der Astronomie" (HdA), a new center for education and public outreach, whose establishment had been decided in December 2008, has been finally erected on the Campus of the MPIA during 2011. The new institution will amplify and strengthen the efforts of all Heidelberg astronomers directed to this goal.

Students come from all over the world to the MPIA to carry out research for their diploma or doctoral thesis. A majority of these students are formally enrolled at the University of Heidelberg. In turn, a number of scientists at the MPIA have adjunct faculty status at the University

Undergraduate students can get a first taste of scientific work at the MPIA. The Institute offers advanced practical courses or enables the students to participate in "mini research projects". These last about two months and cover a wide range of questions, including the analysis of observational data or numerical simulations, as well as work on instrumentation. These practical courses offer the students an early, practically oriented insight into astrophysical research and are an excellent preparatory step for a later diploma or doctoral thesis.

The International Max Planck Research School (IMPRS) for Astronomy and Cosmic Physics, which was established by the Max Planck Society and the University of Heidelberg, started in 2005, and offers PhD students from all over the world a three-years education under excellent conditions in experimental and theoretical research in the field of astronomy and cosmic physics. It is supported by the five astronomical research institutes in Heidelberg. After a successful evaluation in 2009, the IMPRS-HD was extended for another period

The institute's mission also includes educating and informing the general public about astronomical research.

Fig. I.4.1: The HdA was finished in autumn 2011. The main entrance is to the right.

Credit: MPIA

Members of the institute give talks at schools, education centers and planetaria. They also appear at press conferences or on radio and television programs, in particular on the occasion of astronomical events that attract major public attention. Numerous groups of visitors come to the MPIA on the Königstuhl and the Calar Alto Observatory.

Our initiative for the general public, a series of "Public Lectures on Sunday Morning", which was in its seventh year in 2012, always leads to a sold-out auditorium at MPIA and now at the Haus der Astronomie. Also, as in previous years, the one week long practical course which was offered to interested schoolchildren was immediately booked out – applicants came from all-over the country. And again, the MPIA participated in the Girls' Day, an annual nationwide campaign intended to encourage schoolgirls to learn about professions that are still mainly male-dominated. At various stations throughout the MPIA, about 40 schoolgirls got a general idea of the work at an astronomical institute.

In 2012, there were a lot of other activities and events, in particular an Open House with thousands of visitors. A more detailed description can be found in chapter V.

Finally, the monthly magazine "Sterne und Weltraum" (Stars and Space, SuW of the Spektrum-Verlag) is published at the MPIA. This journal is intended for the general public and offers a lively forum both for professional astronomers and for the large community of amateurs in the field. A significant fraction of the readers are teachers and pupils. In parallel to SuW, didactic material is produced monthly within our successful project "Science to schools!", which helps teachers to treat interesting themes of current astronomical research during regular classes in physics and natural sciences. The project "Science to schools!" was sponsored by the Klaus Tschira Foundation from 2005 to 2009, and is now continued in the "Haus der Astronomie". The didactic material is made freely available through the web and is widely used in german-speaking countries.

The "Haus der Astronomie" – a Center for Education and Public Outreach

In December 2011, the "Haus der Astronomie", which was founded in December 2008, has been finally erected on the campus of the MPIA. In this facility, the educational and public outreach activities of all astronomers in Heidelberg are concentrated and developed further. Information for the media and the general public, the development of didactic material, simulations and visualizations, and the training of university students and teachers of physics, astronomy and natural sciences play a major role. Furthermore, the HdA supports contacts and communication between scientists. The Klaus Tschira Foundation has financed the building and its technical equipment, and the Max Planck Society is operating the facility. In addition to these Institutions, the City of Heidelberg, the State of Baden-Württemberg, and the University of Heidelberg are contributing to the personnel costs, and the astronomers at the MPIA and at the University's Center for Astronomy will also bring in activities related to public and educational outreach.

During 2009, the center's core team was assembled, and construction work was started on October 2009 with a festive groundbreaking ceremony. At the end of 2010, the basic structure of the building, including the planetarium dome was finished. This was celebrated in a topping-off ceremony on December 17 2010. And only one year later, on December 16 2011, we celebrated in the presence of Peter Gruss (President of the Max Planck Society), Klaus Tschira (the building's sponsor), Theresia Bauer (Minister for Science, Research and the Arts, State of Baden-Württemberg), Gabriele Warminski-Leitheußer (Minister for Education, Youths and Sports, State of Baden-Württemberg), Bernhard Eitel (Rector of Heidelberg University), and Eckart Würzner (Lord Mayor of the City of Heidelberg) the inauguration of the "Haus der Astronomie" (see chapter V for more details about the HdA).

II. Highlights

II.1 Rare image of Super-Jupiter sheds light on planet formation

An infrared imaging search with the Subaru telescope has captured a rare image of a "Super-Jupiter" around the massive star ϰ Andromedae. The gas giant has a mass about 13 times that of Jupiter, while the host star has a mass 2.5 times that of the Sun. There are strong indications that this planet formed in a manner similar to ordinary, lower-mass exoplanets: in a "protoplanetary disk" of gas and dust that surrounded the newborn star. This makes the planet an important test case for current models of planet formation and their predictions about planets around massive stars.

Of the nearly 850 exoplanets – planets orbiting stars other than the Sun – currently known, only a minute fraction have been captured in actual astronomical images. The vast majority of detections rely on indirect methods. The reason for this discrepancy: stars are much brighter than their planets (typically by a factor of a billion or more); using traditional observational techniques, the planet will be hidden in the glare of its host star.

Recently, we managed to obtain an image of a large "Super-Jupiter" around the massive star ϰ And. Our discovery made use of the Subaru 8-meter telescope on the summit of Mauna Kea in Hawaii, operated by the National Astronomical Observatory of Japan.

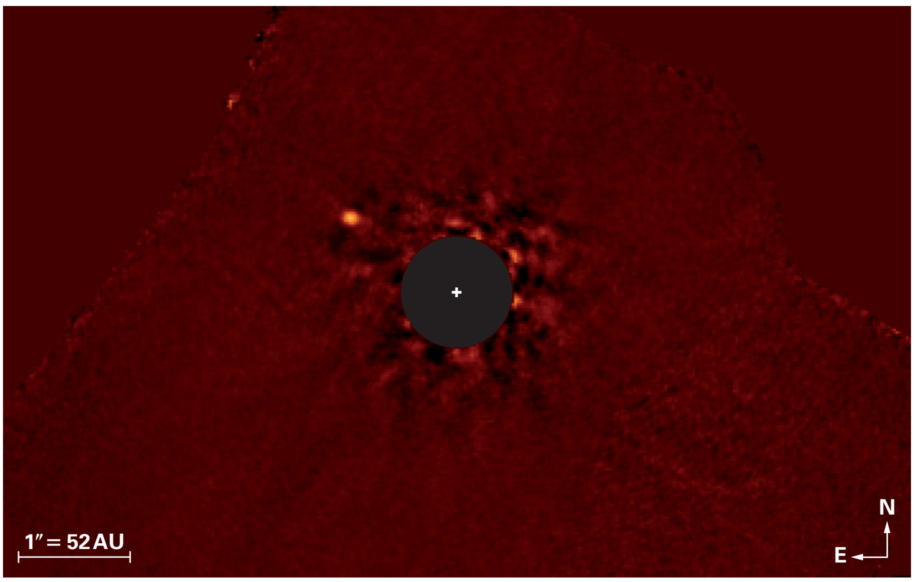
The ϰ And system

ϰ And is located in the constellation Andromeda, at a distance of about 170 light-years (about 52 pc) from Earth. It is a very young star, with an estimated age of 30 million years (our Sun, for comparison, is around 5 billion years old), and it is massive and hot (spectral type B9, estimated mass between 2.4 and 2.5 times that of the Sun, effective temperature on the order of 10 000 K).

Young planets retain significant heat from their formation, making them comparatively bright at infrared wavelengths. ϰ And b has a surface temperature of ~1700 K (about 1400 degrees Celsius). This makes young star systems attractive targets for direct imaging planet searches.

ϰ And b has an estimated mass of around 12.8 times that of Jupiter. Judging by its mass alone, the object could either be a massive planet or a very lightweight brown dwarf. However, a comparison of ϰ And b bright-

Fig. II.1.1: False color, near infrared (wavelength 3.8 micrometers) image of the ϰ And system, generated from data collected in July 2012 with the Subaru Telescope in Hawaii. Almost all of the light of the host star, on which the image is centered, has been removed through image processing; the host star is covered by the dark, software-generated disk in the center. The speckled pattern surrounding the software-generated mask at the center represents the residuals from the starlight subtraction. The Super-Jupiter ϰ And b is clearly visible to the upper left. It has a projected separation of 1.8 times the distance between Neptune and the Sun.



Credit: NAOJ / Subaru / J. Carson (College of Charleston) / T. Currie (University Toronto) ness between four different infrared wavelengths revealed infrared colors similar to that of the handful of other gas giant planets successfully imaged around stars. Also, some models of planet formation predict the mass of gas giants to increase with the mass of the host star; since the mass of ϰ And is between 2.4 and 2.5 times that of the Sun, a large planetary mass for a Super-Jupiter is not surprising.

In the context of planet formation – which is where the chief interest in ϰ And b lies; cf. below –, it is of minor interest where on the boundary between planets and brown dwarfs ϰ And b is located, and we have defined their term "Super-Jupiter" to include both kinds of objects – as long as the object has formed in the same way as the planets in our own Solar System, namely by core accretion from a protoplanetary disk around a young star.

ϰ And b appears to orbit its host star at a distance of at least 55 AU (that is, 55 times the mean distance of the Earth from the Sun; for comparison: Neptune's mean distance from the Sun is 30 AU). However, just as objects can appear foreshortened when viewed at an angle, a planet's apparent distance from its host star, as observed from Earth, will generally be smaller than the true distance.

ϰ And is believed to be a member of the Columba stellar moving group – an association of stars that have formed as a group an estimated 30 million years ago, and are still drifting through the galaxy on somewhat similar orbits. Another member of that group is the famous high mass star, HR 8799, which is one of the first star systems where astronomers were able to directly image an extra-solar planet. Although the HR 8799 mass is not nearly as large as that of ϰ And, the HR 8799 star system hosts several gas giant planets with masses and infrared colors similar to that of ϰ And b.

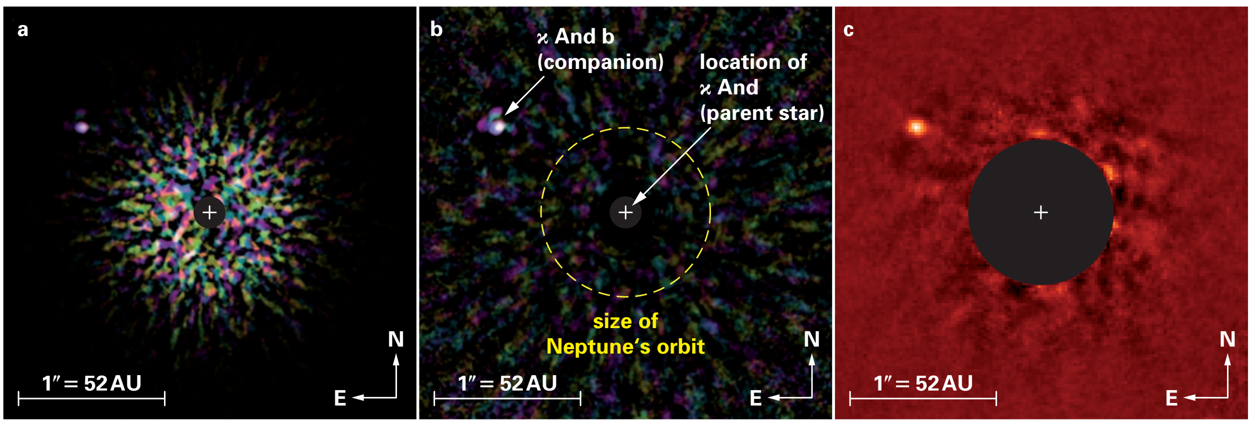
Imaging ϰ And b – a difficult task

Obtaining an image of its companion ϰ And b required advanced techniques both for observation and for image analysis. A particular challenge was that the orbit of the newly detected object is only somewhat larger than that of Neptune – most planetary images have been obtained for planets in significantly larger orbits.

The observations were made with the Subaru Telescope, the flagship telescope of the National Astronomical Observatory of Japan, a reflecting telescope whose main mirror is 8.2 meters in diameter. The instruments we used – the "astronomical cameras" – were the IRCS infrared camera and HiCIAO, the "High-Contrast Coronagraphic Imager for Adaptive Optics". HiCIAO is especially designed for the observations of faint objects near bright stars, such as exoplanets and protoplanetary disks. It uses state-of-the-art adaptive optics, a technique that can compensate for the disturbances caused as a distant stars' light passes through the Earth's atmosphere (the "blurring" of stellar images viewed at high magnification), and it physically blocks out part of the stars' light ("coronagraph") to enable imaging of the much fainter objects next to it.

Even so, in a single infrared snapshot, the tiny point of light that is ϰ And b is completely lost amid the overwhelming glare of the host star. We were able to distinguish the object's faint light only after using a technique known as angular differential imaging, where a time-series of individual images are combined in a manner that

Fig. II.1.2: Three false color images of the ϰ And system, generated from data collected in July 2012 with the Subaru Telescope in Hawaii. Almost all of the light of the host star, on which the image is centered, has been removed through image processing; the host star is covered by the dark, software-generated disk in the center. In each image, the Super-Jupiter ϰ And b is visible to the upper left. *Left*: Near infrared image (wavelength between 1.2 and 2.4 micrometers) *Center:* A "signal-to-noise ratio map" generated from the left image. The whiteness of each speckle indicates that probability that we are dealing not with an artefact ("noise"), but with the trace of a real object ("signal"). The white feature toward the upper left, representing a high signal-to-noise value, indicates the high-confidence, super-Jupiter detection. *Right*: Near infrared image (wavelength: 3.8 micrometers).



Credit: NAOJ / Subaru / J. Carson (College of Charleston) / T. Currie (University Toronto) exploits the telescope's changing orientation relative to the sky across longer observations, allowing for the otherwise overwhelming glare of the host star to be removed from the final, combined image.

ϰ And b is one of only 30 planets that astronomers have been able to image directly. The Super-Jupiter was detected in independent observations in January and July 2012 at four different wavelengths. A comparison of relative positions between the two epochs showed that the Super-Jupiter ϰ And b shows the same slight movement on the night sky as does its host star ("common proper motion", in this case around two hundred-thousandth of a degree per year). This is convincing evidence that the two objects are indeed gravitationally bound.

Massive stars can have planets, too

While there are images of planets around host stars with a larger estimated mass, most of these are for stars in a much later stage of development ("post main sequence"), or concern companions orbiting at much greater distances than those in the Solar System. Both are indications that the planets in question have not formed in the same way as our own Solar System, namely by core-collapse from a protoplanetary disk around a young star.

ϰ And, on the other hand, is a fairly young star, and the distance from the object ϰ And b to its host star is on the same order as that of Neptune within our own Solar System (30 AU for Neptune vs. 55 AU for ϰ And b). This indicates that ϰ And b should indeed have formed from a protoplanetary disk, making ϰ And by far the most massive star to exhibit evidence of planet formation in a manner similar to the birth of our own Solar System.

In recent years, observers and theoreticians have argued that large, massive stars like this are more likely to have massive planets than smaller stars such as our Sun. Yet there have also been concerns: massive young stars emit enormous amounts of high-energy radiation. This radiation could dissipate parts of the protoplanetary disk, which would in turn disrupt planet formation.

The discovery of the Super-Jupiter ϰ And b suggests that stars as massive as 2.5 solar masses are still fully capable of producing planets within their primordial circumstellar disks – key information for researchers working on models of planet formation.

A key advantage of direct exoplanet detection is the target's immediate accessibility for follow-up examination by traditional astronomical techniques, such as an in-depth analysis of its light by spectroscopy. This is the aim of ongoing observations of the light emitted by ϰ And b across a broad range of wavelengths. The ongoing observations will lead to a better understanding of the gas giant's atmospheric chemistry, and yield more precise information about the object's orbit and the possible presence of additional planets. In the end, we should have a better picture of the Super-Jupiter's genesis, and about planet formation around massive stars in general.

Beth Biller, Thomas Henning,
Wolfgang Brandner, Markus Feldt
as part of the SEEDS collaboration
(PI: Motohide Tamura,
National Astronomical Observatory of Japan)

II.2 Dark clouds, young stars, and a dash of Hollywood: New results from Herschel explorations of stellar birthplaces

Using the Herschel Space Telescope, we have examined the earliest stages of star formation in unprecedented depth. In the low-mass sector, the result is a three-dimensional map of the molecular cloud B 68, a possible future birthplace for a low-mass star. The reconstruction employs ray-tracing techniques more often encountered in digital computer graphics for feature films than in astronomy. Observing much more massive molecular clouds, we managed to identify a previously unobserved class of object that is likely the earliest known precursor of the birth of massive stars.

Stars are born in hiding, when dense regions within clouds of gas and dust collapse under their own gravity. But the clouds not only provide the raw material for star formation, they also absorb most of the light from their interior, hiding from view the crucial details of stellar birth – one of the key astronomical processes if we want to understand our own origins!

Recently, we – that is, MPIA scientists belonging to two groups in the EPoS ("Earliest Phases of Star formation") project led by Oliver Krause – were able to report two new results in understanding the earliest stages of star formation: one concerning low-mass, the other concerning high-mass stars. Both observational projects rely on infrared observations with Esa's Herschel Space Telescope.

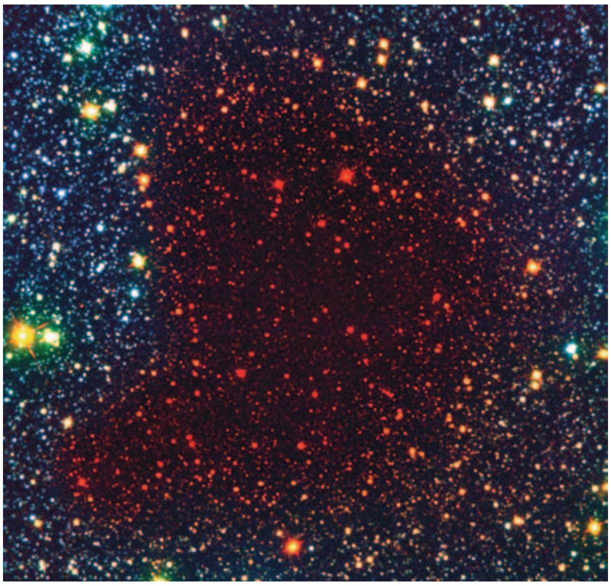
Hunting for young stars in the infrared

The clouds in which stars are born are opaque to ordinary, visible light. Visible-light observations can not reveal what is occuring deep inside the clouds where star formation is taking place. Fortunately, opacity depends on the kind of radiation in question. While dust grains absorb ordinary, visible light, infrared radiation passes virtually unhindered. At the longest infrared wavelengths, far-infrared radiation carries information about the very heart of star formation regions – these regions are very cold, and what little light they do emit is in the far-infrared regime.

In particular, this is true for the very cool gas (around 10 K, or –263 °C) in which the earliest phases of star formation take place, and for the somewhat warmer regions in which a protostar has already formed (around 100 K, or –173 °C).

Unfortunately, it is much harder to discern small details when observing in the far-infrared rather than with visible light. For sharp viewing, you need a much larger

Fig. II.2.1: Images of the dark cloud Barnard 68 in visible light (*left*) and in the near-infrared (*right*). The images are not part of the EPoS study, but were taken using telescopes of the European Observatory (Eso). They illustrate very well the basic premises of infrared astronomy: In visible light, a dark cloud like Barnard 68 is opaque. Using infrared light, one can peer through the dark cloud, in this case revealing background stars. With mid- or far-infrared light, as in Fig. 2, one can obtain data about the structure of the cloud itself.



Credit: ESO

telescope. The other bad news is that far-infrared radiation reaching us from space is absorbed completely by the Earth's atmosphere. You need a telescope in space to observe this kind of radiation.

That is why ESA's *HERSCHEL* Space Telescope (launched in May 2009 and deactivated in April 2013) was a key tool for studies of star formation: its 3.5 meter mirror (making it the largest space telescope of its day) and its highly sensitive far-infrared sensors meant that it was able to look inside dark clouds (far-infrared radiation!) and reveal details sharp enough (large mirror size!) for researchers to be able to create and test realistic models of star formation.

For our observations, we used the HERSCHEL instruments PACS and SPIRE which, together, cover a wavelength range between 70 and 500 µm (far-infrared radiation). PACS ("Photodetector Array Camera & Spectrometer") is a combination of camera and spectrograph for wavelengths between 57 and 210 µm. It was developed and constructed by a consortium led by the Max Planck

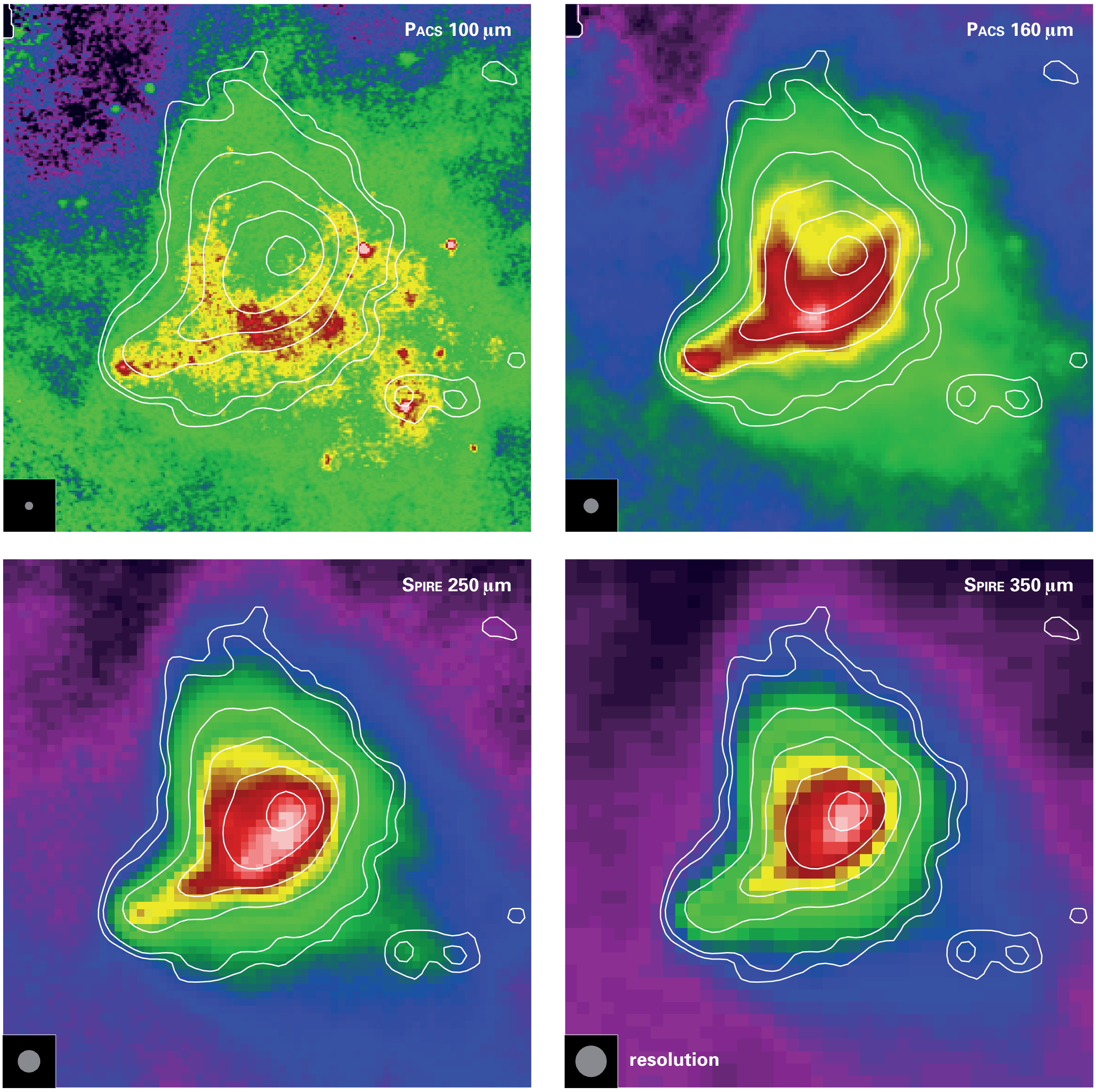


Fig. II.2.2: False-colour image of the dark cloud Barnard 68, prepared using data from the HERSCHEL Space Telescope at different far-infrared wavelengths. The way in which the cloud appears to change shape depending on wavelength is a sign of uneven external illumination. In the bottom left corner, there are traces of an isolated object. This could be a cloud fragment in collision with Barnard 68. The wavelengths for the images are 100, 160, 250 and 350 micrometers, respectively. The image colors show the intensity of the radiation received at that wavelength, from purple and blue at low intensity to high intensities in red and white.

Credit: MPIA / Markus Nielbock

Institute for Extraterrestrial Physics in Garching, with key contributions by the Max Planck Institute for Astronomy in Heidelberg. SPIRE ("Spectral and Photometric Imaging Receiver") can produce images in wavelength bands centered on 250, 350 and 500 µm and produce spectra in the wavelength range between 200 and 670 µm. The instrument was developed and constructed by an international consortium led by the University of Cardiff.

Reconstructing Barnard 68

On the trail of the origin of low-mass stars (with less than about twice the mass of our Sun), a team led by one of us (Markus Nielbock) completed a detailed investigation of one of the best-known potential stellar birthplaces: the dark cloud (or "globule") Barnard 68 in the constellation Ophiuchus. B 68 is thought to be a pristine, starless object with a mass 3.1 times that of the Sun. The main question astronomers are interested in is whether or not the globule will eventually collapse and give birth to a star.

The answer lies in the balance of rivalling forces of expansion and collapse, for which the key indicators are the temperature of the dust and the density, and the ways those two quantities change throughout the cloud. Combining HERSCHEL's unrivalled sharpness and sensitivity in the far-infrared range with a method more often encountered in visual effects companies working on Hollywood blockbusters than in astronomy, we were able to construct the most realistic 3D model of the cloud to date.

The method, adapted for this particular use by MPIA's Ralf Launhardt, uses what is known as ray-tracing: For each minute portion of the object that we can see, the line of sight is traced back into the object itself. The contribution by each portion of the light's path – is light being absorbed at this particular point? Is it being emitted? If yes, at which wavelengths? – are added up. Raytracing is routinely used to produce realistic-looking computer-generated creatures, objects or whole scenes. Here, it helped to match light emitted and absorbed within Barnard 68 at different wavelengths, using simplified assumptions about the cloud's three-dimensional shape. The result was a realistic model of the 3D distribution of the dust temperature and density (cf. Fig. II.2.3).

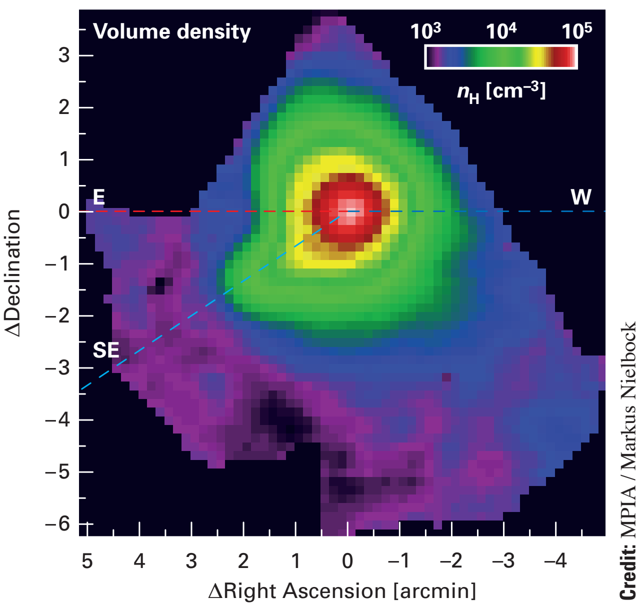
The results have shaken up some of what astronomers thought they knew about this cloud. In previous studies, the cloud used to be treated as a spheroid – a plausible way to simplify various calculations necessary for theoretical modeling. But the new results show that this assumption is only valid for the central region (cf. Fig.II.2.4). At intermediate radii, the temperature and the density undergo large variations.

In addition, the radial density distribution fails to fit the classical paradigm of a self-gravitating isothermal sphere, for which it should decline with r^{-2}. Instead, it seems to be significantly steeper. Therefore, the emerging picture is one of Barnard 68 condensing from a drawn-out filament. In addition, it appears to be heated by unevenly distributed external radiation from the direction of the central plane of our home galaxy. The astronomers also found some signs pointing to a cloud fragment in collision with Barnard 68, which might lead to the cloud's collapse, and the formation of one or more low-mass stars, within the next hundreds of thousands of years, and whose existence had been predicted by a previous study (Burkert & Alves 2009).

On the trail of the most primitive protostars

As cosmic clouds go, Barnard 68 is rather small. Clouds of this size will give birth to a few low-mass stars at most. To find out how high-mass stars are born (mass greater than about twice the mass of the Sun), another team led by one of us (Sarah Ragan) turned HERSCHEL's PACS camera to 45 significantly more massive dark clouds. As an example, Fig. II.2.5 shows the molecular cloud IRDC 316.72+0.07. These clouds contain numerous stars about to be born, which, in the images, appear as single points dotting the extended dark cloud. Fig. II.2.6 shows examples both for a dark core – an overdense region that has not (yet) formed a star – and a protostar; as the image shows, the two kinds of objects are easily distinguished at the far-infrared wavelength used in the HERSCHEL observations.

Fig. II.2.3: False-colour images of the modelled distribution of the dust temperature and its density in a slice that cuts through the centre of B 68. The dust temperature ranges from 8 K in the core centre to almost 20 K to the southeast. The area of the highest dust density coincides with the range of lowest temperatures. The three coloured, dashed lines represent cuts through B 68 that match the ones in the radial profile plot Fig. II.2.4.



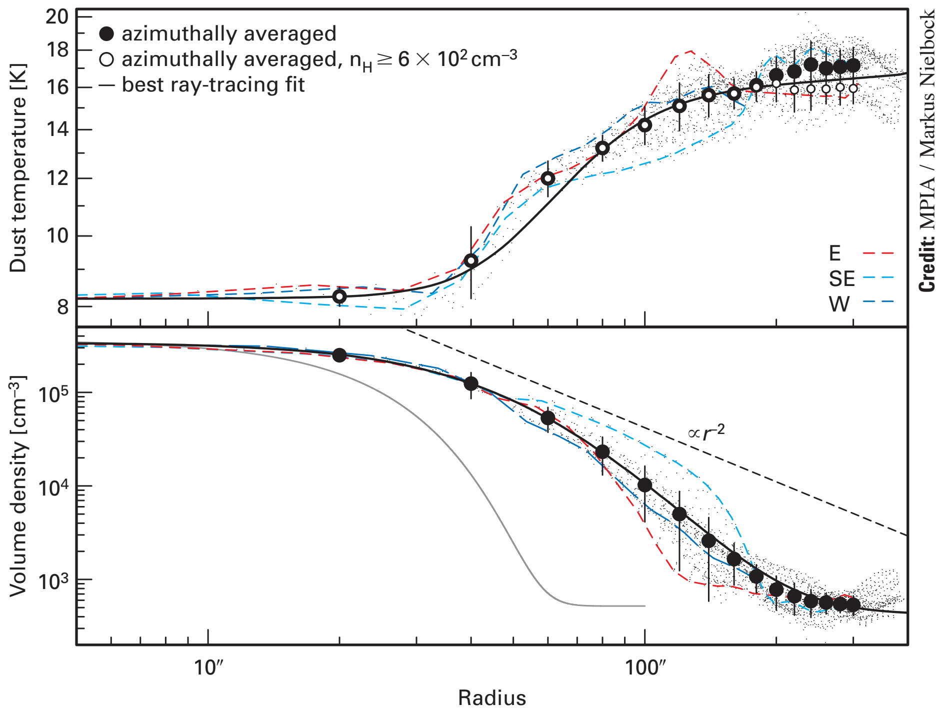


Fig. II.2.4: Radial profiles of the dust temperature and the density of B 68 based on the corresponding maps shown in Fig. II.2.3. The map pixel values are represented by the small dots. The big filled dots represent azimuthally averaged values inside 20″ wide annuli. The open white dots in the upper panel show the same for those dust temperatures that are attained at densities above 6×10^2 cm^{-3}. The error bars reflect the 1σ rms scatter of the azimuthal averaging and hence indicate the deviation from the spheroid assumption. The solid lines visualise the ray-tracing fit to the data. The coloured dashed lines correspond to the radial distributions along three selected directions, as outlined in Fig. II.2.3. The dotted lines show the canonical density power-laws for self-gravitating isothermal spheres, and the grey curve depicts a Gaussian profile with a FWHM equal to the spatial resolution of the maps.

While previous missions, such as Nasa's Spitzer Space Telescope, have also searched for these protostars, Herschel enabled us to probe deeper into the clouds than ever before. Since younger protostars are hidden much more effectively within their clouds than older ones, Herschel observations were essential in finding the youngest and most primitive protostars.

Because Herschel simultaneously observes multiple wavelengths, we have enough information to model each protostar's average temperature and mass, similar to how we modeled B 68. However, since our high-mass clouds are also further away, instead of multiple positions on one object, we have only one. The protostellar cores have typical mean temperatures between 20 and 30 degrees above absolute zero. The temperature is deduced by fitting a blackbody curve to the observations at different wavelengths, as shown in Fig. II.2.7.

The new observations swelled the ranks of known protostars from 330 to nearly 500 and, most excitingly, led to the discovery of a new type of not-quite-a-star:

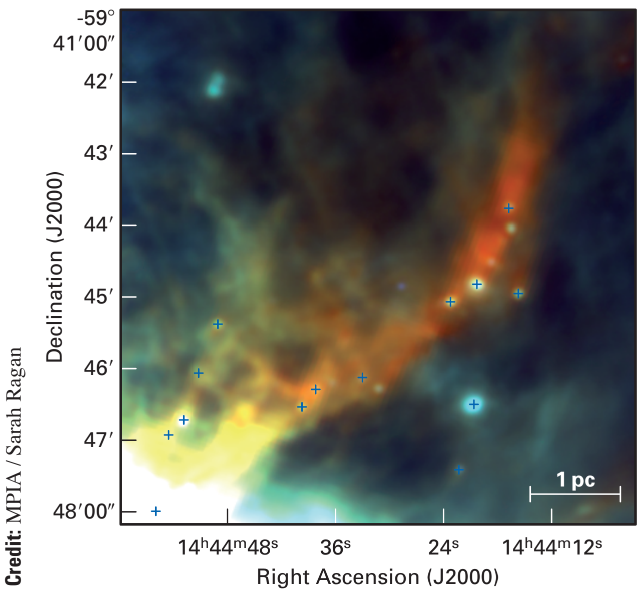


Fig. II.2.5: A false-color image of the molecular cloud IRDC 316.72+0.07. Each "+" symbol indicates the presence of a protostellar core: a region that has started to collapse, but has not yet formed a new-born star. This is the first time these early stages of star formation have been observed. The image shows infrared data taken with the Pacs instrument aboard the Herschel Space Telescope. The three colors represent three different wavelengths of far-infrared light: 70 µm (*blue*), 100 µm (*green*), and 160 µm (*red*).

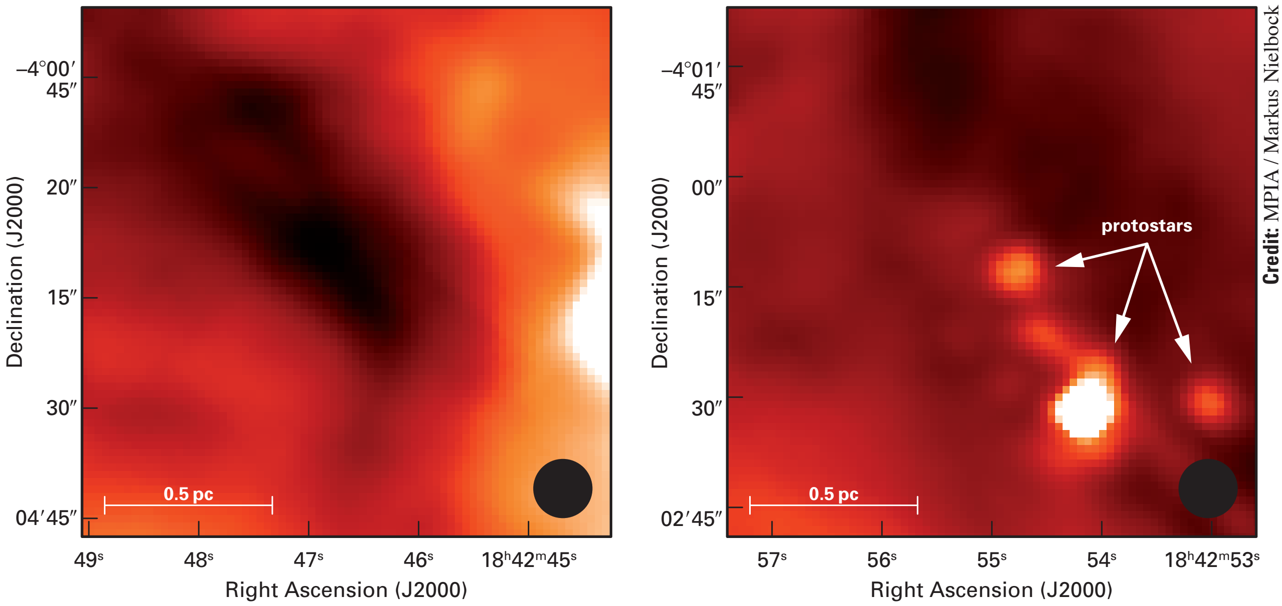
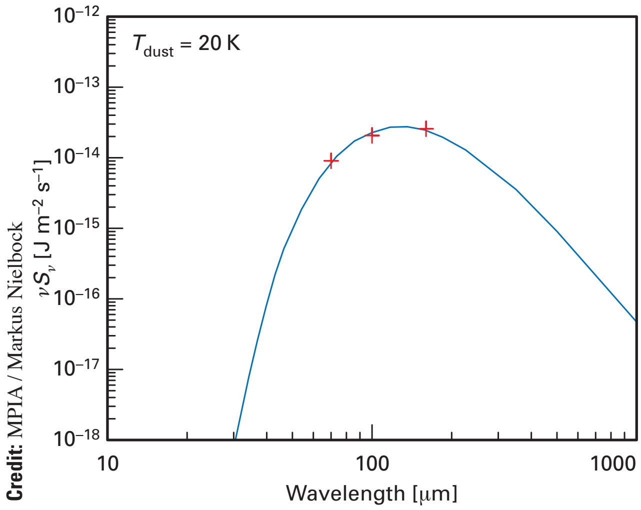


Fig. II.2.6: PACS 70 micron zoomed-in images of examples of a dark core (*left*) and protostars (*right*) in IRDC028.34+0.06. Our models indicate that 70 µm is the key wavelength in which one can discern between these types of objects.

dense regions at most 15 degrees above absolute zero (–258 °C) with no sign of a protostar. These regions are likely to be in an early precursor stage of star formation. In astronomy, where timescales of hundreds of millions or of billions of years are the norm, the fact that this precursor stage is expected to last less than 1000 years makes it extremely short-lived and therefore a rare find. Studying these elusive, pristine objects lays a necessary foundation for all subsequent studies of star formation.

The results presented here have been published in Astronomy & Astrophysics as Nielbock et al., *"The Earliest Phases of Star formation (EPoS) observed with HERSCHEL: the dust temperature and density distributions of B 68"* and as Ragan et al., *"The Earliest Phases of Star Formation (EPoS): A HERSCHEL Key Program – The precursors to high-mass stars and clusters"*.

Fig. II.2.7: Example spectral energy distribution of a protostar including the new Herschel PACS data at 70, 100, and 160 micrometers which is used to model the temperature. Also shown is the best fit for a blackbody curve, which is known to model dust emission well. The blackbody temperature corresponding to this protostar is 20 degrees above absolute zero.



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II.3 Giant black hole could upset galaxy evolution models

We have discovered a black hole that could shake the foundations of current models of galaxy evolution. At 17 billion times the mass of the Sun, its mass is much greater than current models predict – in particular in relation to the mass of its host galaxy. This could be the most massive black hole found to date. The observations used the Hobby-Eberly Telescope and existing images from the Hubble Space Telescope. The discovery could upset the accepted relationship between black hole mass and galaxy mass, which plays a key role in all current theories of galaxy evolution.

To the best of our astronomical knowledge, every galaxy with a significant bulge contains a supermassive black hole: a black hole with a mass between that of hundreds of thousands and billions of Suns. The best-studied supermassive black hole sits in the center of our home galaxy, the Milky Way, with a mass of about four million Suns.

For the masses of galaxies and their central black holes, an intriguing trend has emerged: a direct relationship between the mass of a galaxy's black hole and that of the galaxy's stars. This is one of several "black hole scaling relations" linking central black hole mass with the stellar velocity dispersion, the bulge luminosity and the bulge mass.

These scaling relations are not completely understood – at least three completely different theories have been put forth to explain the connection. The existence of these relations implies a tight co-evolution between the central black hole and its host galaxy, making them a key aspect for the study of galaxy evolution.

One of the reasons we lack a complete picture of the black hole scaling relations is the paucity of data points: there are less than a hundred galaxies for which the central black hole mass can be measured.

Testing the link between galaxys and their central black holes

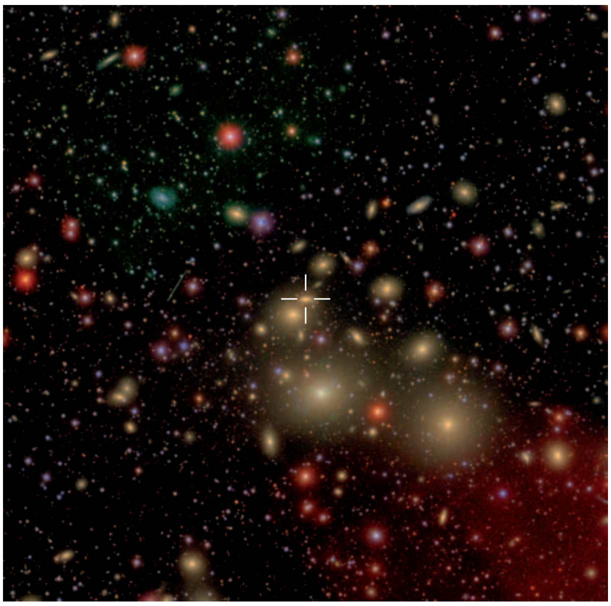
A good way of testing a relationship is to look at the extremes. For the correlation of black hole and galaxy mass, little was known about the very biggest masses. That is why, in 2010, we (more concretely, Remco van den Bosch) began a systematic search for the most massive black holes in the cosmos. For black holes of this mass, it should be possible to trace stellar motion (and hence measure black hole masses) out to distances of hundreds of millions of light-years.

The initial step of the systematic search used the Hobby-Eberly Telescope at McDonald Observatory in Texas. This telescope has a mirror of unrivaled size, with a total area of 11 by 9.8 meters, composed of 91 hexagonal mirrors. The total size makes the telescope particularly well suited for survey work of this kind, as observations for each galaxy can be completed fairly quickly. Using this telescope, we tackled the task of taking spectra of nearly a thousand nearby (≤ 100 Mpc) massive ($\geq 10^{11}\,M_\odot$) galaxies in the Hobby-Eberly Telescope Massive Galaxy Survey (HETMGS). HETMGS is a low-spatial resolution, long-slit spectroscopic survey.

The result reported here in some detail is one of the first from this systematic search; additional results will be published as follow-up observations and black hole mass-modeling are completed for additional galaxies.

From the spectra taken with the Hobby-Eberly Telescope alone, we derived a first estimate, using a well-known relation between the broadness of certain spectral lines (indicating the "velocity dispersion", roughly the amount by which stellar velocities deviate from the average) and central black hole mass. In order to do so, we needed to track the motion of the galaxy's innermost stars – those whose orbits are strongly influenced by the black hole's gravity. The greater the black hole mass, the greater its influence and the speed of the stars in orbit around it.

Fig. II.3.1: NGC 1277 is embedded in the nearby Perseus galaxy cluster, at a distance of 250 million light-years from Earth. All the ellipticals and round yellow galaxies in the picture are galaxies located in this cluster. Compared to all the other galaxies around it, NGC 1277 is a relatively compact.



Credit: David W. Hogg, Michael Blanton, and the SDSS Collaboration

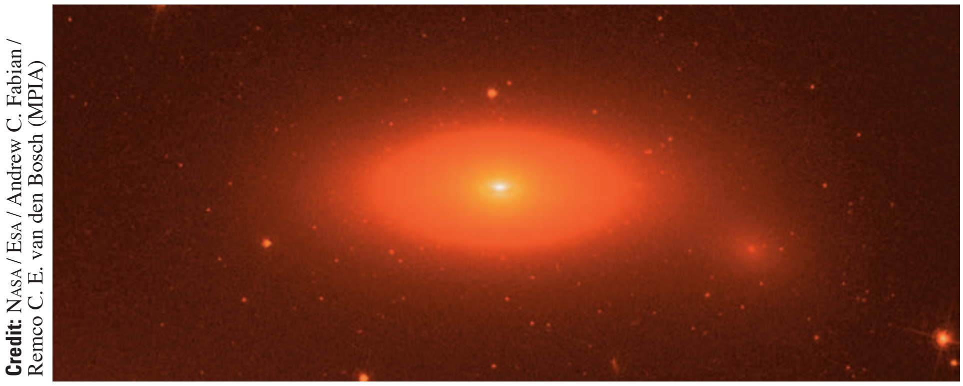


Fig. II.3.2: Image of the disk galaxy (lenticular galaxy) NGC 1277, taken with the HUBBLE Space Telescope. This small, flattened galaxy contains one of the biggest central super-massive black holes ever found in its center. With the mass of 17 billion Suns, the black hole weighs in at an extraordinary 14 % of the total galaxy mass.

Aspects of stellar motion can be measured by looking at the spectrum of light emitted in the galaxy's central region. Movement influences specific features ("Doppler shifts of spectral lines") in the galaxy's light in a systematic way, and these changes can be detected in the spectrum, allowing astronomers to reconstruct stellar motion.

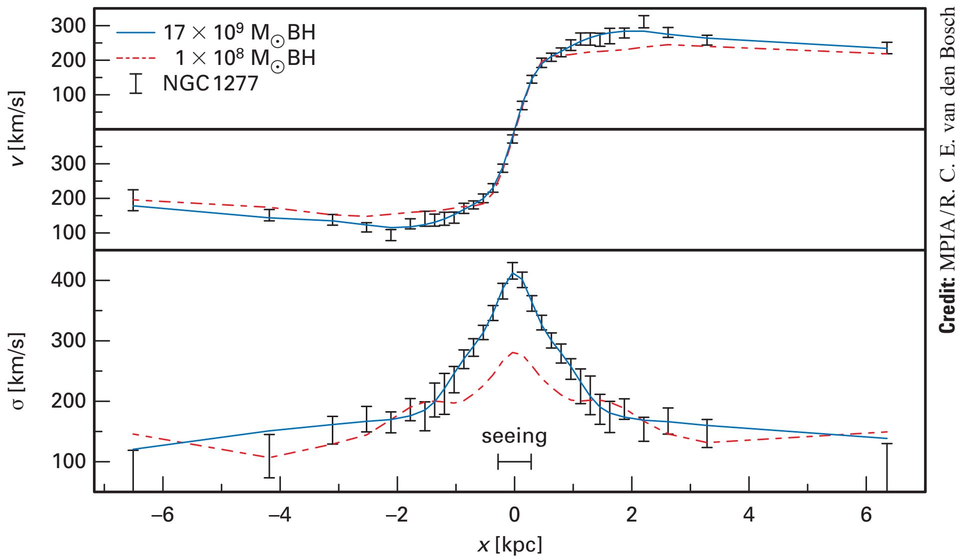
The speeds and direction in which the stars move is influenced by the distribution of mass in the galaxy. The heavier the black hole, the faster the stars move in the center. The centers of galaxies are too dense and too distant to resolve the individual stars, and so we can only measure the distribution of velocities in the spectral absorption lines.

Fig. II.3.3: Stellar velocity and dispersion for NGC 1277 from the HETMGS long-slit observations and corresponding best fit Schwarzschild model (*black line*) with a black hole mass of $17 \times 10^9 M_\odot$. A fit with black hole mass $10^8\ M_\odot$ (*red line*) as suggested by the scaling relations obviously underestimates the central dispersion peak.

Promising candidates and a record-holder

To measure the black hole mass, we created a dynamical model of the galaxies that consists of all possible orbits along which stars can travel. Through a systematic search, we then determined which combination of orbits and black hole mass fit the observed distribution of stellar velocities best.

Our effort currently focusses on 18 of the HETMGS galaxies which show intriguing properties: they are very compact (half-light radii $R_e \leq 2$ kpc), they rotate rapidly ($v_{max} \approx (150-300)$ km/s), and their velocity dispersion (an indicator of typical speeds of stars within the galaxy) is very high with an exceptional central peak ($\sigma \geq 300$ km/s), indicating high-speed stars presumably in orbit around a compact, massive central object, namely a very massive central black hole.



Credit: MPIA/R. C. E. van den Bosch

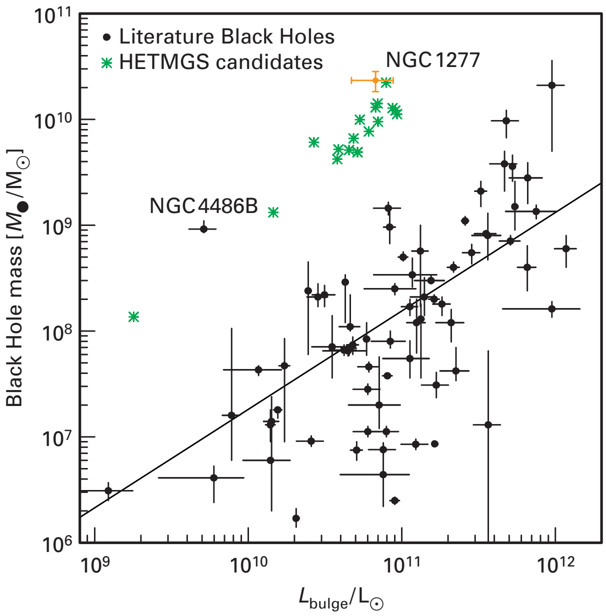


Fig. II.3.4: Relation between the bulge luminosity and the black hole mass for previously known black holes (*black dots*), NGC 1277 (*red dot*) and preliminary values for 18 high-s candidates from the Hobby-Eberly survey (HETMGS, *green points*).

For only one of these 18 galaxies, NGC 1277, high spatial resolution imaging with the Hubble Space Telescope was already available, and it was thus the focus of the black hole mass measurement. Using the brightness profile from the HST image together with the spectroscopic data, we fitted an orbit-based dynamical model that resulted in a black hole mass of (17 ± 3) $10^9 M_\odot$, roughly 17 billion times that of the Sun, cf. Fig. II.3.3.

With this mass, the newly discovered black hole in the center of the disk galaxy NGC 1277 might even be the biggest known black hole of all: the mass of the current record holder is estimated to lie between 6 and 37 billion solar masses (McConnell et al. 2011); if the true value lies towards the lower end of that range, NGC 1277 breaks the record. At the least, NGC 1277 harbors the second-biggest known black hole.

The big surprise is the relation between the black hole mass and the galaxy mass. Typically, the black hole mass is a tiny fraction of the galaxy's total mass. But for NGC 1277, things looked quite different. The galaxy as a whole weighs in at 120 billion solar masses. In other words: The black hole mass for NGC 1277 amounts to 14 % of the total galaxy mass, instead of usual values around 0.1 %. This beats the old record by more than a factor 10. Astronomers would have expected a black hole of this size inside blob-like ("elliptical") galaxies ten times larger. Instead, this black hole sits inside a fairly small disk galaxy.

Is this surprisingly massive black hole a freak accident? The survey has found 17 more candidates that are currently being studied with the Hubble Space Telescope and (the PPAK IFU at) Calor Alto Observatory by MPIA graduate student Akin Yildirim. These galaxies are comparatively small, yet, going by first estimates, appear to harbour unusually large black holes too. By combining the observed motion of the stars from Calor Alto we hope to identify more of the extraordinary large black holes. First results are shown in Fig. II.3.3.

If the additional candidates are confirmed, and there are indeed more black holes like this, astronomers will need to rethink fundamentally their models of galaxy evolution. In particular, they will need to look at the early universe: The galaxy hosting the new black hole appears to have formed more than 8 billion years ago, and does not appear to have changed much since then. Whatever created this giant black hole must have happened a long time ago.

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Glenn van de Ven, Arjen van der Wel
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II.4 Recycling galaxies caught in the act

Reconstructing the flow of material which can provide fuel for galactic star formation – reservoirs, outflows of cool gas into space and inflows back into galaxies – is one of the main goals of research into galaxy evolution. One proposed element of the star formation supply chain are matter cycles on gigantic scales, with matter flowing out of galaxies to return billions of years later. In our local galactic neighbourhood, traces of this mechanism had already been found. Here, we report on the first direct evidence of such gas flowing back into distant galaxies that are actively forming new stars, validating a key part of "galactic recycling".

Star formation regions, such as the Orion nebula, create some of the most beautiful astronomical sights. It is estimated that in our home galaxy, the Milky Way, on average one solar mass's worth of matter per year is turned into stars. This requires a steady supply of raw material – gas, more specifically cool gas, as stars are formed from cold clouds of molecular hydrogen. Gas that is too hot would require unrealistically long cooling times before star formation would become possible.

Simulations of cosmic gas flows show that, when it comes to the supply chain for star formation, galaxies form part of a much broader ecological system. According to those simulations, pristine cool gas from the intergalactic medium should flow into galaxies along the filaments characteristic for cosmic structure on the largest scales. But there is an additional possible piece of the puzzle: a gigantic cosmic matter cycle.

A possible cosmic matter cycle

Gas is observed to flow away from many galaxies. There are several different mechanisms by which gas may be pushed out, notably violent supernova explos-

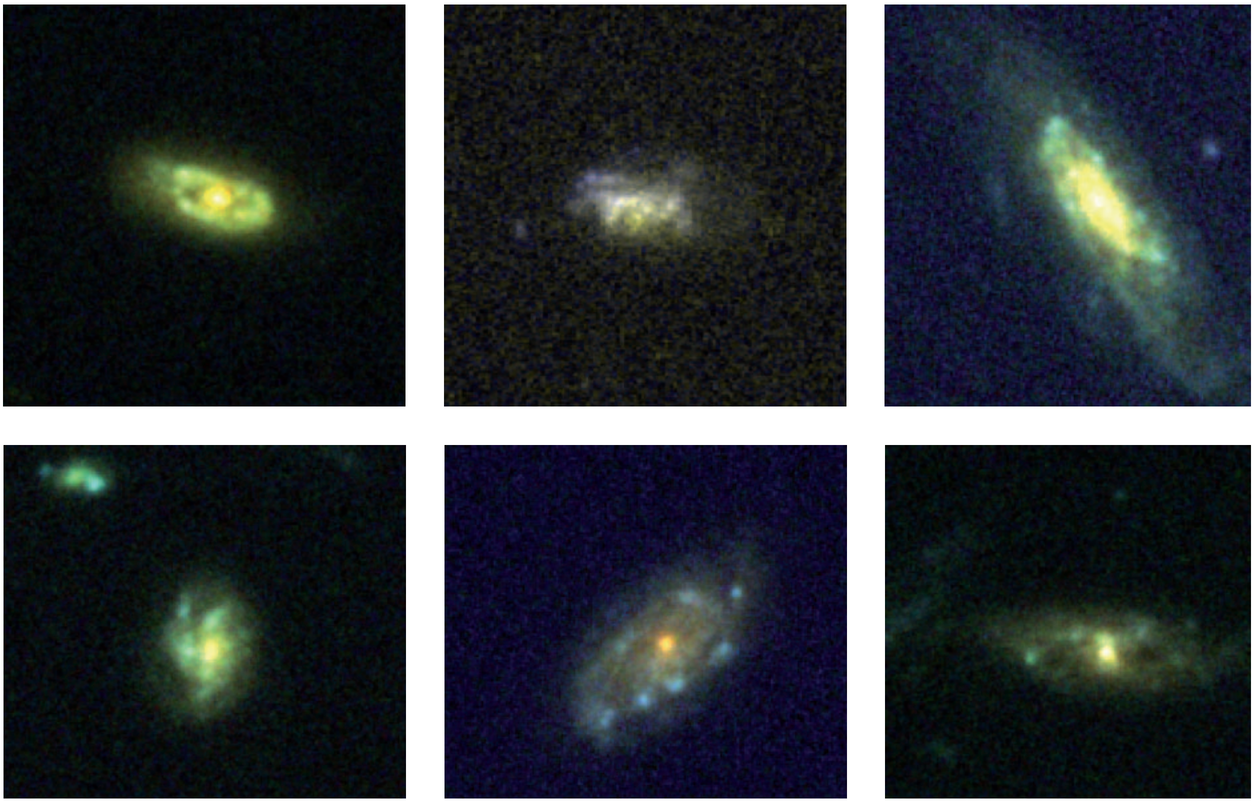
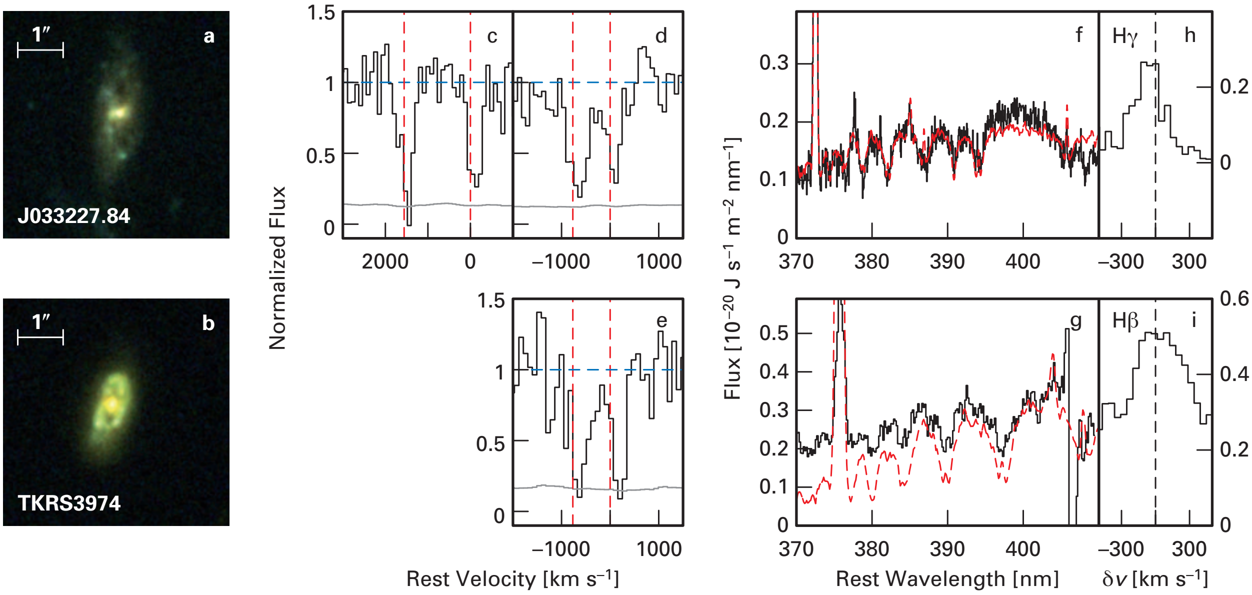


Fig. II.4.1: Images of the six galaxies with detected inflows taken with the Advanced Camera for Surveys on the Hubble Space Telescope. Most of these galaxies have a disk-like, spiral structure, similar to that of the Milky Way. Star formation activity occurring in small knots is evident in several of the galaxies' spiral arms. Because the spirals appear tilted in the images, Rubin et al. concluded that we are viewing them from the side, rather than face-on. This orientation meshes well with a scenario of 'galactic recycling' in which gas is blown out of a galaxy perpendicular to its disk, and then falls back in at different locations along the edge of the disk.

Credit: MPIA / Kate Rubin



Credit: MPIA / Arjen van der Wel

Fig. II.4.2: Combined images and spectra (magnesium iron, hydrogen) for two of the galaxies with detected inflows. Panels (*a*) and (*b*): $5'' \times 5''$ ($\sim 30 \times 30$ kpc) BVi color HST/ACS images. Panels (*c*), (*d*) and (*e*): Fe II and Mg II transitions in the galaxy spectra. Velocities are measured relative to the systemic velocities of the 260 nm line and the 280.3 nm line, respectively, as marked with *vertical dotted lines*. *Horizontal dashed lines* mark the continuum level. The *gray lines* show the 1σ error in each pixel. Panels (*f*) and (*g*): sections of the galaxy spectra showing higher-order Balmer transitions and [O II] emission, with the fitted eigenspectrum template overlaid (*red dashed line*). Panels (*h*) and (*i*): Hγ and Hβ emission lines in the galaxy spectra. This emission is offset from the systemic velocity by ~ 50 km s^{-1} in both galaxies, indicative of a difference in the velocities and/or spatial distributions of stars and the interstellar medium (ISM) of these objects.

ions (which are how massive stars end their lives), and the sheer pressure exerted by light emitted by bright stars on gas in their cosmic neighbourhood.

As this gas drifts away, it is pulled back by the galaxy's gravity, and could re-enter the same galaxy on time scales of one to several billion years. This process might solve the mystery: the gas we find inside galaxies may only be about half of the raw material that ends up as fuel for star formation. Large amounts of gas are caught in transit, but will re-enter the galaxy in due time. Add up the galaxy's gas and the gas currently undergoing cosmic recycling, and there is a sufficient amount of raw matter to account for the observed rates of star formation.

There was, however, uncertainty about the viability of this proposal for cosmic recycling. Would such gas indeed fall back, or would it instead reach the galaxy's escape velocity, flying ever further out into space, never to return?

Is recycling viable for more distant galaxies?

In the local universe, inflow into spiral galaxies had been previously observed (Wakker 2001 and Lehner & Howk 2011 for the Milky Way; Sancisi et al. 2008 for galaxies with distances up to about two hundred million light years). For more distant galaxies, in which galactic winds – outflows of gas – are known to be much stronger, the data was inconclusive: previous observations of distant (redshift $z > 0.5$) star-forming galaxies (e.g., Weiner et al. 2009, Steidel et al. 2010) had only been able to detect outflows – which is readily explained by those studies' need to average over several hundred galaxies in order to be able to extract an average motion value from their data. In such averaging, the inflow signal from some of the observed galaxies will be drowned out by the much more common outflow signals.

There had been previous observations finding inflows of gas (Sato et al. 2009, Coil et al. 2011), but in those cases, the objects under study were older galaxies in which star formation had already ceased. The work described here provides the first direct link between inflows and distant star-forming spiral galaxies – a key ingredient in understanding how galaxies grow.

On the trail of galactic recycling

In order to detect gas flows, we used the Keck I telescope on Mauna Kea, Hawaii, for a systematic study of gas flows associated with a hundred galaxies at distances between 5 and 8 billion light-years ($z \sim 0.5$–1). We made sure that the galaxies in our sample are indeed star-forming (cf. the rest-frame color-magnitude diagram in Fig.II.4.4). The data used in this study were ob-

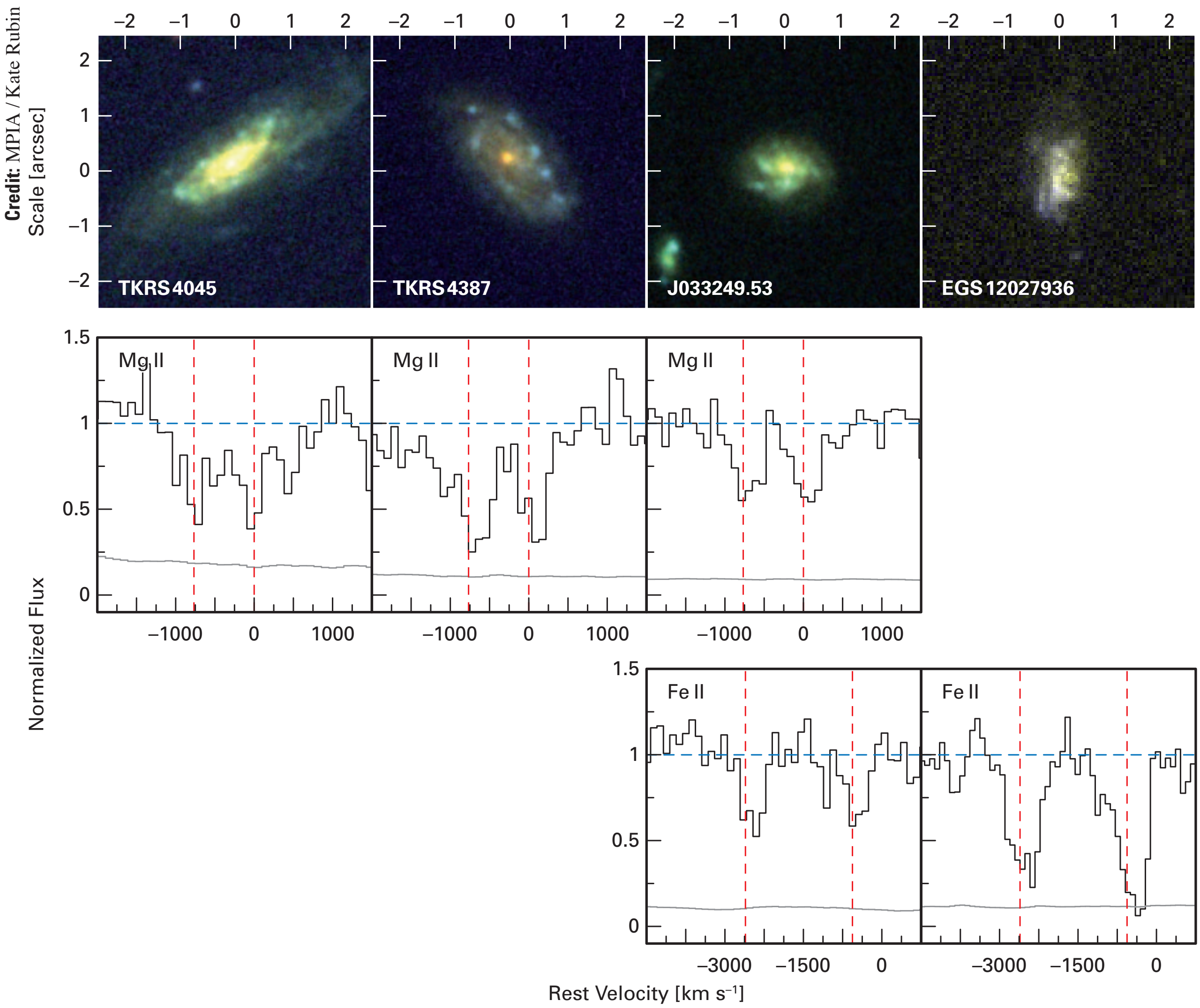


Fig. II.4.3: The remaining four objects in our inflow sample. *Top:* BVi color HST/ACS images. *Middle:* Mg II transitions, with velocities measured relative to the 2803 Å line. *Bottom:* Fe II transitions, with velocities measured relative to the 2600 Å line. Colored curves are marked as in Figure II.4.2.

tained with the Low Resolution Imaging Spectrometer (LRIS) at the Keck I telescope on the summit of Mauna Kea, Hawaii.

Thanks to the Doppler effect, spectroscopic measurements can be used to determine a gas cloud's velocity directly towards, or away from, an observer. For galaxies as distant as these, individual gas clouds are impossible to resolve. Instead, we used a simple model positing the presence of two clouds: one at rest relative to the galaxy's stars, one moving. Fitting this model to the data, we obtained an average velocity for the moving gas. In 66 % of the cases, this averaged motion was outwards. In six cases, motion was inwards, back towards the galaxy, with velocities (80–200) km/s. Spectra and small images of the galaxies are shown in figures II.4.2 and II.4.3. In the color-magnitude diagram of Fig. II.4.4, the six galaxies with inflows correspond to the six red dots.

Can we be sure that this is matter from the galaxy itself? The detection method uses spectral lines associated with the chemical elements magnesium and iron (Mg II $\lambda\lambda$2796, 2803 and Fe II $\lambda\lambda$2586, 2600). These elements are produced in stars, and are not present in the pristine intergalactic medium. Hence, measurements of this kind cannot detect inflow onto a galaxy of pristine intergalactic matter (although astronomers are very actively searching for this kind of inflow!). Instead, the gas clouds in question have clearly been inside a galaxy at some point in the past, and as the observed galaxies are isolated, matter previously ejected by the galaxy itself is the most likely candidate. There is, however, an outside chance that the gas belongs or once belonged to small dwarf galaxies being attracted to their larger cousins.

A question of tilt

The galaxies included in our survey are located in regions in the sky that had previously been imaged with

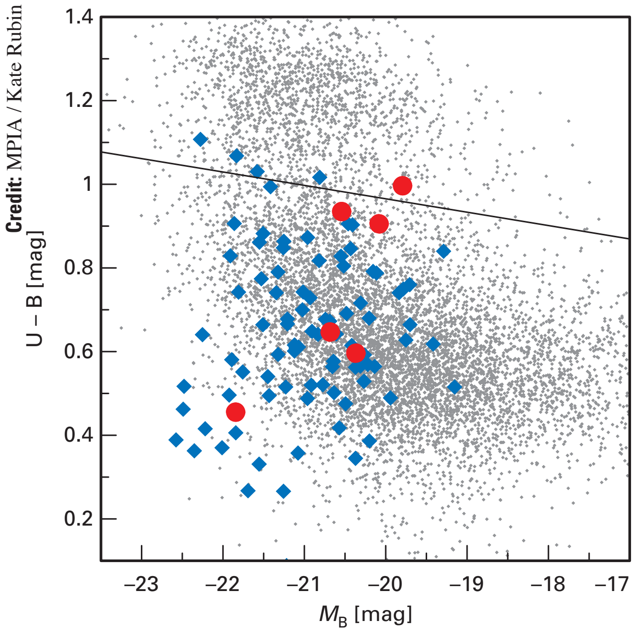
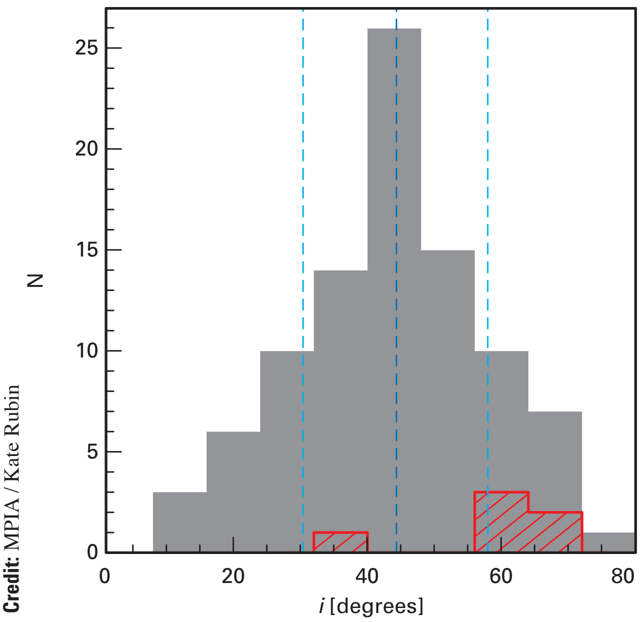


Fig. II.4.4: Rest-frame color-magnitude diagram of our sample with inflows (*red circles*) and without (*blue diamonds*). The solid line divides the red sequence (galaxies in which star-formation activity has ceased) in the upper portion of the plot from the blue cloud (star-forming galaxies) below. Half of the inflow sample are star-forming galaxies in the blue cloud, while the other half lie in the so-called green valley. Gray dots are galaxies with $0.3 < z < 1.05$ from the AEGIS survey, shown for comparison.

Fig. II.4.5: The distribution of inclinations measured from HST/ACS imaging for our complete sample. The median and $\pm 1\sigma$ inclinations are marked with dashed lines. The distribution of inclinations for galaxies exhibiting inflows (*red*) is skewed to high values (i.e., they are edge-on).



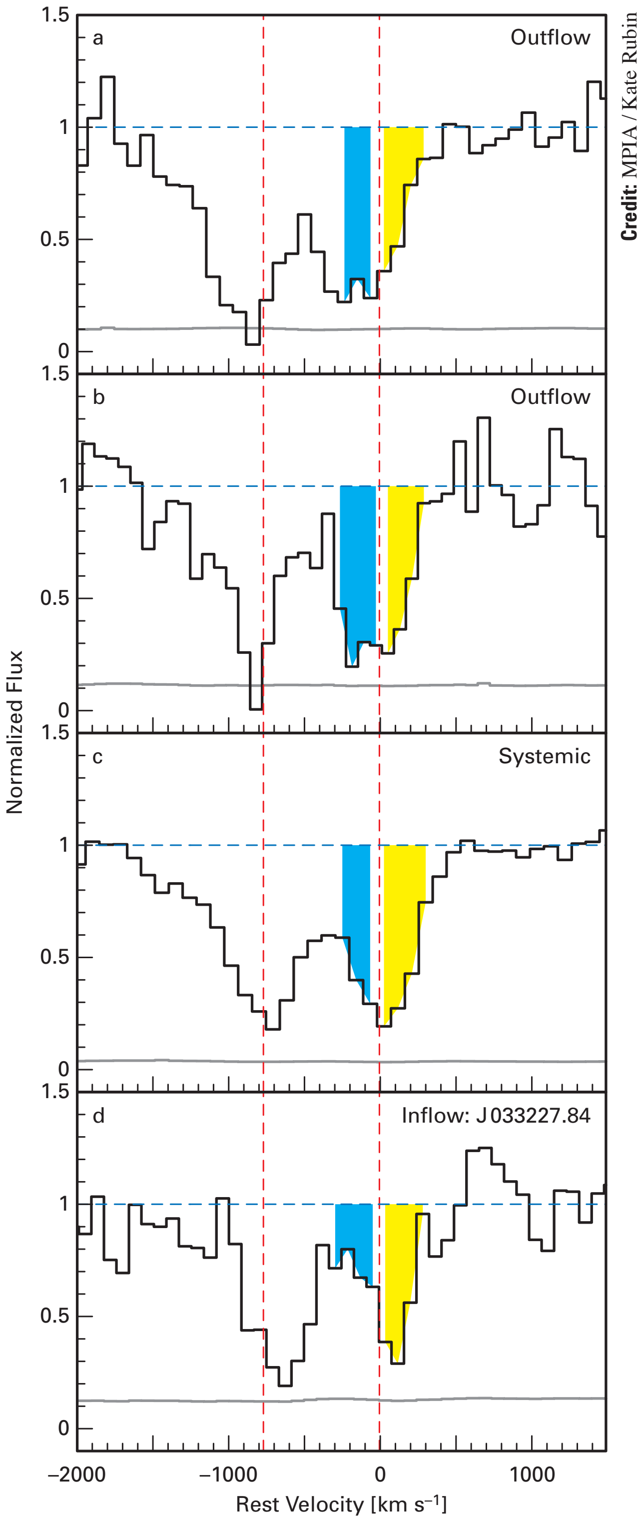


Fig. II.4.6: Comparison of the Mg II line profiles for a series of galaxies, each showing significant equivalent widths (> 1.3 Å) at $v > 30$ km s^{-1} (*yellow*), with a wide range in blueshifted (*cyan*) and systemic absorption strengths. Dashed, dotted, and gray curves are as in Figure II.4.2. Despite the significant redshifted absorption, we only confidently identify inflow for the system without strong blueshifted/systemic absorption, the galaxy at the bottom which is one of our six inflow examples.

the Hubble Space Telescope's Advanced Camera for Surveys (ACS). These images yielded interesting additional information: they show five of the six galaxies are disk galaxies that we see almost edge-on. This is a significant proportion of substantial tilts (high inclinations), cf. Fig. II.4.5, which is interesting because there is one model of galactic recycling, the "fountain model", in which outflows occur mostly perpendicular to the disc, and inflows predominantly sideways.

There is also the fact that, in measurements such as ours that detect an average flow, weaker inflows may be masked by stronger concurrent outflows. This is confirmed by a closer look at the absorption lines, a small sample of which can be seen in Fig. II.4.6: In a number of cases, hints of an inflow are present, but could not be identified with sufficient confidence either because of a dominating outflow or for lack of clear separation from the spectral line associated with the galaxy's stars (systemic component).

Combining orientation-dependence and masking effects, the real proportion in our sample of galaxies with orientation-dependent inflow could be as high as 40 %.

Thus, our observations not only provide the first direct link between inflows and distant star-forming spiral galaxies – representing, as they do, the first unambiguous detection of inflow into isolated, star-forming galaxies in the distant universe. The numbers also allow for cosmic recycling, in the shape of "galactic fountains", as a common element of galactic supply chains. Further research is needed to explore the specifics and extent of cosmic recycling – and the question of which role is played by inflows of pristine intergalactic matter.

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III. Selected Research Areas

III.1 Massive Star Formation in different environments

Massive stars are born deeply hidden inside molecular clouds. Observations of sites of massive star formation have shown that stars do not form in isolation, but in groups ranging from large and low stellar density associations to compact and very dense starburst clusters. The key questions are how these embedded clusters form, and why their morphologies look so different. In this contribution we review the research at MPIA addressing these questions.

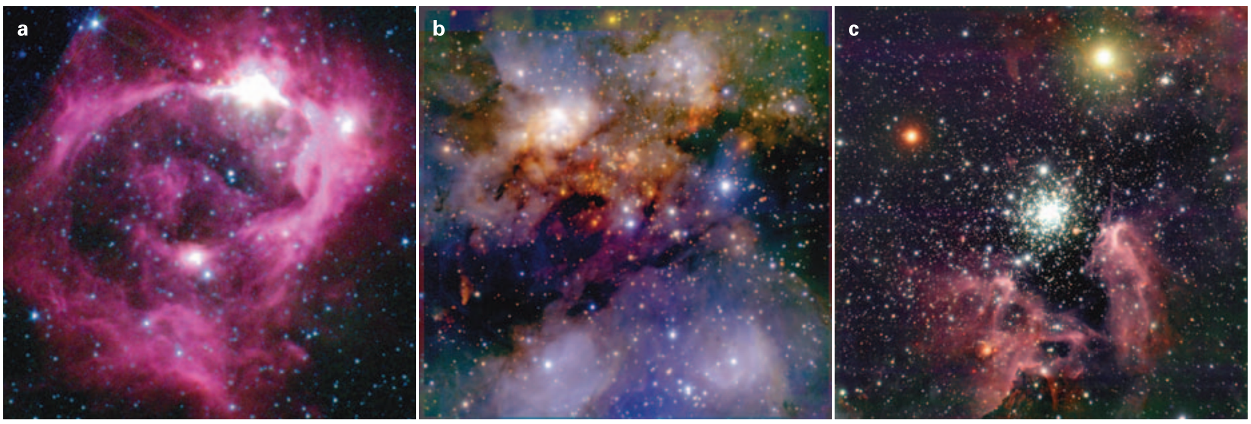
Despite the impact on their surroundings, the formation and early evolution of massive stars is poorly constrained, primarily because of their scarcity and short lifetimes. Massive stars form deeply embedded in giant molecular clouds (GMCs) and are typically found on kiloparsec distances. This makes the observational study of the formation and the evolution of the young massive stars challenging. An additional complication is that massive stars do not form alone and isolated. They form in groups and aggregates, calling for the need of high-angular resolution observations to resolve the individual massive stars in these groups.

Observations of regions of star formation in our Galaxy show that star-forming regions come in all kinds of morphologies and densities. On the extreme end of the stellar density spectrum, the stars form in very compact clusters with very high stellar densities, the so called starburst clusters. These clusters consist of several 10 000 solar masses in stars within less than a parsec diameter. In less extreme environments, a comparable amount of stellar mass is distributed over several tens of pc in low-stellar density associations. This raises the question whether the same star formation mechanism is responsible for the formation of these different structures. Determining the star formation history, by means of characterizing their stellar content, will provide insights in how these different regions are formed.

Embedded clusters in our Galaxy

Embedded clusters containing the recently formed stars in our Galaxy are still partly hidden in their natal molecular cloud. Therefore many of them remain undetected at optical wavelengths. Near-infrared galactic plane surveys like 2Mass, UKidds and the latest Vista surveys have revealed many new embedded clusters. However, in spite of these advances, our census of the embedded cluster population in our Galaxy is still far from complete. Especially the detection of clusters more distant than a few kpc is highly incomplete. Embedded clusters have masses ranging from a few 100 solar masses unto several times 10^4 solar masses for the most massive objects. The most massive embedded clusters are scarse in our Galaxy and only a few 10s of these objects are known in our Galaxy. At MPIA we have concentrated in studying a selected sample of well know embedded clusters in great detail. These embedded clusters cover a large range of mass and stellar density, therefore probing different star formation environments (Fig. III.1.1).

Fig. III.1.1: *Left:* Color composite of Spitzer data of embedded cluster RCW 34 and the surrounding bubble (blue: 3.6 micron, green: 4.5 micron, red: 8 micron). *Middle:* Luci near-infrared JHK color-composite of W3 Main. *Right:* Near-infrared JHK color composite of starburst cluster NGC 3603 and immediate surroundings (see also the title page of this annual report).



Credit: a/b: MPIA / Arjan Bik, c: Bernhard R. Brandl, Cornell University

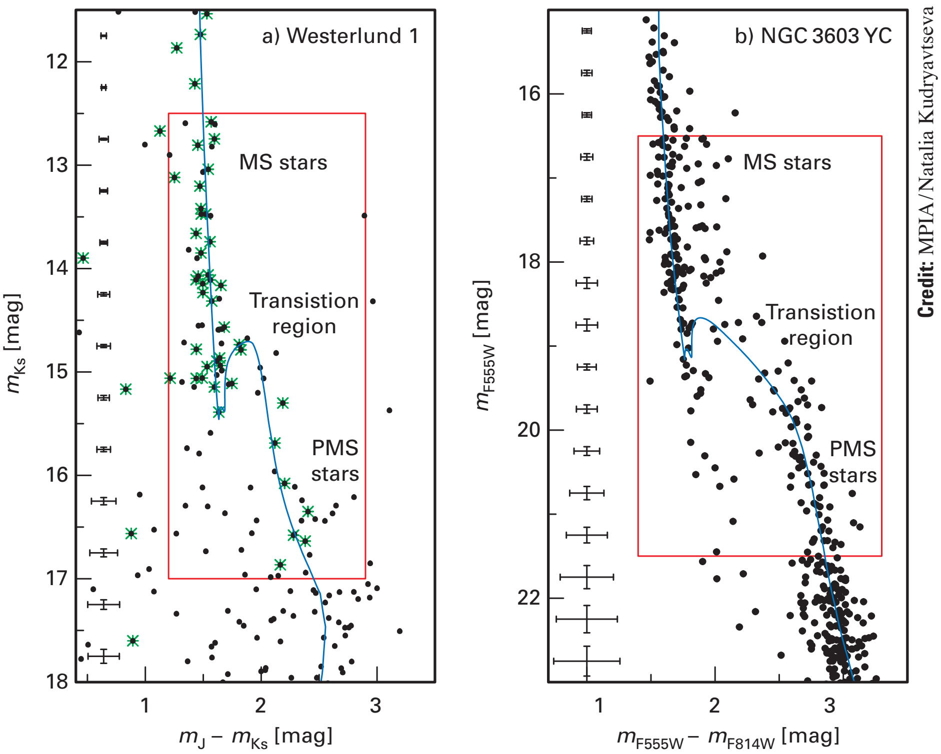


Fig. III.1.2: CMD of the starburst clusters Westerlund 1 and NGC 3603 YC, which are fitted well by single isochrones, suggesting single-age stellar populations in either of the clusters.

Characterizing the embedded clusters

These regions are studied using a variety of different observational techniques. The stars are characterized in detail by photometry at optical and near-infrared wavelengths as well as optical and near-infrared spectroscopy. The dust and gas still present in most of these regions are detected and characterized using the SPITZER

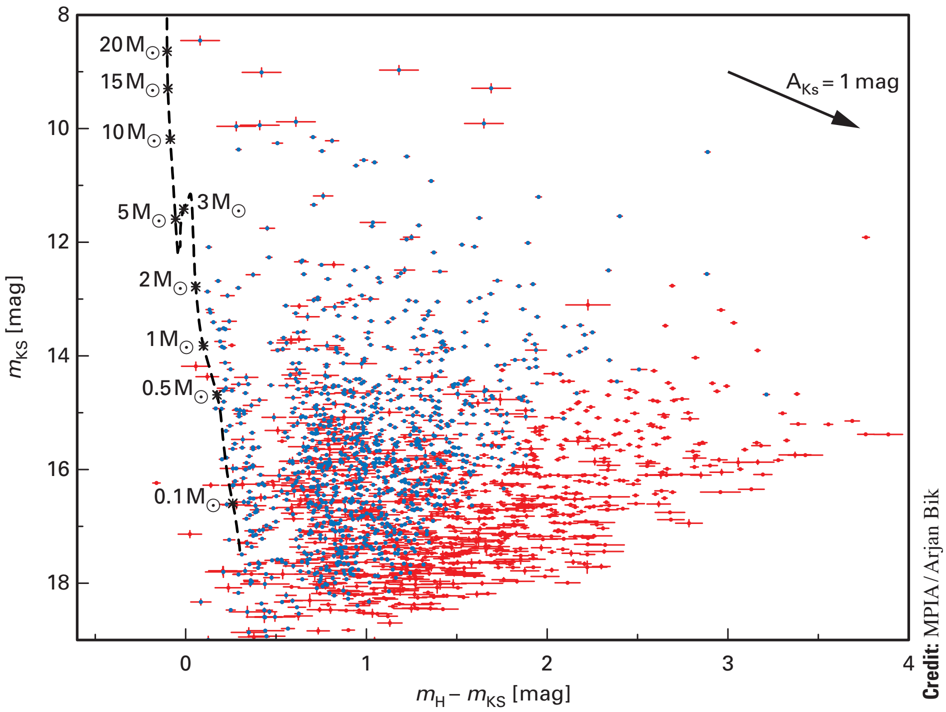


Fig. III.1.3: CMD of embedded starcluster W3 Main. The spread in observed color is caused by the highly spatially variable extinction.

and HERSCHEL galactic plane surveys as well as the mm surveys ATLASGAL and the Bolocam GPS survey. This allows a complete characterization of the stars and their interaction with the dust and gas from the natal molecular cloud the embedded clusters have formed in as function of different cluster environment.

Imaging observations of embedded clusters reveal their stellar content. Observations with the adaptive optics assisted instrument NACO at the VLT provide the most detailed look into the centers of the very dense starburst clusters. For lower density systems, seeing limited observations with e.g. LUCI1 at the LBT allow a detailed photometric characterization of the stellar content. Analysis of the color-magnitude diagram (CMD, Fig. III.1.2) leads to the derivation of fundamental cluster properties like age, distance and cluster mass. Comparing the positions of the stars in e.g. a K vs J–K CMD with theoretical stellar evolution models and isochrones leads to a photometric determination of the stellar mass and age. When extinction is low or uniform, the CMD is an excellent diagnostic tool to determine properties of the stellar clusters (e.g. Gennaro et al, 2011, MNRAS, 412, 2469). However, in the case of variable extinction and strong contamination of fore- and background stars, the analysis of the CMD becomes more complicated (Fig. III.1.3, Bik et al, 2013, accepted by A&A). Differential extinction will redden the position

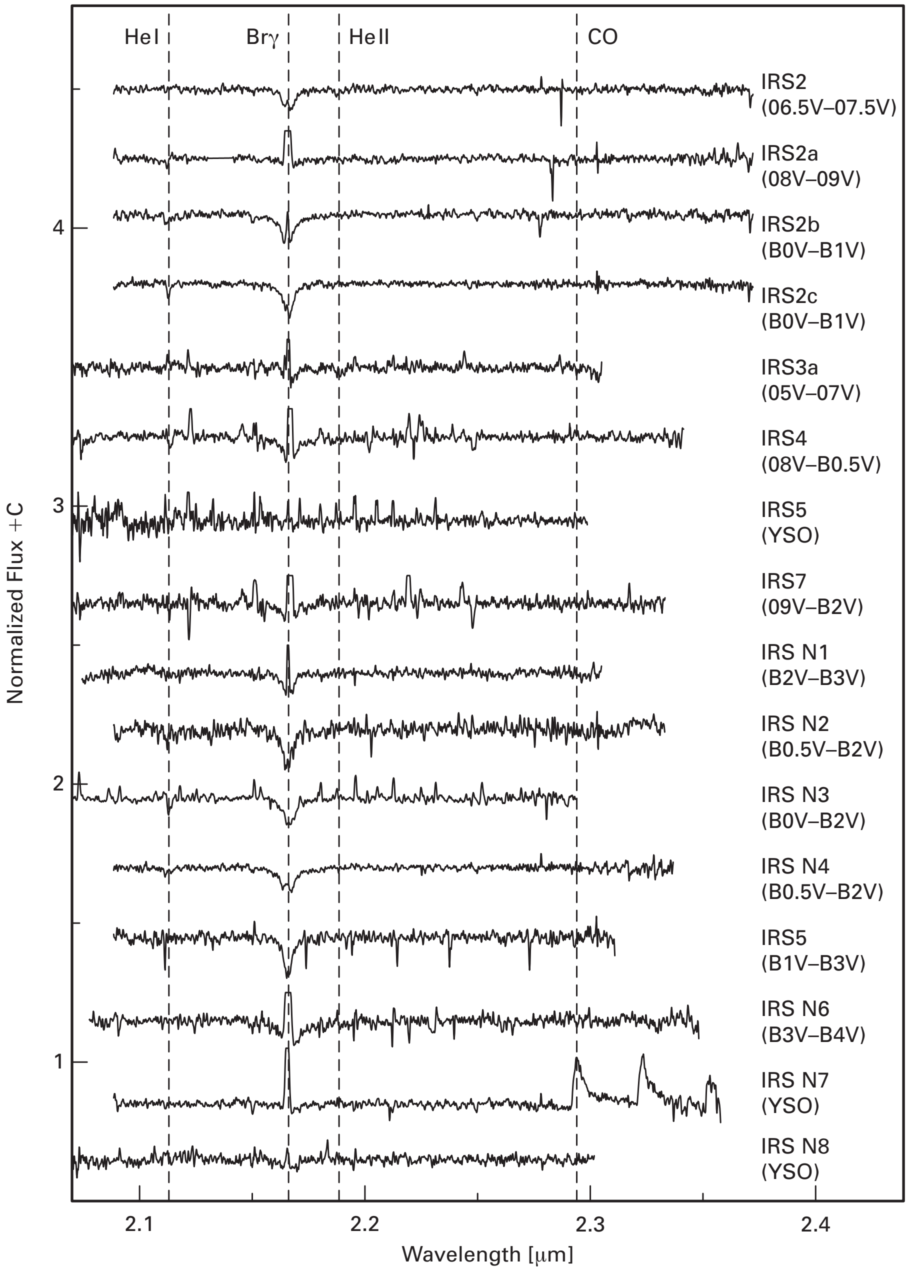


Fig. III.1.4: *K*-band spectra of massive stars in W3 Main observed with LUCI at the LBT. The most important diagnostic lines are marked.

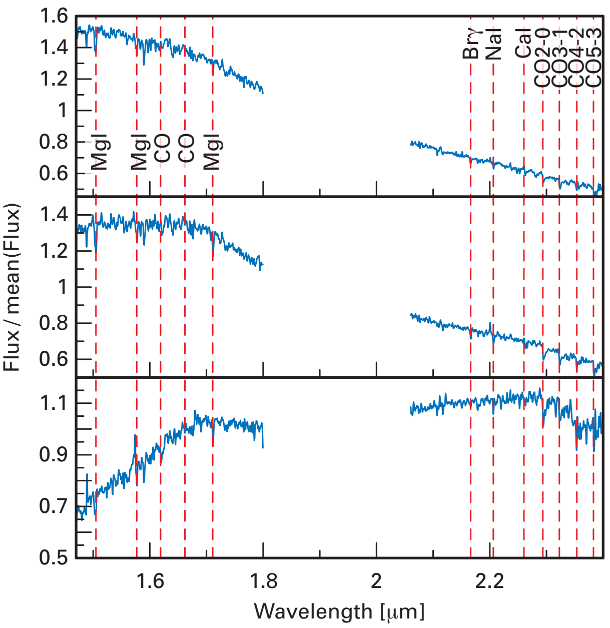
Credit: MPIA/Arjan Bik

of each star differently, resulting in a much more messy CMD without a clear sequence present of cluster member stars. Additionally, infrared excess sources, young stars still surrounded by circumstellar disks are another complicating factor to interpret the photometric data of embedded clusters.

A powerful tool is using near-infrared spectra of the stellar content to derive the cluster properties. Using reference spectra of optically classified stars, the near-infrared spectra of embedded massive stars and lower-mass pre-main-sequence stars can be unambiguously classified. Using advanced techniques like Integral Field spectroscopy using SINFONI at the VLT and multi-object-spectrsocopy with LUCI1 at the LBT we are able to take spectra of many cluster members simultaneously. This allows an efficient characterization of the entire massive star content of the embedded clusters. The massive stars (more massive than ~5 solar masses) are classified based on their hydrogen and helium absorption lines (Fig. III.1.4, Bik et al, 2012, ApJ, 754, 87). The stars with masses between 1 and 5 solar masses are classified using their metal lines (Ca, Mg) and CO molecular absorption bands (Fig. III.1.5, Bik et al, 2010, ApJ, 713, 883; Wang et al, 2011, A&A, 527, 32). The derived spectral types can be related to an effective temperature using theoretical model atmosphere calculations.

The derived effective temperatures and luminosities allow the placement of the objects in a Herzsprung Russell Diagram (HRD, Fig. III.1.6) and they can be compared to theoretical models of stellar evolution. The massive stars are compared to main sequence models and the most massive stars (30 solar masses or more) evolve of the main sequence after a few Myrs, so their post-main sequence evolution can be used to constrain the age of the cluster. The lower-mass stars evolve much slower and have not reached the main sequence yet. Their age is determined by comparison to pre-main-sequence tracks.

Fig. III.1.5: *K*-band spectra of intermediate mass PMS stars observed with SINFONI at the VLT. The most important diagnostic lines are marked.



Credit: MPIA / Arjan Bik

With the wealth of galactic plane surveys available in the infrared (SPITZER), far-infrared (HERSCHEL) and sub(mm) (ATLASGAL, BGPS) we can obtain detailed information not only of the stars, but also of the gas and dust. This allows us to study the interplay between the stars and the natal molecular cloud material in detail. The strong UV output of the massive stars has a strong influence on the gas and dust, nearby the massive stars, the dust is destroyed and the gas is ionized, creating HII regions. Further away the effect of the massive stars might trigger new generations of star formation by compressing molecular clouds and initiating the collapse to form stars.

Star formation history

We have studied a sample of embedded clusters covering a large range of masses and morphologies using the methods described above. This allows us to derive the progression of star formation in the GMCs as a function of stellar cluster properties. In all studied embedded clusters we find multiple episodes of star formation present. In Gennaro et al. (2012, A&A, 542, 74) a clear progression of star formation in the molecular could has been found after spectral typing the stars in the embedded clusters inside CN 15. Stellar photospheres of main sequence B stars were detected in the oldest cluster in the cloud, while YSOs and deeply embedded ultra-compact HII regions were identified in neighbouring regions in the same GMC.

The analysis of RCW 34, an embedded cluster in the Vela Molecular cloud complex, shows a similar picture (Bik et al, 2010, ApJ, 713, 883). Spectroscopy of the PMS stars resulted in an age estimate of the cluster surrounding an O8V star of 2 Myr. Spitzer imaging of this regions showed that the complex was a lot larger then seen from our near-infrared data alone. The near-infrared cluster is located at the northern edge of a much larger bubble seen in the SPITZER image (Fig. III.1.1). To the north of the cluster, a ionization front was seen in our Integral Field spectroscopy marking the interaction between a dense molecular cloud and the embedded cluster. In fact the dense molecular cloud is the youngest star formation side, also showing here the presence of multiple generations of star formation in the same complex.

A detailed analysis of the stellar content of the embedded cluster W3 Main (Fig. III.1.1) shows that also inside embedded clusters different generations of stars and currently forming stars can co-exist. Our LUCI1 spectra of the massive stars reveal the spectral types of 15 massive stars between 10 and 35 solar masses. Comparing their location in the HRD suggests that the most massive star (IRS2) is already evolved from the main sequence as an estimated age of 2–3 Myr. Radio data and (sub)-mm data of W3 Main show that in the same cluster star formation is currently still active. Several Hyper-compact and ultra-compact HII regions are detected inside W3 Main. Also right in the center of the cluster a high-mass protestellar object IRS 5 is located. IRS 5 is a small protocluster of stars still in the process of formation. A detailed study of the molecular gas around IRS5 suggests that gas as wrapped around one of the brightest HII regions in W3 Main (Wang et al, 2012, ApJ, 754, 87) suggesting that the formation of IRS 5 is triggered by the expanding HII region around the already formed massive star. These data suggest that the center of W3 Main is the youngest region where the star formation is still ongoing. Towards the outer regions, the HII regions get bigger, suggesting an older age. Combining all this information results in the conclusion that in this embedded cluster, star formation started about 2–3 Myr ago and is currently still active.

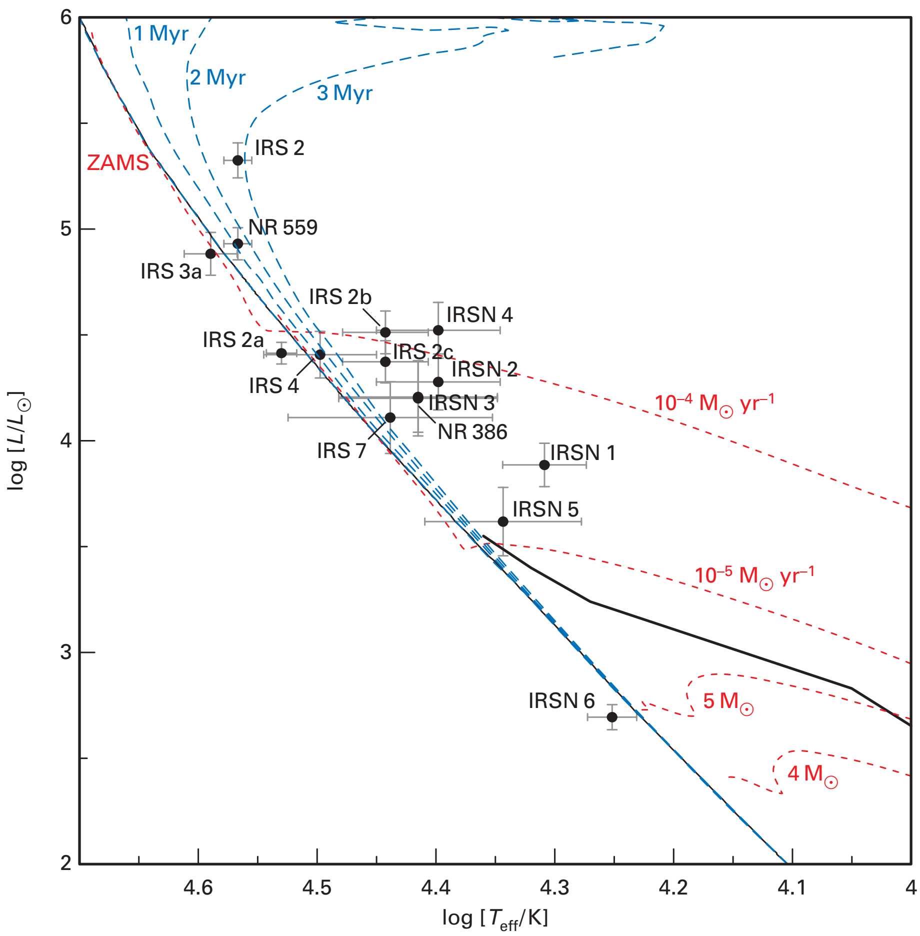


Fig. III.1.6: HRD of the massive stars in W3 Main. Theoretical isochrones are overplotted as lines in the HRD.

Credit: MPIA/Arjan Bik

Galactic starburst clusters

Galactic starburst clusters represent the most extreme mode of present-day star formation in the Milky Way. They are ideal laboratories for studies over the entire stellar mass range from less than 0.1 to more than 120 solar masses. We focussed our studies on the two spiral arm clusters Westerlund 1 and NGC 3603 YC (Fig. III.1.1), and the two galactic center clusters Arches and Quintuplet. Multi-epoch astrometric monitoring with the Very Large Telescope and the Hubble Space Telescope enabled us to distinguish cluster members from field or foreground stars. Masses of individual cluster members were derived from their photometric properties and by comparison with model isochrones. The astrometry also provided information on the clusters internal dynamics.

Among the most surprising results are

i) The Galactic Center starburst clusters Arches and Quintuplet move relatively fast with respect to the surrounding field, indicating that both clusters are moving on Rosetta-shaped orbits around the center of the Milky Way. The orbits track back to the formation of the clus-

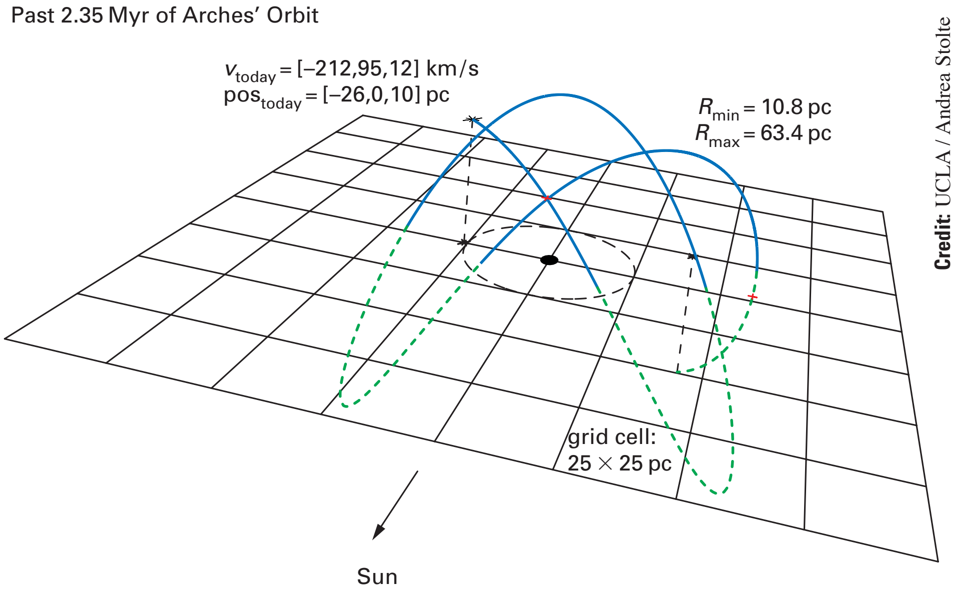


Fig. III.1.7: Visualization of a plausible 3D orbit of the Arches cluster around the center of the Milky Way over the past 2.35 Myrs, hinting at the Rosetta-shape of the orbit.

ters, indicating that either of them might have formed by collisions of molecular clouds belonging to two distinct orbital families (Fig. III.1.7).

ii) Stars within each of the spiral arm clusters NGC 3603 YC and Westerlund 1 are almost coeval (Fig. III.1.2). For both clusters, the age spread of the cluster populations amounts to less than 10 percent of the respective cluster age. Star formation in the approximately 1 Myr old cluster NGC 3603 YC lasted for not longer than 100 000 yr. Thus all cluster members within a volume with a radius of half a Parsec indeed originated in a single burst of star formation. For the 4 Myr old cluster Westerlund, which has about twice the diameter and 4 to 6 times the mass of NGC 3603 YC, all stars formed within a burst lasting not longer than 400 000 yr. Like for the galactic center clusters, collisions between two molecular clouds provide the most plausible explanation for the occurrence of starbursts in Milky Way spiral arms.

iii) The dynamical and photometric mass estimates for each of the clusters are in close agreement with each other. This hints at high star formation efficiency and that the clusters are dynamically stable and could survive for extended periods of time.

Summary

Summarizing, we find that each star formation harbours different episodes of star formation. Different parts of the GMCs collapse at different times and form distinct generations of star formation. However, evidence for age spread inside W3 Main suggest that even inside a cluster different generations are present. However, this is hard to detect and even for the one of the best studied clusters, the Orion Nebula cluster, a huge debate in the literature showing and disproving the presence of age spread is reported (e.g. Da Rio et al, 2010, ApJ. 722, 1092). For starburst clusters on the other hand no evidence for age spread has been found, suggesting a different formation mechanism for these extreme objects. Further detailed studies covering a large range of clusters should confirm this suggestion that starburst clusters are form in one burst of star formation while more extended regions of star formation form over a longer time scale.

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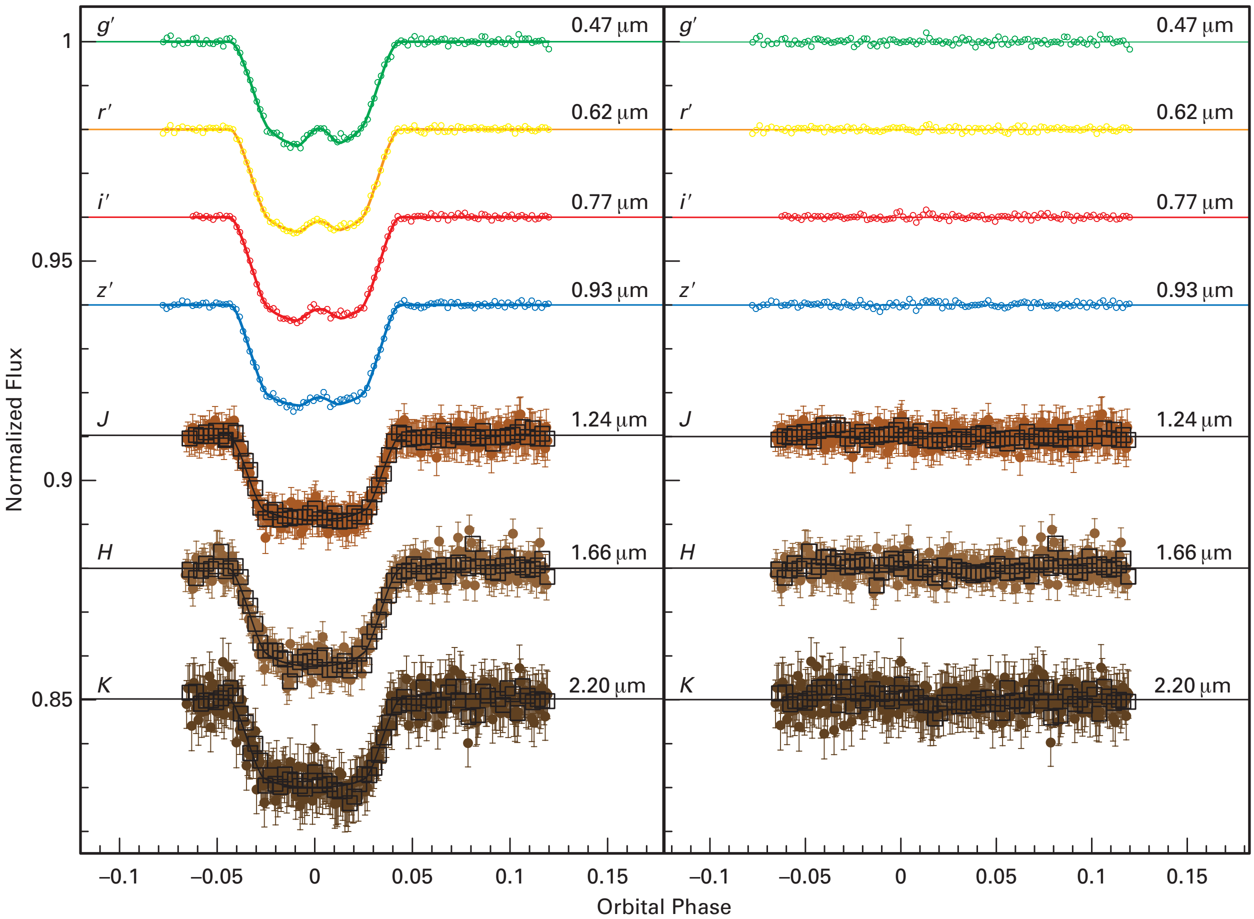
III.2 Studying the Atmospheres of Extrasolar Transiting Planets

Among all the extrasolar planets detected so far, those that transit their parent stars are of especially great interest. Only for these objects is it possible to directly measure both their bulk physical properties (mass and radius) and conditions in their atmospheres. Transiting extrasolar planets (TEPs) have provided myriad fascinating surprises and puzzles since their discovery, thus opening a new, hybrid field that combines aspects of both astrophysics and planetary science. The ever-increasing number of confirmed TEPs is progressively revealing a remarkable diversity, and the growing sample is a promising avenue for establishing the correct theoretical framework of planet formation and evolution. Accurate estimates of the planet properties (mass, radius, orbital semi-major axis, etc.) are vital for this purpose, and photometric follow-up of TEPs can dramatically improve our knowledge of the planet's characteristics.

Another fascinating opportunity offered by TEPs is the possibility to probe their atmospheres. Due to atomic and molecular absorption, the analysis of the spectrum, over particular ranges of wavelengths, of the parent stars during transit (primary eclipse) and secondary eclipse events is an excellent way to probe their atmospheric composition (Seager & Deming 2010). The transmission-spectroscopy technique, initially performed with the use of space telescopes (Hubble and Spitzer) and then also with ground-based photometers and spectrometers, has led to the detection of Rayleigh scattering, plus absorption lines associated with Na, K, CO, H_2O, TiO, VO in the atmospheres of several hot, short-period

Fig. III.2.1: *Left panel:* simultaneous optical and Nir light curves of one transit event of Wasp-19b observed with Grond. Black empty squares show the three Nir light curves binned to reduce the scatter. The best fits are shown as solid lines for each dataset. The passbands are labelled on the left of the figure, and their central wavelengths are given on the right. The error bars of the optical data have been suppressed for clarity. The bump observed in the optical light curves, roughly at the mid-transit time, is interpreted as the occultation of a starspot by the planet. *Right panel:* the residuals of each fit.



Credit: MPIA / Luigi Mancini

TEPs. We are pursuing studies along these lines here at MPIA, including photometry and spectroscopy of both big & hot, and smaller & cooler, planets.

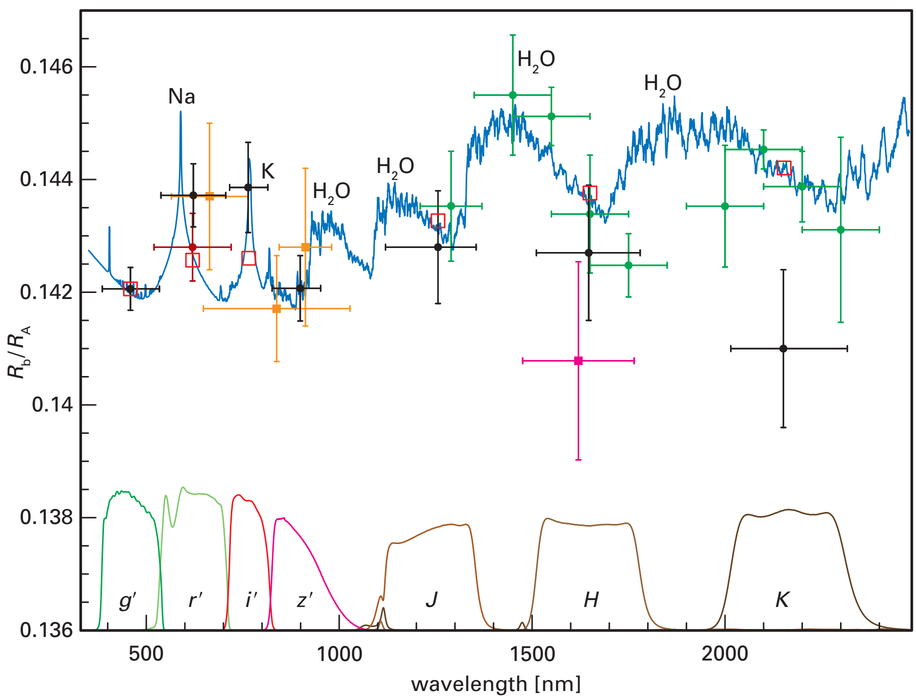
Simultaneous Multiband Photometry of Hot Jupiters

A powerful technique to probe the atmospheres of TEPs is to study their transits with simultaneous photometry at different wavelengths. This observational strategy permits measurements of the radius of TEPs in each bandpass to look for possible variations that can be attributed to the absorption of the light from the parent stars at specific wavelengths due to their atmospheric constituents. An advantage of this technique over the spectroscopic approach (see below) is that the differential photometry approach is less susceptible to some systematic effects (variations in telluric transparency, slit losses, etc.) and observations can be acquired more efficiently using smaller-aperture telescopes.

We are exploring this science case by using two imaging instruments designed for simultaneous multi-colour photometry: Busca, mounted on the 2.2 m telescope at the German-Spanish Calar Alto Observatory, and Grond, on the Eso / MPG 2.2 m telescope at the Eso observatory in La Silla. Grond in particular, is a versatile tool for these studies because it is capable of simultaneous photometric observations in four optical and three Nir passbands.

As an example, Grond observations of a planetary transit of Wasp-19b are shown in Fig. III.2.1. Anomalies were detected in the four optical bands and interpreted as the consequence of the planet crossing dark spots on the stellar photosphere of the parent star. WASP-19b is an extremely short-period, hot-Jupiter moving on a circular orbit around a G8V star every 0.79 days. Its expected equilibrium temperature (> 2000 K) places it in the class of highly irradiated planets. The broadband photometric transmission spectrum is shown in Fig. III.2.2, where data from Grond are in black. The vertical bars represent the errors in the measurements and the horizontal bars show the full widths at half maximum transmission of the passbands used. The experimental points are compared with a synthetic spectrum that does not include TiO and VO opacity. The atmosphere of Wasp-19b seems to be dominated by absorption by H_2O, Na, and K, and there is no evidence for a strong optical absorber at low pressure. These results agree well with the fact that Wasp-19b's atmosphere lacks a dayside temperature inversion in its upper atmosphere. We are building on these and other successful observations by pursuing more Grond observations of additional systems.

Fig. III.2.2: Variation of the planetary radius, in terms of planet/star radius ratio, with wavelength. *Black diamonds* are from Grond. The *vertical bars* represent the errors in the measurements and the *horizontal bars* show the full widths at half maximum transmission of the passbands used. The observational points are compared with two models. These use profiles which are intermediate between planet-wide and day-side. The synthetic spectrum shown (*solid blue line*) does not include TiO and VO opacity; *red open boxes* indicate the predicted values in each bandpass, given this model. Transmission curves of the Grond filters are shown at the bottom. Prominent features are labelled.



Credit: MPIA / Luigi Mancini

Infrared Transmission Spectroscopy of Extrasolar Ice Giants

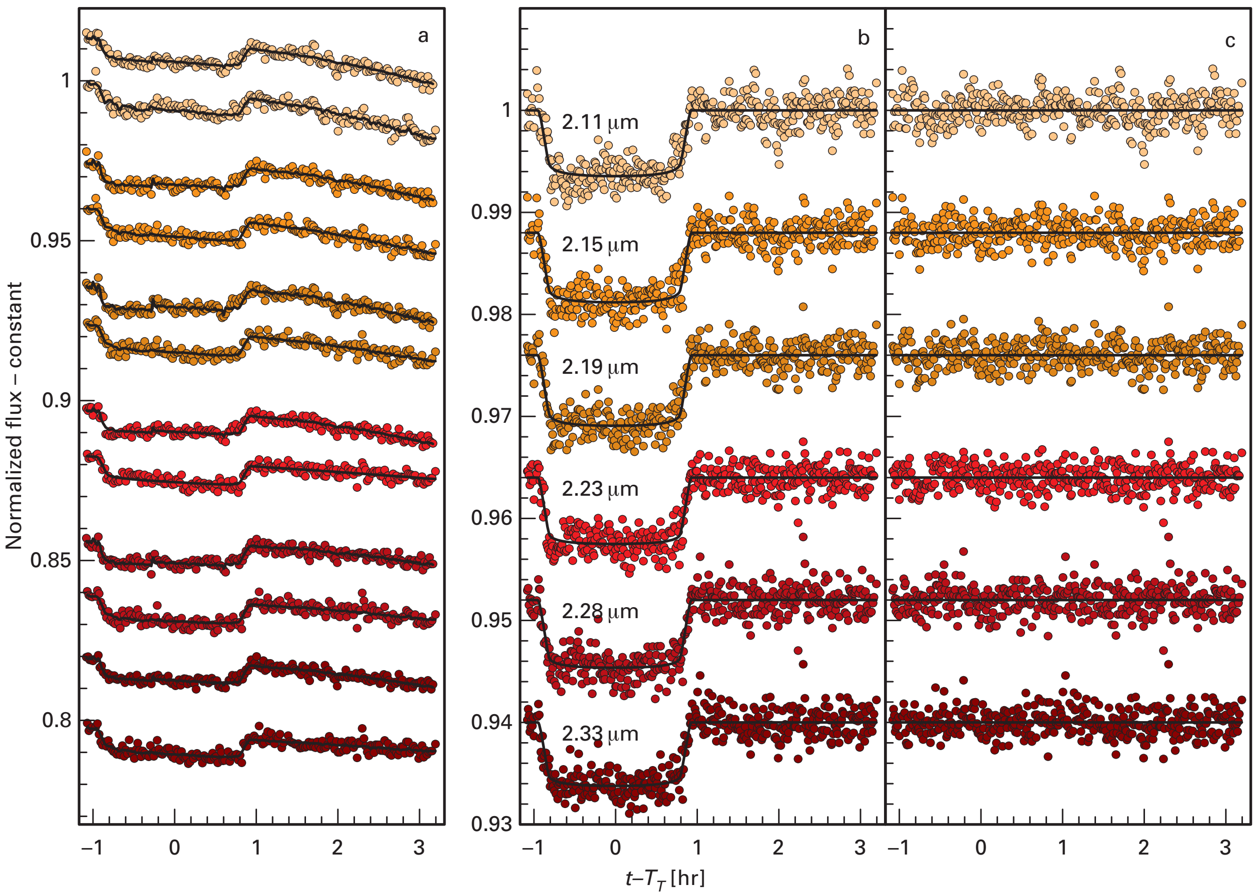
One interesting type of planet is the small, low-mass variety that radial velocity surveys and the Kepler mission show to be so common. Most such planets are not amenable to followup observations to determine their atmospheric compositions. Although a few have bright enough host stars and exhibit deep enough transits that they can still be studied in this way, to date only two planets of Neptune size or smaller have been subjected to detailed scrutiny: GJ 1214b and GJ 436b. Another recently-discovered example of these smaller, cooler planets is GJ 3470b, a ~ 700 K planet with roughly the mass and radius of Uranus.

We used the new Keck/MOSFIRE near-infrared multi-object spectrograph to observe one transit of GJ 3470b and look for the spectroscopic signatures of H_2O and/or CH_4 in the planet's transmission spectrum. Multi-object spectrographs are especially suited to this sort of work: the ability to monitor multiple reference stars simultaneously allows correction for variable telluric absorption, and very wide (10″– 12″) slits can be constructed to prevent seeing fluctuations from affecting the spectrograph's throughput. Thus, although MOSFIRE was designed for faint extragalactic studies rather than precise spectrophotometry of bright sources, with proper calibration the instrument delivers performance far beyond its design specifications.

In such spectroscopic analyses, after data calibration and spectral extraction all spectra of target and calibration stars are aligned to a single wavelength grid. Light curves are constructed in several narrow bandpasses by integrating the light of all targets over these regions, and constructing relative light curves in each channel. These light curves are then fit in the same way as in any other transit light curve analysis; the light curves (before and after correction for systematics) and residuals to the fits for this analysis are shown in Fig. III.2.3. We measured GJ 3470b's transit depth in six bandpasses from 2.09–2.36 micron, and compared these measurements (and others from previous broadband photometry) with predictions from radiative-transfer models of the planet's atmosphere.

Fig. III.2.4 shows the measurements and atmospheric models for GJ 3470b. We see no spectral variation in our *K*-band data. The ensemble of measurements rule out cloud-free atmospheres in chemical equilibrium assum-

Fig. III.2.3: Keck / *Mosfire K*-band light curves from one transit of GJ 3470b. *From left to right:* (*a*) raw spectrophotometric data exhibiting a systematic offsets between the two nod positions, and best-fit models; (*b*) normalized and corrected measurements and models; (*c*) residuals to our best-fit measurements.



Credit: MPIA / Ian Crossfield

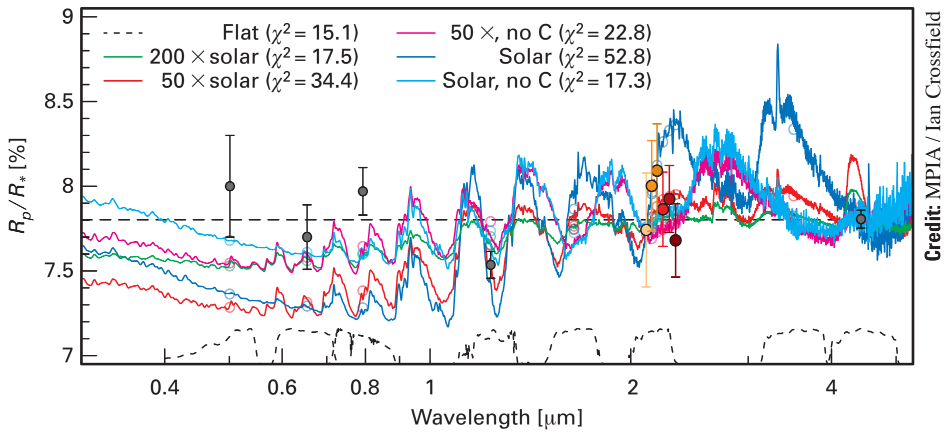


Fig. III.2.4: Measurements and models of GJ 3470b's transmission spectrum. *Colored points with error bars* are our MOSFIRE measurements; *black points* are previous measurements. The *solid lines* show our model transmission spectra. The ensemble of measurements rule out equilibrium-chemistry models with solar composition (*blue*) and 50 × solar abundances, but an atmosphere depleted in CH_4, highly enriched in metals, or covered in haze all remain plausible.

ing either solar abundances (5.4 sigma confidence) or a moderate level of metal enrichment (50 × solar abundances, 3.8 sigma), confirming previous results that such models are not representative for cool, low-mass, externally irradiated extrasolar planets. Current measurements are consistent with a flat transmission spectrum, which suggests that the atmosphere is explained by high-altitude clouds and haze, disequilibrium chemistry, unexpected abundance patterns, or the atmosphere is extremely metal-rich (> 200 × solar).

Our analysis predicted that if the atmosphere is cloud-free its spectral features should be detectable with future observations, and that transit observations at shorter wavelengths will provide the best opportunity to discriminate between plausible scenarios. Indeed, a simultaneous analysis using two-color optical LBT photometry shows strong evidence for Rayleigh scattering in GJ 3470b's atmosphere, confirming our conclusions. If the haze is not too optically thick, GJ 3470b's relatively deep primary transit, bright host star, and low density will permit a detailed characterization of its atmosphere via transmission spectroscopy during transit. We are especially heartened by the prospects for studying this and other similar objects using MPIA's access to LBT with both LUCI (infrared spectroscopy) and LBC (optical photometry). The high S/N possible for GJ 3470b will lead to this planet becoming a touchstone object that will strongly influence our understanding of cool, low-mass planetary atmospheres.

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III.3 The merger-AGN connection: irrelevant since $z \sim 1$

Black holes are objects different to anything else we know in the Universe. They are the combined distortion of space-time if matter is condensed enough to make escape from its surface impossible. Black holes are the deepest gravitational potential wells possible, which potentially release extraordinary amounts of gravitational energy if matter manages to fall to near their horizon.

Since 15 years we know that supermassive central black holes reside at the centers of most if not all massive galaxies. They grew from seeds of still unknown mass in the early Universe by accretion of gas and by merging with other black holes to end up with 10^6 to $10^{10}\,M_\odot$ in the most massive systems; this is only a few 100 to a 1000 times less massive than all the stars in a hosting galaxy combined.

The modes in which these black holes grow have been known for more than 50 years. "Active galactic nuclei" (AGN) are centers of galaxies showing an enormous radiative emission which has long been shown to be the very gravitational energy converted into radiation. AGN are growing black holes. In the most extreme cases these systems are called quasars or quasi stellar objects (QSOs), with radiative emission substantially exceeding that of all stars in the host galaxy and, when integrated over some time, also exceeding the binding energy of all of the remaining galaxy-wide gas.

At this point AGN become very interesting for the general field of galaxy formation and evolution – and beyond the generally interesting field of understanding how black holes grow. If the gas in the galaxy could be affected by black hole accretion, then so would its star formation. Hence black holes could be a key player in the evolution of galaxies, or rather in the truncation of star formation in the late stages of massive galaxy growth.

Since the actual impact of AGN accretion on galaxy evolution is a field of active debate we need to understand under which circumstances and in which environments supermassive black holes actually grow by accretion. Why and how does gas lose more than 99.999 % of its angular momentum to get down the gravitational well? Starting out at galaxy scales or beyond, there are vast regimes in distance from the black hole where the gas likely experiences no forces of friction. So by which mechanism is angular momentum lost?

Testing an old paradigm ...

25 years ago an evolutionary paradigm had been put forward that linked the merger of massive gas rich galaxies to the triggering of AGN. In this scenario the merger would stir up the gas in the system, providing both a burst of dusty star formation as well as zero angular momentum gas which could subsequently fall towards the black hole. In a time sequence the galaxy would first be visible as a dusty ultra-luminous infrared galaxy, then a dust-obscured AGN, which after some time, when the AGN radiation is able to blow away the dust, emerges as a quasar.

After these 25 years, during which people have tried to provide observational evidence to this picture, the results are mixed. Some studies suggested that indeed AGN host galaxies are often distorted, supporting a previous major galaxy merger. While others find contradictory results. At the end, the paradigm was clearly not applicable to all AGN, specifically not to the low mass end, but for the bulk of luminous AGN as well as the high mass or luminosity regime this picture was still deemed plausible.

However, historically, if a scenario still has to be called "plausible" after 25 years of research, then this scenario has a problem – after this time one would have expected a decisive test to falsify it or overwhelming support. In retrospect it is understandable, why this did not happen: Samples of AGN investigated for testing this hypothesis were observationally very expensive. High-resolution imaging data was at a premium and comparison samples of inactive galaxies either ignored or not obtained at the same spatial resolution, depth, and/or bandpass – an asymmetry which made a comparison of active and passive galaxies basically impossible.

... using new data

This changed only when large homogeneous imaging datasets of AGN and inactive galaxies became available, from which samples and comparison samples could be selected a posteriori. Using namely the Cosmos imaging survey was providing both samples of AGN from X-ray data through the XMM- and Chandra coverage of the 2 square degree Cosmos field, as well as high spatial resolution imaging data from the Hubble Space Telescope (HST) and its Advanced Camera for Surveys. Together with spectroscopic and photometric redshift measurements as well as black hole mass estimates from multiband photometry and several spectroscopic campaigns a complete characterization of the AGN content of Cosmos was made.

This allowed us to make an unprecedented comparison of the distortion incidence rate of AGN host galax-

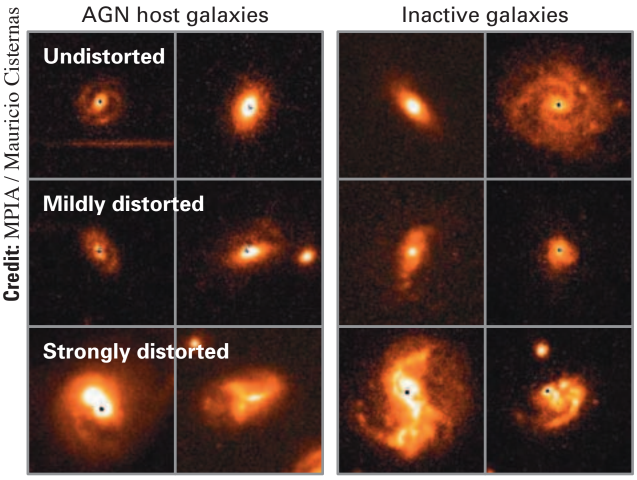


Fig. III.3.1: Grades of distortion as classified by the 10 experts. Rows from top show examples for undistorted and mildly and strongly distorted galaxies.

ies and similarly massive inactive galaxies (in full reported in Cisternas et al. 2011) and hence ask and answer the question: What is the relevance of major mergers and interactions as triggering mechanisms for black hole growth?

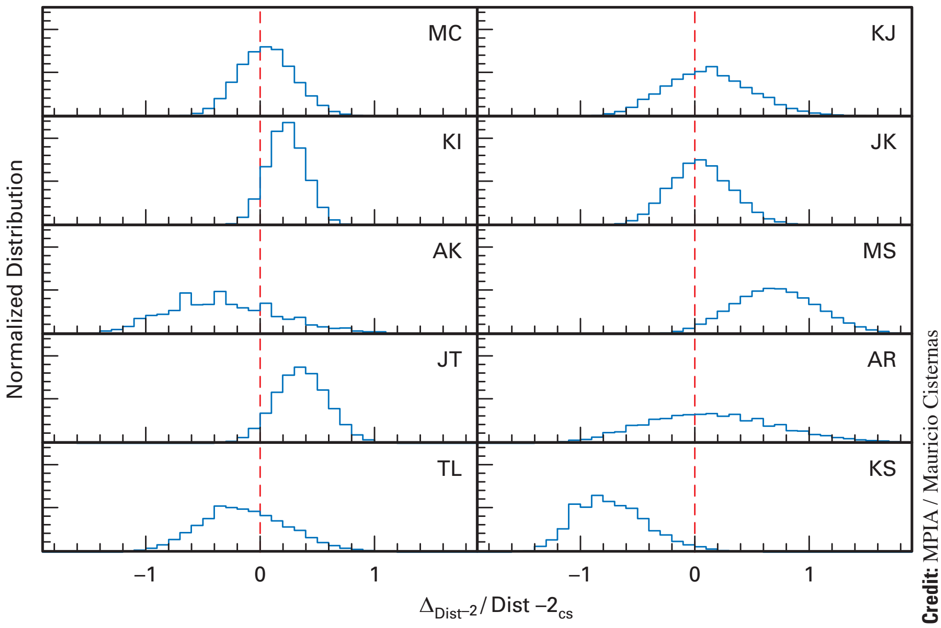
To answer the question we selected unprecedented 140 broad-line AGN from COSMOS in the redshift range $0.3 < z < 1.0$. We matched each AGN with nine inactive galaxies with a similar mass to the AGN host galaxy and in the same redshift range, spanning a mass range up to $M_* < 5 \times 10^{11}\ M_\odot$. This particular population of AGN was selected because it dominated the mass-density growth of black holes over the past ~ 8 billion years. Hence this experiment was able to make a statement about whether galaxy merging had an impact in those systems producing the bulk of new black hole mass density in the second half of our Universe's lifetime.

Our approach to answer the above question consisted of an imaging-based analysis of the morphological structures of the AGN host galaxies and their control sample, then calculate whether there was a higher incidence of strongly distorted (= previously merging) galaxies with AGN in them or without. The vast HST imaging dataset provided I-band images at 0.1 arcseconds resolution, corresponding to between 400 and 800 parsec linear scales at $z = 0.3$ and 1.0, respectively, enough to diagnose major distortions in massive galaxies with 20 to 50 kiloparsec diameter.

The best classification by neural network: the human brain

The decision whether a galaxy is distorted or not was carried out by visually inspecting and then classifying the full ~ 1200 object-strong sample (Fig. III.3.1). Since the AGN exhibit their characteristic bright nucleus, it was removed by image decomposition techniques prior to this classification, as were fake nucleus-residuals implanted into the inactive galaxy images. In this way the two samples were visually indistinguishable. The full sample was then visually classified by 10 experts, not knowing which of the galaxies was an AGN host and

Fig. III.3.2: Normalized probability distributions from each of the 10 people classifying the sample that the fraction of strongly distorted galaxies is larger for AGN host galaxies (negative values) or for inactive galaxies (positive values). The width of the distribution is determined by the limited sample size specifically of distorted objects.



which not, to guarantee the absence of (sub)conscious biases.

Visual classification has shown to be more powerful and reliable than any existing automatic programme. The features of post-merging are very diverse, from double nuclei and tidal arms to asymmetries and faint stellar shells. Hence no programm existing today is able to pin down the whole dynamic range of these "symptoms". The human brain on the other hand, specifically when previously trained to diagnose distortions typical of galaxy merging, is very sensitive.

In addition, the combination of 10 different people allowed to get 10 independent views with 10 independent sets of experiences. Since their personal definition of “strong distortion” might differ, each individual nevertheless applied its though subjective but same criteria to every galaxy it classified.

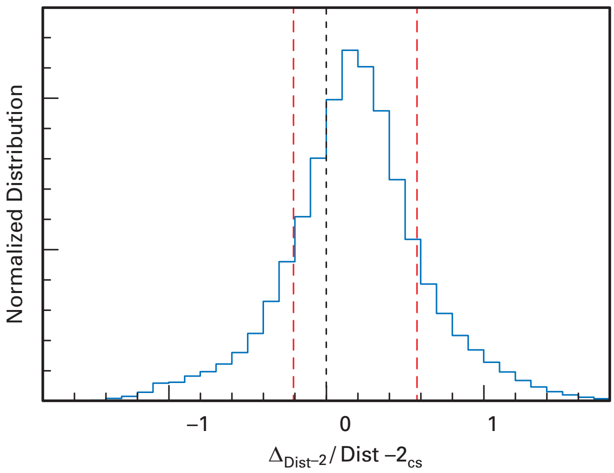
Results: AGN fuelling is not dominated by galaxy mergers

For each person we then calculated whether their fraction of distorted galaxies was higher for AGN hosts or for inactive galaxies. The normalized probability distributions for galaxies being in our second distortion bin, i.e. being strongly distorted, are shown in Fig. III.3.2. It showed that for some of the classifiers slightly more AGN were distorted, for some more inactive galaxies were distorted, and for some the fractions were exactly identical.

We then combined the individual classifier’s results into one probability distribution which shows that the distorted galaxy fractions of the two samples are identical (Fig. III.3.3). While the peak lies slightly off the value “0” this value of completely identical distortion fractions for the two samples is contained within the central 68 % interval. Hence there is not even a 1 sigma signal that the distortion fractions are different. This is the main result of this study: AGN host galaxies do not show a significantly higher distortion or recent merger rate than inactive galaxies.

Further, we could also use the cumulative probability distribution of the absolute fraction of strongly distorted AGN (Fig. III.3.4) to set an upper limit: at 95 % confidence this fraction lies at 24 %. This means not only are AGN host galaxies not more commonly distorted than their inactive counterparts, more than 75 % of them are also not strongly distorted in the first place. Combined with the fact that ~ 60 % of these galaxies, AGN host or not, are disk-dominated galaxies adds to the result that most of the AGN host galaxies clearly did not have a major galaxy merger in their recent past.

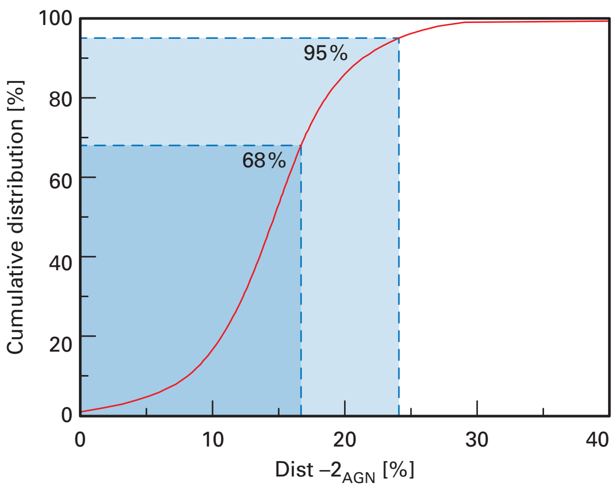
Our findings provide the best direct evidence that, since $z \sim 1$, the bulk of black hole accretion has not been triggered by major galaxy mergers. This is in line with the finding from a previous paper (Jahnke & Macciò 2011) where we showed from a theoretical point of view that a physical coupling between galaxy and black hole growth is not required, hence black holes do not necessarily have to grow when the galaxy undergoes a substantial change. Hence our results imply that alternative mechanisms, i.e. internal secular processes and minor



Credit: MPIA / Mauricio Cisternas

Fig. III.3.3: Combination of the 10 probability distributions of a difference in strong distortion fraction between inactive and AGN host galaxies in our sample. There is no difference within 1 σ of the distribution, hence there is no excess of distorted AGN host galaxies compared to normal, inactive galaxies.

Fig. III.3.4: Cumulative probability distribution for the fraction of strongly distorted AGN host galaxies, after combining the classification of 10 people. The distribution shows a strong distortion rate of ~ 15 %, identical to the inactive galaxy population, with a 95 % probability that the rate is below 25 %. In return this means that the fraction of not strongly distorted, or not recently merging, host galaxies is most likely ~ 85 % and with 95 % confidence above 75 %. Merging is a subdominant state for AGN host galaxies since $z = 1$.



Credit: MPIA / Mauricio Cisternas

interactions, are the leading causes for the episodes of major black hole growth since $z = 1$. We also exclude an alternative interpretation of our results: a substantial time lag between merging and the observability of the AGN phase could wash out the most significant merging signatures, explaining the lack of enhancement of strong distortions on the AGN hosts. We show that this alternative scenario is unlikely due to (1) recent major mergers being ruled out for the majority of sources due to the high fraction of disk-hosted AGN, (2) the lack of a significant X-ray signal in merging inactive galaxies as a signature of a potential buried AGN, and (3) the low levels of soft X-ray obscuration for AGN hosted by interacting galaxies, in contrast to model predictions.

In summary: There is strong evidence out to $z = 1$, the past 8 billion years, that major galaxy merging does not play any dominant role in the fuelling of black holes. Major merging might still trigger AGN in some galaxies and might be important at either the highest black hole accretion rates or in the early Universe, but this part of parameter space is, still, uncharted. But we are working on it.

Acknowledgements: This project was carried out in collaboration with 20 colleagues from the Cosmos project as well as individual researchers in Spain, and the University of Heidelberg.

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III.4 How to make astrophysical jets?

Jets as highly collimated beams of high-velocity material are an ubiquitous phenomenon. They originate from young stars, microquasars, or active galactic nuclei, and can thus be found over a wide range of energy output or spatial extent. The common understanding is that magnetohydrodynamic (MHD) forces are responsible for generating these outflows. Furthermore, from observations it is clear that accretion and ejection are related to each other – one efficient way to remove angular momentum from a disk is to eject it vertically into an outflow.

Our projects deal with various aspects of astrophysical jets. Our main foci are, however, jet formation (i.e. the acceleration and collimation process) and jet launching (the accretion-ejection process). We perform time-dependent MHD simulations applying different codes. Due to the nature of the numerical setup, our simulations may be scaled to protostellar jets and also extragalactic jets. We investigate the details of different physical effects such as relativistic de-collimation, radiation pressure, or the influence of the disk turbulent diffusivity. The derived mass fluxes may be considered as an essential feedback parameter.

Relativistic jet collimation

It has been shown by analytical approximations in the literature that MHD jets do self-collimate. While this also has been numerically confirmed for non-relativistic jets, the question of relativistic jet collimation is not yet settled. In relativistic MHD the electric fields leads to de-collimating force components. We have thus performed special relativistic MHD simulations treating the formation of relativistic jets from disk winds. Newtonian gravity was added in order to establish the physical boundary condition of an underlying accretion disk. The fiducial disk surface (respectively a slow disk wind) is prescribed as boundary condition for the outflow. As a general result we obtain well collimated jets with mass flux weighted half-opening angles of 3 – 7 degrees, thus confirming MHD self-collimation also for relativistic jets. The final jet speed is highly dependent on the magnetic energy flux (Poynting flux) injected from the disk. For the standard setup we obtain only mildly relativistic outflows with Lorentz factors of 1 – 2. When we increase the outflow Poynting flux by injecting an additional disk toroidal field, the jet speed increases to a Lorentz factor of 8 – 10, consistent with observational indications for AGN jets.

Synchrotron radiation and Faraday rotation

Using the jet properties resulting from the MHD simulations, such as matter density, gas pressure, magnetic field direction, or Lorentz factors (i.e. Dopplershift), we are in the situation to derive actual emission maps, predicting VLBI radio or (sub-) mm observations of nearby AGN cores. For this we have developed a special relativistic synchrotron transport code, taking into account self-absorption and internal Faraday rotation. We find e.g. that the strict bi-modality of the polarization direction suggested by other authors can be circumvented when the structure of a collimating jet is considered. Depending on the pitch angles of the emission region, we also get a spine-and-sheath polarization structure. The relativistic swing effect skews the polarization compared to the non-relativistic case. The frequency-dependent core shift in the radiation maps following our jet simulations is compliant with analytical estimates of conical jets in the literature.

Fig.III.4.1 presents mock observations of spectral index, polarization degree and rotation measure for various inclinations. Asymmetries in the spectral index and polarization degree can be observed most articulately at high inclinations of >30 degree. The necessary resolution for this detection in case of a low Faraday rotation amounts to 50 micro-arcseconds, which could be reached with the next generation space-VLBI. At 30 degree inclination, the predominant polarization vector flips from perpendicular alignment (with respect to the projected jet direction) for the Blazar case to parallel alignment for the radio galaxy case at high inclinations.

MHD jets & radiation pressure

Massive young stars and accretion disks around compact objects induce a strong radiation field that may affect the collimation and acceleration of an outflow. In order to study the formation of jets in such an environment, we have investigated the impact of a line-driven radiation force on acceleration and collimation of a MHD jet. The study was focussed to understand the physical processes that govern the dynamics of jets around young massive stars, but could be applied as well for disk jets from AGN.

For the radiation forces we have considered the luminosity of both the central object and the disk. In our approach we first launch a pure MHD jet, and then, when the MHD outflow has achieved steady state, switch on the radiative forces and study their effect on the existing MHD outflow (see Fig. III.4.2).

Credit: MPIA / Oliver Porth

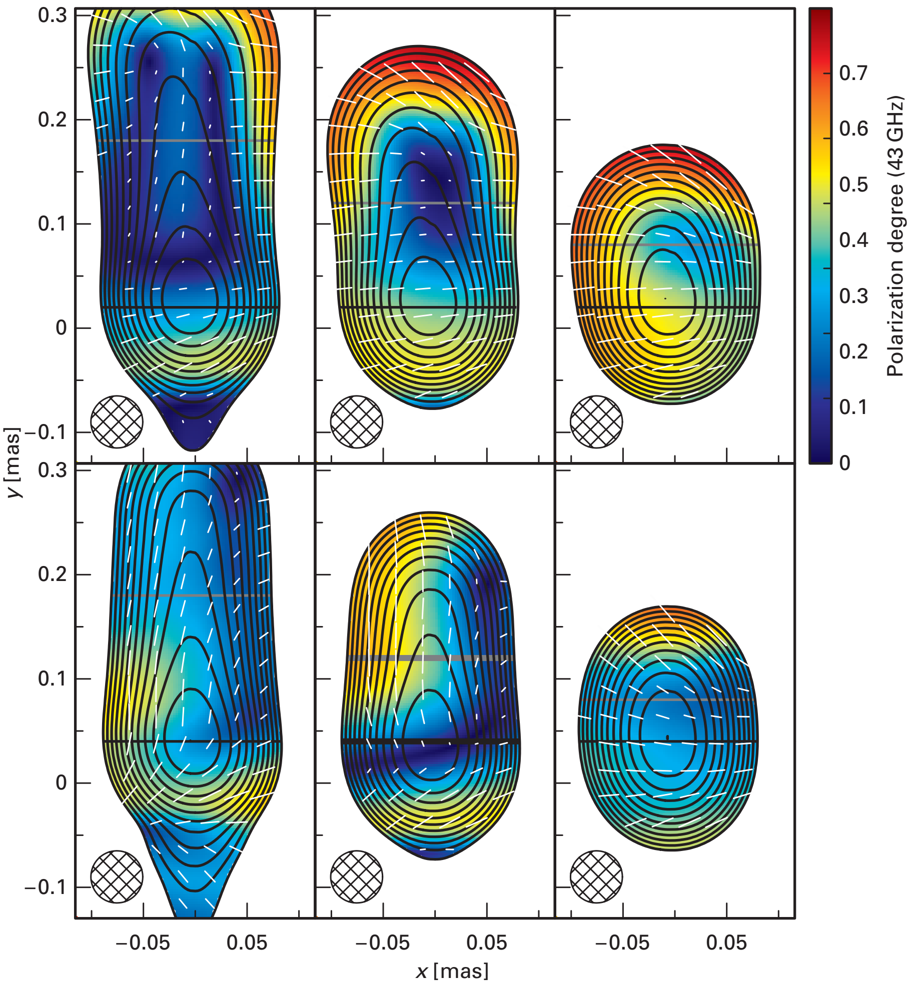
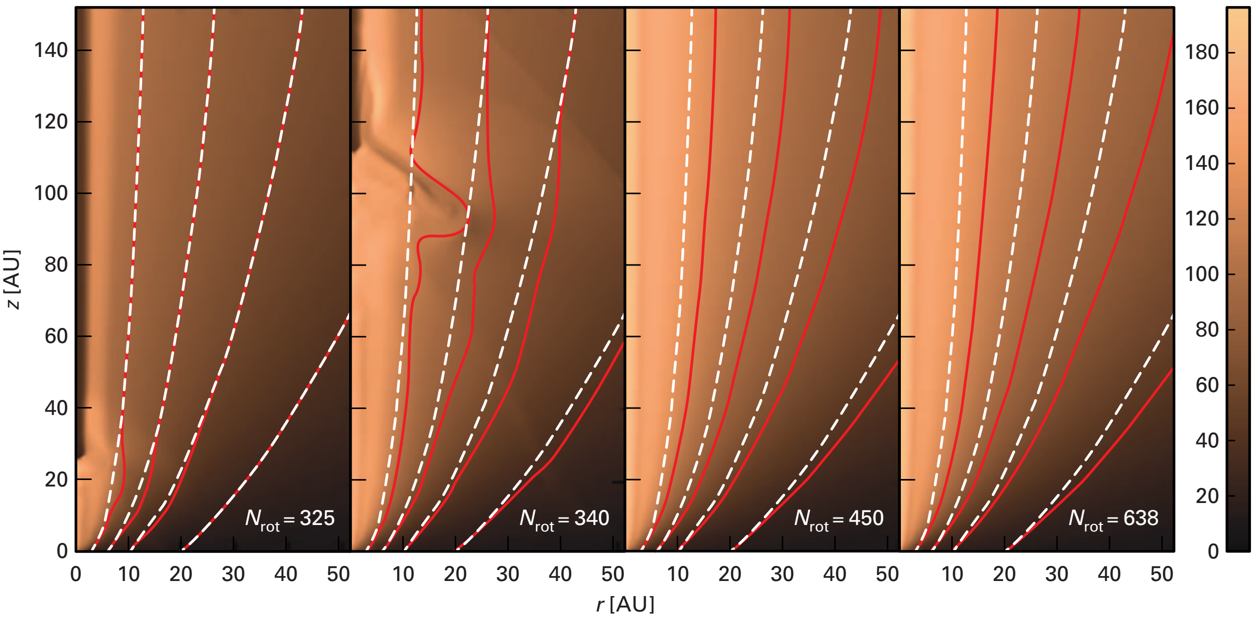


Fig. III.4.1: *Top:* Polarizations for inclination 30, 20, 10 degrees (*left to right*) emitted from regions with co-moving pitches $B_\varphi/B_p > 1$ (*above*) and $B_\varphi/B_p > 2$ (*below*). The polarization degree $\Pi_{43\mathrm{GHz}}$ is color-coded, with $I_{43\,\mathrm{GHz}}$ contours. The spatial scale is mas, the restoring beam has a FWHM = 0.05.

Fig. III.4.2: *Bottom:* Jet vertical speed (*colors*) and poloidal field lines. Field structure with (*red, full*) and without (*white, dashed*) radiation pressure. Scaling as for a massive young star (velocity in km/s, radii in AU).



Credit: MPIA / Bhargav Vaidya

The line driven force from the central object significantly modifies the dynamics. With radiative forces, the outflow velocity is increased by a factor of 1.5 – 2 as compared to the pure MHD flow. The degree of collimation is lowered, visible e.g. in a 30 %-change in the magnetic flux profile, or the wider opening angle of the magnetic field lines. Since the radiation forces also affect the mass outflow rates for simulations, even small change in the line force parameter (thus the strength of the line force) may lead to significant changes in mass flux – up to 30 %. Line forces from the underlying hot disk do not play a significant role, simply because they are some orders of magnitude smaller than all other forces that affect the flow dynamically. Implementing artificially high disk radiation forces however, has shown us that the disk radiation will affect primarily the acceleration, and not the collimation.

From accretion to ejection

Our studies discussed above were related to the formation of a collimated jet out of a slow (prescribed) disk wind. The launching mechanism, the mass loading of accreting disk material into the outflow was not considered. Observations tell us that disks live longer than jets, and also that not all disk sources show signatures for strong outflow activity. The fundamental question arise which kind of disks launch jets and which kind of disks do not?

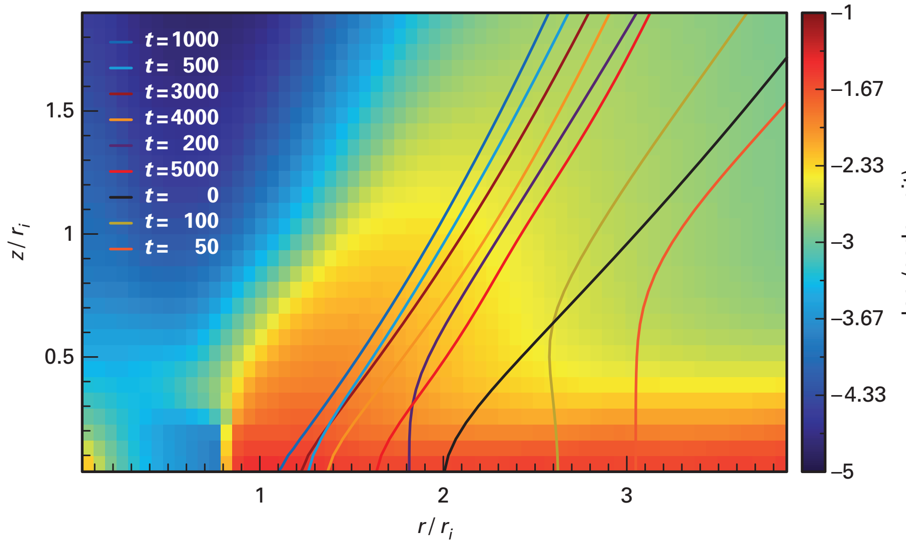
This is the topic of the following sections. Here, we have studied the actual launching mechanism, in particular, we study the mass fluxes in disk and jet, and how the magnitude and distribution of the disk (turbulent) magnetic diffusivity affects the mass loading and jet acceleration. We have applied time-dependent MHD simulations, in this case solving the resistive MHD equations throughout disk and outflow. Our simulations last for up to 10 000 dynamical time scales corresponding to 1800 orbital periods of the inner disk. In general, we obtain a continuous and robust outflow launched from the inner part of the disk. The outflow mass loss rate is high and about 20 – 30 % of the accretion rate, confirming previous simulations, but deviating from early semi-analytic works.

We consider in detail the advection and diffusion of magnetic flux within the disk and we find that the disk and outflow magnetization may substantially change in time. This may have severe impact on the launching and formation process – disk areas with initially highly magnetization may evolve into a weak magnetization state that cannot drive strong outflows. Fig. III.4.3 shows the time evolution of a specific magnetic flux surface. The magnetic field first diffuses outwards since accretion is not established ab initio. As soon as the outflow is launched, disk angular momentum is lost and accretion sets in. The magnetic field is advected with the accretion stream until a steady state is reached.

For very long time scales, the mass loss by accretion and ejection changes the disk structure and the magnetic flux diffuses outwards again into a new equilibrium state. Accreting material diffuses inwards across the poloidal field. A substantial fraction is lifted upwards and couples to the field lines. Magneto-centrifugal forces further accelerate this disk wind into a fast outflow. Magnetic pinching forces collimate the flow beyond the Alfvén surface. We find a lower degree of jet collimation than previous studies, most probably due to our revised outflow boundary condition.

For magneto-centrifugally driven jets we find that for i) less diffusive disks, ii) a stronger magnetic field, iii) a low poloidal diffusivity, or a iv) lower numerical diffusivity (resolution), the mass loading of the outflow is in-

Fig. III.4.3: Time evolution of one magnetic flux surface demonstrating advection and diffusion of magnetic field along the accretion disk. The color shows the density of the disk at $t = 5000$.



Credit: MPIA / Somayeh Sheikhnezami

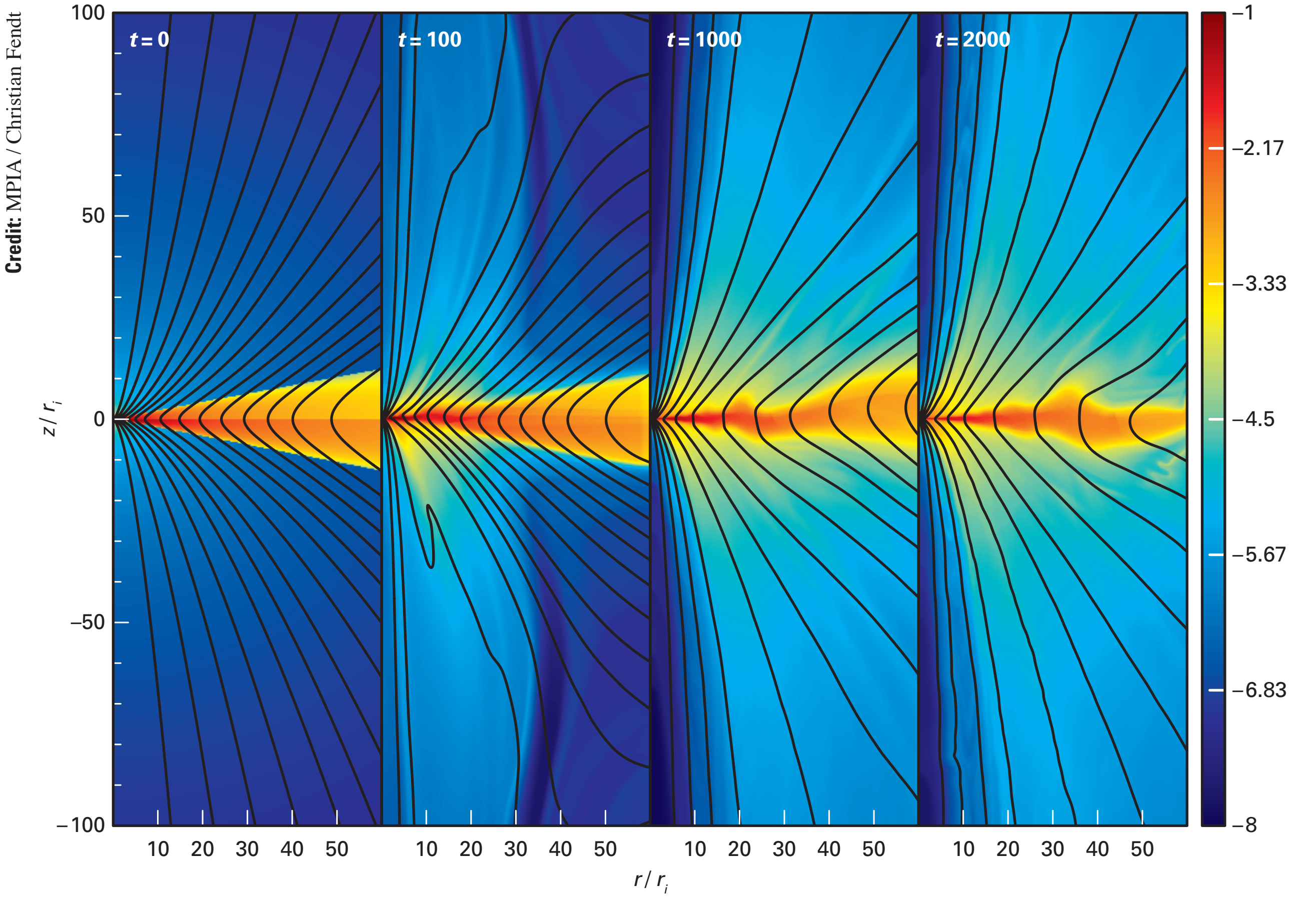


Fig. III.4.4: Time evolution of the bipolar jet–disk structure for a simulation starting from an initial state with different thermal scale heights for the upper and lower disk hemispheres. Shown is the evolution for dynamical time $t = 0$, 100, 1000, 2000 of the mass density (*colors*) and the poloidal magnetic field (*lines*).

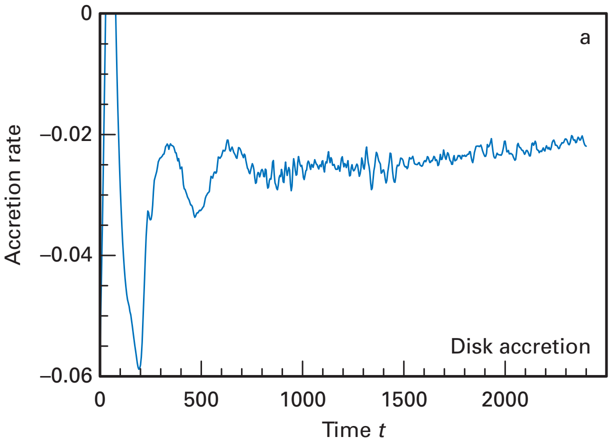
creased – resulting in more powerful jets with high mass flux. For weak magnetization the (weak) outflow is driven by the magnetic pressure gradient. The mass ejection-to-accretion ratio along with the momentum and energy transfer rates from inflow to outflow are essential properties for any feedback mechanism in star formation or galaxy formation modelling and could only be derived from simulations resolving the inner region of the jet-launching accretion disk.

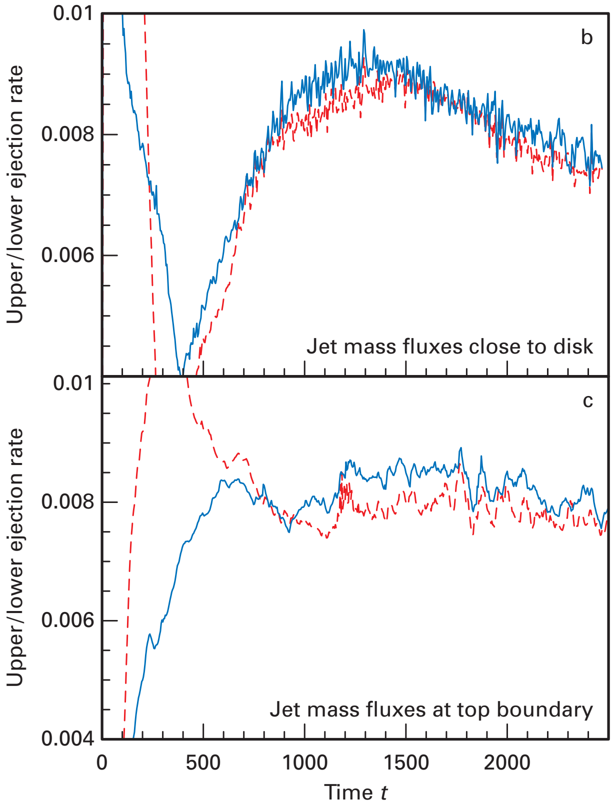
Bipolar jet asymmetry

Observations have confirmed the coexistence of bipolar jets in most jet-forming regions. Jet and counter jet appear, however, typically asymmetric in shape with only very few exceptions. One of the best studied sources is the young star RW Aur, where jet/counter jet velocity differences of about 50 % close to the source were found in the literature. Also in the case of extragalactic jets asymmetries between jet and counter jet are observed regularly, a typical example may be M87. For highly relativistic parsec-scale jets, beaming may play the dominant role, depending on the inclination angle. For kpc jets, which are expected to move slower with about 0.1 c, beaming must be weak; however, extinction by the galactic disk may affect the observed bipolar jet structure. Due to the detection method used (radio synchrotron emission), a direct measurement of jet velocities or mass fluxes is not possible for extragalactic jets.

We have extended our previous approach, performing now simulations of the disk-jet structure on a bipolar computational domain covering both hemispheres. We apply various models such as asymmetric disks with (initially) different scale heights in each hemisphere, symmetric disks into which a local disturbance is injected, and jets launched into an asymmetric disk corona. The typical disk evolution (see Fig. III.4.4) first shows substantial disk warping and then results in asymmetric outflows with a 10–30 % mass flux difference (Fig. III.4.5). We find that the magnetic diffusivity profile is essential for establishing a long-term outflow asymmetry. We conclude that bipolar asymmetry in protostellar and extragalactic jets can be generated intrinsically and maintained over a long time by disk asymmetries and the standard jet launching mechanism.

It is clear that our numerical results such as mass flux or velocity asymmetries are model-dependent; however, they seem to be generic to all of our models applying different parameters. What is also important is that





Credit: MPIA / Christian Fendt

Fig. III.4.5: Time evolution of the mass fluxes. Shown are the evolution of the accretion rate and the mass ejection rates from the upper (solid line) and lower (dashed line) disk surfaces (all in code units). Ejection rates are measured in the control volumes between 1.5 and 10.0 inner disk radii (*b*), while the accretion rate (*a*) is integrated at a radius of 10.0 inner disk radii (*a*). For comparison, we show the asymptotic vertical mass fluxes through the jets, integrated at a vertical height of –75 or 75 inner disk radii from the disk, respectively (c).

these number values change in time. Velocity differences of 20 %–30 % may lead to propagating shocks along the jet. For the timescale of these fluctuations, we find a typical value of about 500–1000 dynamical timescales, which is equivalent to say 100–200 inner disk Keplerian periods or about five years for protostars. This timescale is in the range of the observed 10–50 yr time intervals indicated by the jet knot separation. For AGN jets, the timescale for jet fluctuations corresponds to 2 yr, assuming an inner disk radius of 10 Schwarzschild radii and a central black hole mass of 10^8 solar masses. This is remarkably similar to the ejection times observed in e.g. 3C 120 or 3C 390.3.

The main result from our simulations is that we obtain long-term fluctuations in jet velocities and mass loss rates, on timescales much larger than the typical kinematic timescale of the jet launching area, i.e., the Keplerian time in the range of about 10 days for protostars or 3 days for AGN jets. These timescales are set by the dynamical evolution of the underlying diffusive disk.

Outlook & plans

Our latest project concerns the origin of the jet-driving magnetic field. Is it advected from the ambient interstellar medium? Is it dynamo self-generated by the jet-driving disk itself? In order to treat this problem we have introduced a mean-field dynamo term in our MHD code. Our simulations start from an initial state with weak magnetic field – unable to launch strong outflows. Switching-on the mean field dynamo leads to stronger and stronger magnetic flux and subsequent ejection of outflows. A sufficiently strong magnetic field (saturated by a quenching mechanism) finally gives rise to collimated jets of high velocity. Time dependent ejection (and accretion) can now be governed by purely adjusting the dynamo process.

Our current setup is simple in many respects. We were interested to disentangle the main dynamical effects for jet launching. Our next steps will include a more realistic prescription of disk accretion, taking into account considering e.g. viscosity (angular momentum transfer), heating and cooling (disk vertical structure & and mass loading), numerical resolution (magneto-rotational instability). Concerning extragalactic jet launching we just started a project considering general relativity for our MHD simulations.

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Deniss Stepanovs

IV. Instrumental Developments and Projects

In this chapter, we report on further activities belonging mainly to our instrumentation projects and related technical developments. Since the number of ongoing projects is rather large, we are only presenting here a selection of our current activities. Since this selection varies over the years, we encourage the reader to have also a look into other Annual Reports of the institute.

IV.1 The Mid-InfraRed Instrument (MIRI) aboard JWST

The James Webb Space Telescope JWST will be the astrophysics flagship space mission of the current decade. JWST is jointly being developed by the space agencies of the USA, Canada and Europe and will comprise four science instruments: MIRI, NIRSPEC, NIRCAM and FGS/NIRISS.

MIRI is the mid-IR instrument of JWST covering the wavelength range from 5 µm to 28 µm. The instrument provides imaging over a $1\overset{\prime}{.}3 \times 1\overset{\prime}{.}9$ field of view as well as coronagraphic capabilities on the basis of three 4-quadrant phase mask coronagraphs and one Lyot coronagraph. A complex setup employing 12 individual gratings – mounted on two Dichroic/Grating wheel Assemblies (DGAs) – provides high-resolution spectroscopy ($\lambda/\Delta\lambda = 1000-3000$) from 5 µm – 28 µm while an additional double prism assembly – mounted on a dedicated 18 position Filter Wheel Assembly (FWA) – will yield lower-resolution ($R = 100$) spectroscopy over the range from 5 µm to 10 µm.

MIRI is being developed as a 50:50 partnership between the US and Europe. A European consortium of nationally funded institutes is responsible for building most of the MIRI optical system while the detectors, focal plane electronics and the cryo-cooler are contributed by the US.

MPIA is a major partner of the MIRI European Consortium led by G. Wright of UK-ATC. The responsibilities of the MPIA are (i) the development of optical wheel mechanisms, (ii) leadership of the electrical system engineering team, and (iii) strong participation in activities such as instrument testing, software development and preparation of the instrument calibration and commissioning in space.

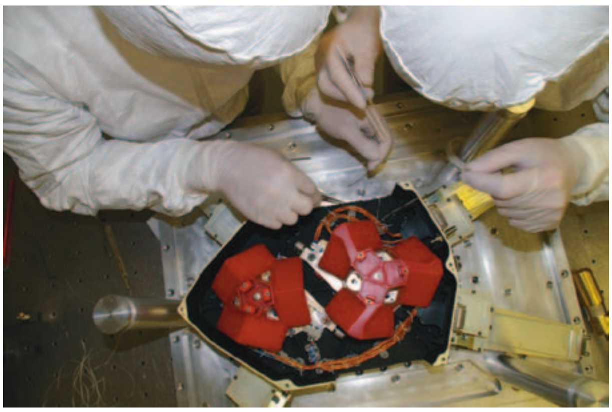
Wheel mechanisms

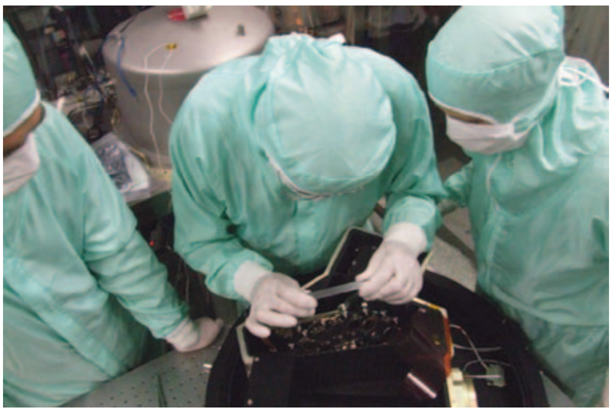
The flight models of the MIRI wheel mechanisms (two DGAs and one FWA) had been successfully integrated, tested and delivered in 2009/2010. MPIA conducted the integration into their corresponding housings (see Fig. IV.1.1). The extensive qualification program was successfully concluded in February 2011 with the close-out of the qualification review.

Flight model test campaign

The MIRI flight model was fully assembled in summer 2010 at Rutherford Appleton Laboratory (RAL). The subsequent environment and performance testing as well as the calibration at cryo-temperature were carried out under strong participation of MPIA. Five MPIA staff members have participated in the ambient and cryo test

Fig. IV.1.1: Integration of the DGA flight models into the spectrometer at ATC (*left*) and integration of the FWA flight model into the Imager (*right*) at CEA.





Credit: MPIA

Credit: MPIA

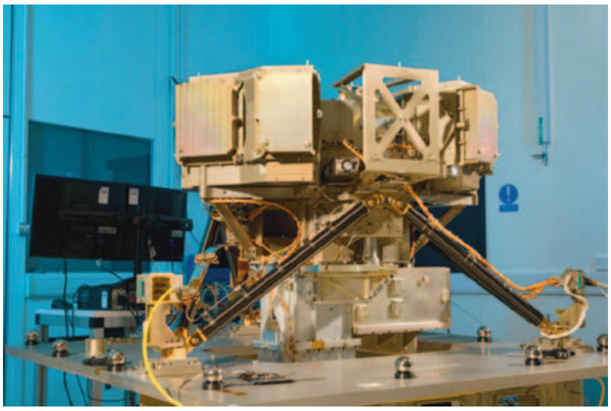


Fig. IV.1.2: The MIRI flight model at Rutherford Appleton Laboratory.

campaign between 2010 and 2012 as part of the MIRI test team. The main objectives of these tests were: wavelength characterization, stability and linearity measurements on the Low Resolution Spectrometer (LRS) and stability and stray light analysis on the imager part of the instrument. In addition, the flight model wheel assemblies was tested and characterized under cryogenic condition. A dedicated simulation tool was developed which allows in-orbit analysing of the wheel behaviour on the basis of the low resolution measurements provided by the Instrument Control Electronic (ICE). EMC and electrical testing were managed by the electrical lead at MPIA. The MIRI flight model test campaign was formally completed in spring 2012 with the acceptance of the MIRI instrument by ESA and NASA and the delivery into Goddard Space Flight Centre.

MIRI is now the first completed JWST science instrument. It has successfully passed all incoming acceptance tests and is currently being integrated into the ISIM (Integrated Science Instrument Module) at Goddard Space Flight Centre. The test team is now preparing for the next test campaign on ISIM level which will be carried out during the year 2013.

The work is done in collaboration with Carl Zeiss Optronics (Oberkochen), and the partner institutes of the MIRI European Consortium.

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Friedrich Müller, Ulrich Grözinger,
Silvia Scheithauer, Örs Detre,
Ralf-Rainer Rohloff, Armin Böhm,
Karl Wagner

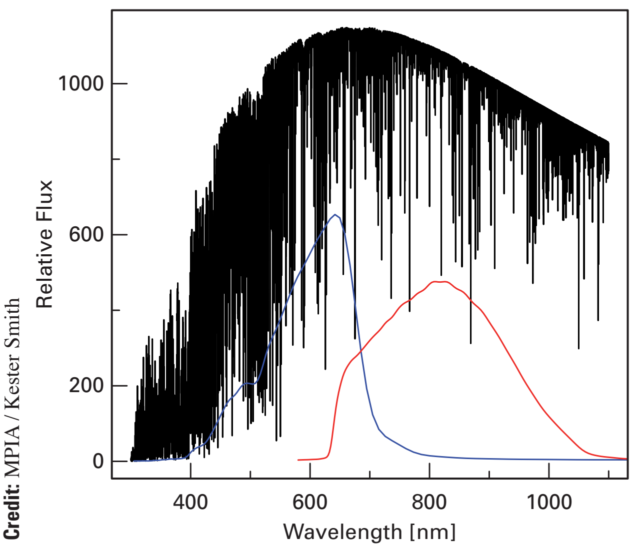
IV.2 Source classification in the GAIA mission

The GAIA satellite, due to be launched in 2013, will observe around 10^9 individual sources. The overwhelming majority of these will be normal single or binary stars, but some small fraction will fall into other classes such as quasars, point-like galaxies or white dwarfs (Bailer-Jones et al. 2008). The task of coordination unit 8 (CU8), lead by MPIA, is to classify all the GAIA sources and estimate astrophysical parameters for them.

The CU8 software system, called APSIS, contains two main work packages with responsibility for classification. One of these is the Discrete Source Classifier (DSC), which sorts the sources into broad astrophysical classes using supervised classification techniques. The other work package, the Object Clustering Analysis package, or OCA, uses unsupervised methods to search for clusters of objects in the GAIA data space. This report concerns the DSC, which is developed at MPIA.

The source classifications will form part of the final database, and are used to trigger various parametrization algorithms further down the APSIS chain. The available input information from the satellite consists of low-resolution spectra from the GAIA photometers, sky position and apparent magnitude, proper motion and parallax. Since the classification scheme must deal with several different types of input data, we have used a modular approach. Several different sub-classifiers, each dealing with a different type of input data, classify the objects probabilistically and the output probabilities are then combined.

Fig. IV.2.1: Example of a cool star spectrum at high resolution (*black*) and as observed by the GAIA prism spectrographs (*red, blue*).



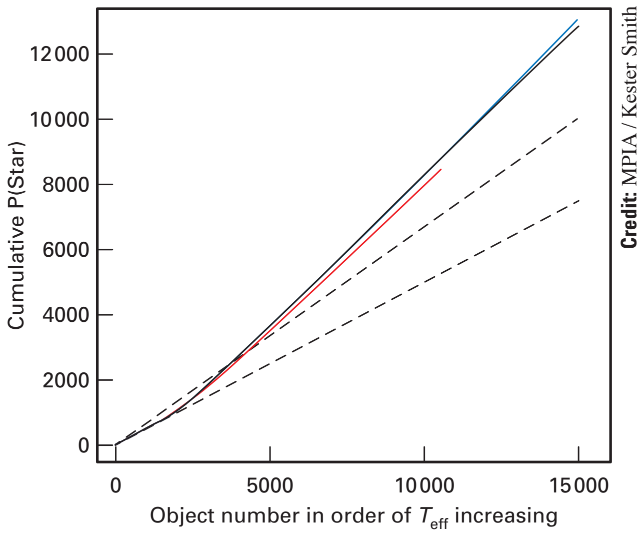


Fig. IV.2.2: Performance of classifier on three stellar libraries. *Black:* Basel, *red:* MARCS, *blue:* A stars. The x-axis is the cumulative count for library objects arranged in order of temperature. The y-axis is cumulative probability of being a star.

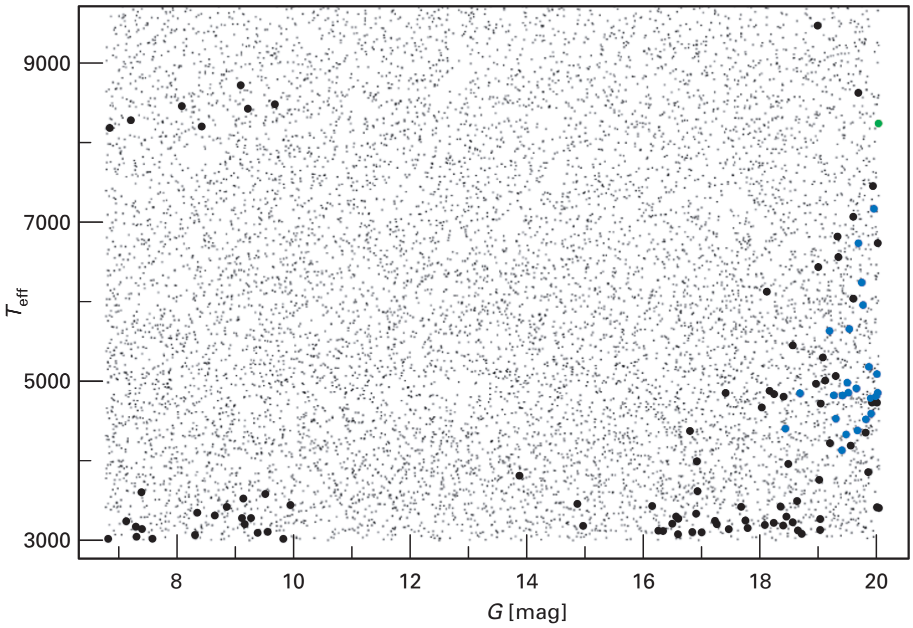
The photometric classifier works with the low-resolution prism spectra (see Fig. IV.2.1). The basic classification algorithm is a Support Vector Machine (SVM), which is increasingly widely used on high-dimensional astrophysical data. An array of SVM models is trained at different magnitudes. Different models deal with common and rare types of objects. A front-end outlier detector identifies sources that do not resemble the training data.

The astrometric classifier works with the parallaxes and proper motions of multi-epoch data and is based on Gaussian mixture models. The mixture model is trained on noise-free data and convolved with the expected uncertainty for each source.

The position-magnitude classifier is based on the sky position and apparent magnitude, and works with a look-up table based on the expected source densities. It includes the relative frequency of occurrence of the different classes of objects.

Testing data for development is generated by feeding high-resolution spectra, from either observations or models, through a dedicated simulator. Fig. IV.2.1 illustrates this process. We use several different stellar atmosphere models as well as the Basel semi-empirical stellar library and SDSS spectra.

Fig. IV.2.2 shows the performance of the classifier as the cumulative probability that the object is a star,



Credit: MPIA / Kester Smith

Fig. IV.2.3: Location of misclassified stars in the T_{eff} – magnitude plane.

P(star), for three stellar libraries, with objects sorted by effective temperature. The dotted lines show the performance of classifiers returning P(star) = 0.5 and P(star) = 0.67 for comparison (dotted lines). The ideal classifier would produce a slope of 1. From this it is clear that the classifier performs well and consistently over most of the T_{eff} range, but has problems for the coolest stars in the Basel library ($T_{eff} < 4000$ K). The other libraries do not have members with $T_{eff} < 4000$ K.

Fig. IV.2.3 shows the misclassifications for another stellar library, based on Phoenix models, in the T_{eff}–magnitude plane. The correctly classified sources appear as small points. The misclassified points are larger symbols, colour coded as follows: outlier (black), quasar (green), galaxy (blue). Most misclassifications are outliers, and most are at the faint end, as expected, but there are some groups of misclassified bright objects. This is probably due to the effect of the CCD gates, which limit the registered flux of bright objects to prevent saturation. There is a cluster of faint sources at around 4000 K misidentified as faint red galaxies.

The overall correct classification rate for the main libraries is well over 90 % and sometimes over 99 %. Furthermore, most of the misclassified sources are identified as outliers, preventing them from contaminating other classes. Some unusual classes of objects have a substantially lower correct classification rate (for example, ultra-cool dwarfs, Wolf-Rayet stars), and so more work is still needed here.

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IV.3 LINC-NIRVANA – Interferometric imager for the Large Binocular Telescope

LINC-NIRVANA (LN) is an innovative Fizeau-mode beam combiner for the Large Binocular Telescope (LBT). LN will deliver 10 mas spatial resolution in the near infrared over a 10″ field of view. In addition to optical-path-difference control, the instrument must correct a wide field of view on the sky using multi-conjugated adaptive optics (MCAO). This substantially increases sky coverage for fringe tracking reference stars.

During the period 2010–2012, LINC-NIRVANA continued to make substantial progress in all subsystems. Highlights of this period include:

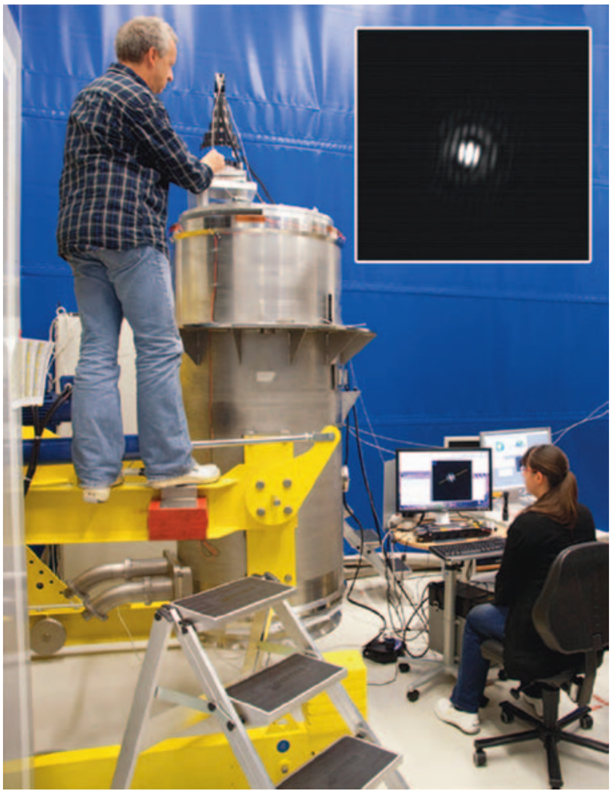
- initiation, construction, and acceptance of Pathfinder experiment (see below)
- delivery, characterization, and acceptance of 2nd high-layer WFS (Wavefront sensor. LN has two high-layer and two ground-layer WFS)
- delivery, characterization, and acceptance of 1st ground-layer WFS
- closing of the high-layer AO loop with 200 modes and five stars
- flexure characterization of wavefront sensors, delay line, and bench
- acceptance of optical bench, cryogenic camera opto-mechanics, warm dichroics
- Assembly, Integration, and Verification (AIV) external review passed
- establishment of consortium-wide and MPIA early (LINC) science teams
- consortium-wide science and software workshops
- cryogenic harmonic drive issues solved, life-cycle testing
- characterization and solution of potential instrument platform flexure issue
- improvement and optimization of delay line and bench eigenfrequencies
- large capacity cooler characterization, optimization, and vibration mitigation
- project risk analysis conducted and tracked delivery of and on-telescope monitoring of vibrations with Optical path difference and Vibration Monitoring System (OVMS)
- completion of the LN to LBT Interface Control Document
- start of on-telescope software control and AO secondary communication

During 2012, we achieved three milestones that retired substantial risk to the overall program. First, we took delivery of the cryogenic metal optics of the science channel. At 50 cm diameter and with high surface quality requirements, these components represent the state of the art. Laboratory tests at operating temperature indicate that the design and procurement were a success. The second milestone followed immediately from this achievement. Shortly after single aperture verification, we were able to produce first fringes with the camera under cryogenic conditions (see Fig. IV.3.1). Meanwhile, our colleagues at the University of Cologne measured first cryogenic fringes with the fringe and flexure tracking system.

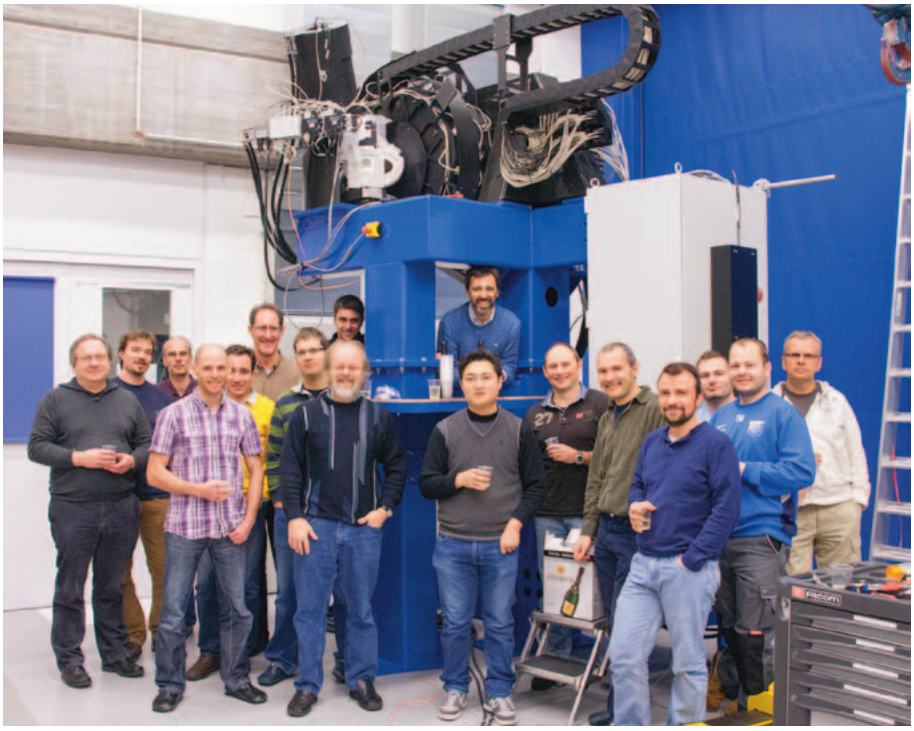
PATHFINDER

The most significant development since the last report was the conception and execution of the PATHFINDER experiment. LINC-NIRVANA is a complex instrument with multiple sub-systems. Commissioning such an instrument is itself complex and prone to delays as one sub-system struggles and the others wait. To address this issue, we conceived the PATHFINDER experiment

Fig. IV.3.1: Cryogenic testing of the camera optics and first cold fringes (*inset*).



Credit: LINC-NIRVANA Team



Credit: LINC-NIRVANA Team

Fig. IV.3.2: Completely assembled LINC-NIRVANA PATHFINDER experiment just prior to PAE.

in late 2010. PATHFINDER aims to implement one of the ground-layer WFS, along with other components and our electronic and software infrastructure, at the right rear bent focus of the LBT. The experiment was approved by the consortium and was strongly supported by the external AIV review committee. A Memorandum of Understanding with the LBT observatory is in place for the operation of PATHFINDER.

PATHFINDER has multiple goals, in addition to retiring risk and accelerating the ultimate commissioning of LINC-NIRVANA. These include:

- verify telescope control system (TCS) communication
- communication with AO secondary and upload of reconstructors
- verify WFS calibration strategy
- verify and refine of field and guide star acquisition
- demonstrate and optimize rotating interaction matrix strategy
- test and fine-tune LN software compatibility with observatory
- commission LN focal station and gain on-sky experience
- be present for interferometry mode TCS software development

The PATHFINDER experiment passed its Preliminary Acceptance Europe (PAE) in December 2012 and is scheduled to ship to the telescope in the first quarter of 2013.

Tom Herbst (Principal Investigator),
Martin Kürster (Project Manager),
Ralph Hofferbert (Project Control Manager),
Harald Baumeister, Thomas Bertram,
Jürgen Berwein, Henrik Beuther, Peter Bizenberger,
Armin Böhm, Michael Böhm, José L. Borelli,
Florian Briegel, Fulvio de Bonis, Albert Conrad,
Dimitrios Gouliermis, Wolfgang Gässler, Armin Huber,
Frank Kittmann, Derek Kopon, Julia Krambs,
Werner Laun, Ulrich Mall, Tobias Maurer,
Daniel Meschke, Lars Mohr, Vianak Naranjo,
Mark Norris, Johana Panduro, Aleksei Pavlov,
Jörg-Uwe Pott, José Ramos, Hans-Walter Rix,
Ralf-Rainer Rohloff, Eva Schinnerer, Clemens Storz,
Jan Trowitzsch, Glenn van de Ven,
Zhaijun Yan, Xianyu Zhang

IV.4 Gravity – A coherent link-up of four 8 m-telescopes to measure stellar positions at the 10 μ arcsec level

Gravity is the second-generation Very Large Telescope (VLT) Interferometer instrument for precision narrow-angle astrometry and interferometric imaging. With its fiber-fed integrated optics, wavefront sensors, fringe tracker, beam stabilization, and a novel metrology concept, Gravity will push the sensitivity and accuracy far beyond what is offered today. Providing precision astrometry of order 10 micro-arcseconds, and imaging with 4 milli-arcsecond resolution, Gravity will revolutionize dynamical measurements of celestial objects: It will probe physics close to the event horizon of the Galactic Center black hole, unambiguously detect and measure the mass of black holes in massive star clusters throughout the Milky Way, uncover the details of mass accretion and jets in young stellar objects and active galactic nuclei; and probe the motion of binary stars, exoplanets and young stellar disks.

MPIA's contribution to Gravity is the four adaptive optics systems, comprising a 22 % share of the project as a whole. The reward in terms of Guaranteed Time Observations is 59 nights with a single unit telescope (about 15 array nights). Each adaptive optics (AO) system consists of a novel cryogenic near-infrared wavefront sensor to beinstalled in the Coude-foci of the four unit telescopes ofthe VLT.

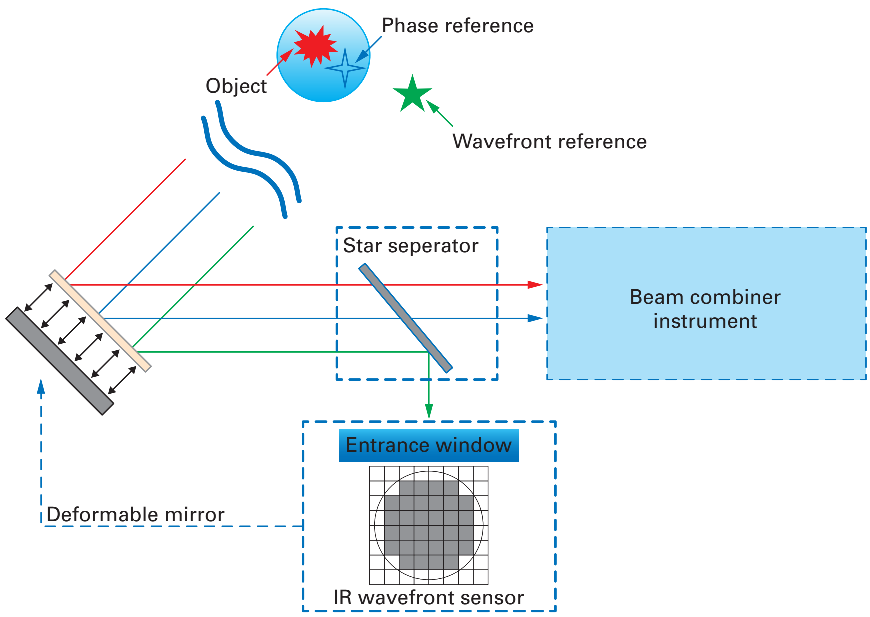
Fig.IV.4.1: Operating principle of the Gravity adaptive optics system. The silicon entrance window is the first optical component of the 80 K/40 K cryostat

The basic principle of the AO system is shown in Fig. IV.4.1. Light from the wavefront reference source is reflected of a deformable mirror (Macao DM) and relayed via the star separator unit into the near-infrared wavefront sensor cryostat. A real-time computer shapes the DM according to the measured wavefront aberrations. A light pick-of system, the AO mode selector, feeds the wavefront sensor with either light from the scientific source or from a dedicated wavefront reference outside the scientific field of view.

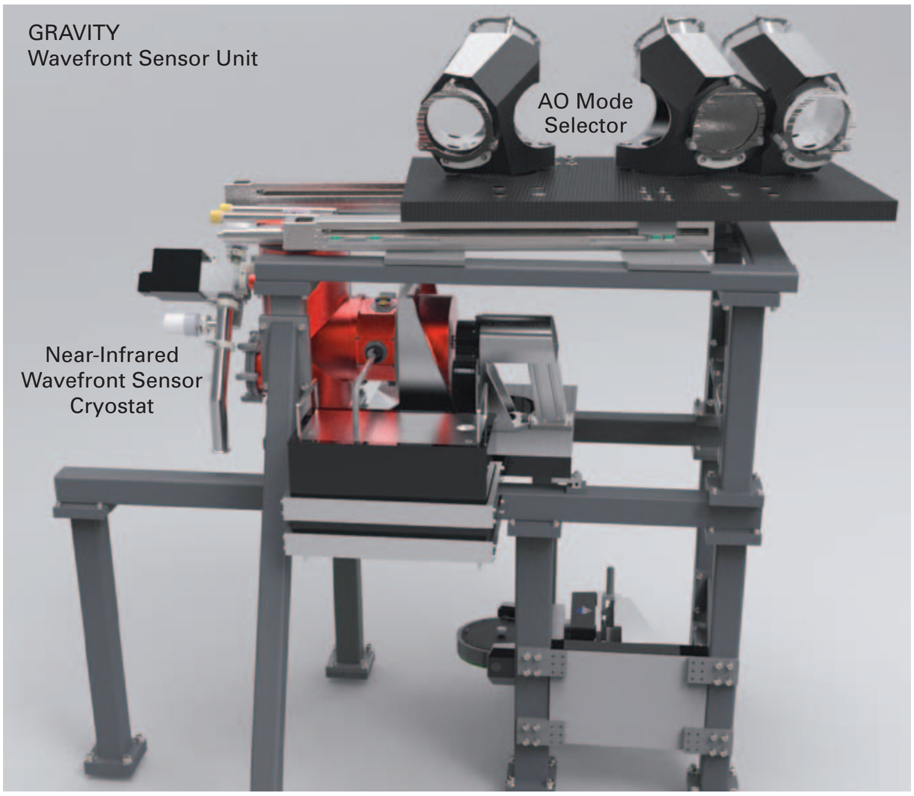
Fig. IV.4.2 shows a CAD model of the AO mode selector and the wavefront sensor cryostat, both fixed to a common structure; the wavefront sensing hardware and feeding optics are located below the AO mode selector.

Detection of exoplanets with GRAVITY

About 70 % of all the stars in our galaxy are M-type dwarfs. These are low mass stars with masses ranging from 0.5 $M_\odot$ down to 0.08 $M_\odot$ and surface temperature of less than 4000 K. These stars fuse hydrogen to helium via the direct proton-proton chain, a slow rate mechanism that resulted in a low luminosity of M-dwarfs. Because of their low intrinsic luminosity, only 8 % of all known exoplanets were found around M-dwarfs. Such optically faint stars are also diffcult to observe with space-based astrometric missions.



Credit: MPIA / Stefan Hippler



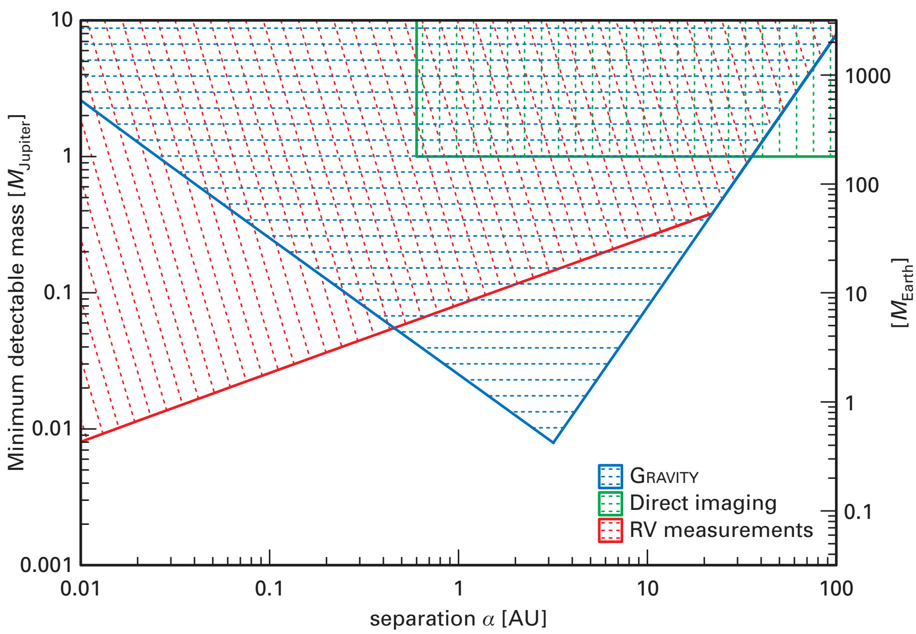
Credit: MPIA

Fig. IV.4.2: CAD model of the wavefront sensor unit with cryostat (*red*) and AO mode selector. Dimensions are about 2 m (width) × 2 m (height) × 1 m (depth).

Fig. IV.4.3: GRAVITY astrometric capabilities as compared to radial velocity measurements (RV) by HARPS (*red*) and SPHERE (*green*) direct imaging. The *blue zone* corresponds to GRAVITY exoplanet detection capabilities around a M7.5 dwarf star at a distance of 6 pc.

The extremely high light gathering power of all four 8 meter UTs of the VLTI and astrometric capability of 10 μ arcsec make GRAVITY an ideal instrument for the detection of very low mass planets around late-type M-dwarfs.

Fig. IV.4.3 shows the astrometric capability of GRAVITY for exoplanet detection around an M7.5 dwarf star at a distance of 6 pc as compared to RV measurements by HARPS and SPHERE direct imaging. In this plot



Credit: MPIA / Kester Smith

we assume the minimum astrometric signal of 50 μ arcsec for the host star, 8.2 m/s RV accuracy of HARPS for this star and SPHERE limits of a 1 $M_{Jupiter}$ planet at a separation of 0.1 arcsec. The right edges of the blue and red zones correspond to an observational time limit of 20 years.

This work is done in collaboration with ESO (Garching b. München, Germany), IPAG (Grenoble, France), PHASE (Paris, France), MPE (Garching b. München, Germany), SIM (Lisbon, Portugal), University of Cologne (Cologne, Germany).

Stefan Hippler, Sarah Kendrew, Armin Böhm, Wolfgang Brandner, Casey Deen, Thomas Henning, Armin Huber, Ralf Klein, Natalia Kudryavtseva, Werner Laun, Rainer Lenzen, Vianak Naranjo, Udo Neumann, Johana Panduro, José Ramos, Ralf-Rainer Rohloff, Pengqian Yang, Neil Zimmerman

IV.5 Special Developments in the Technical Departments

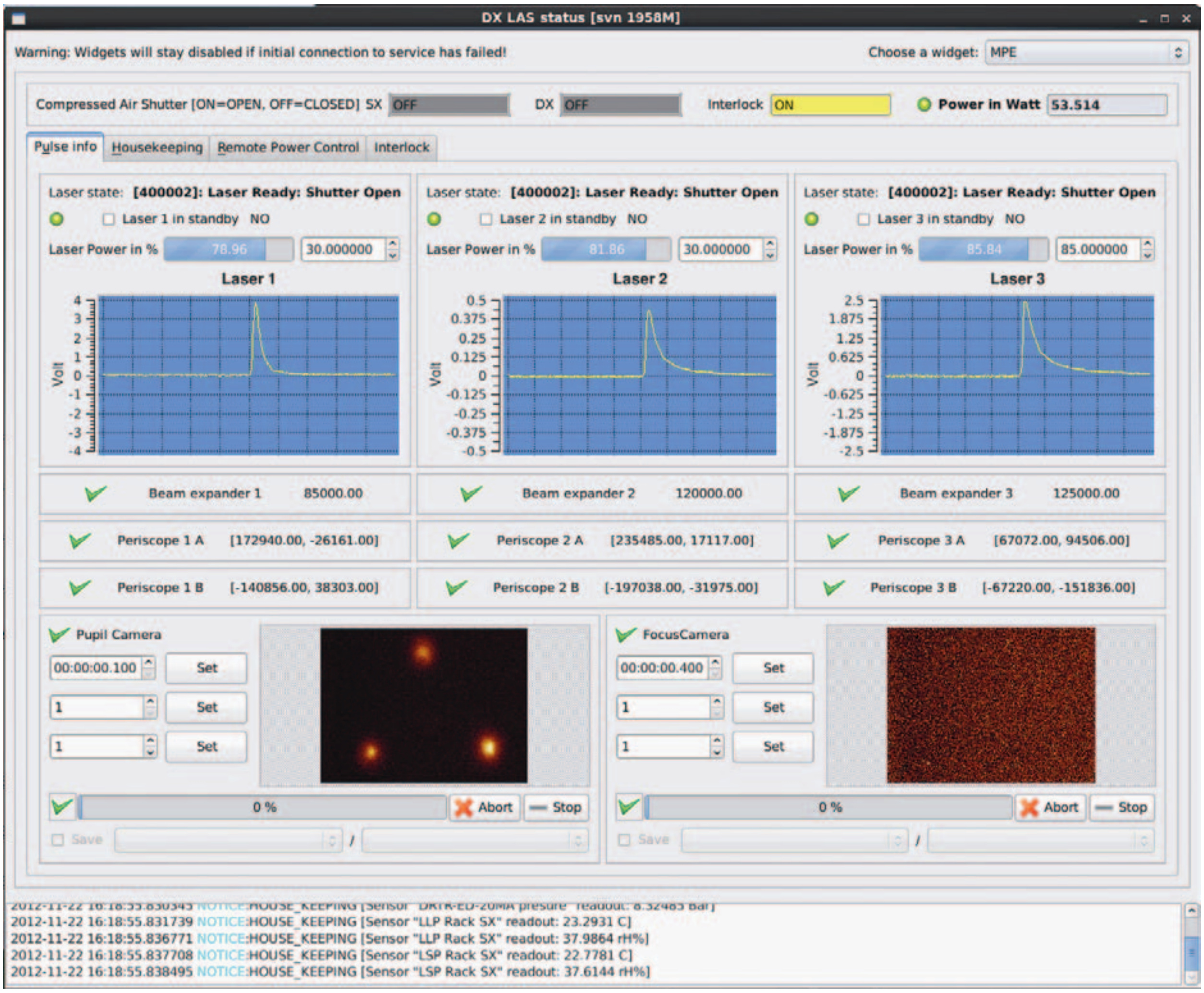
Common instrument control software for LINC-NIRVANA and ARGOS

TwiceAsNice is a new and flexible developer framework for high performance SOA (Service-oriented architecture)-based systems, using the middleware ICE by ZeroC Inc. (www.zeroc.com) for interprocess communication and Trolltechs Cross-Platform Rich Client Development Framework Qt (qt.digia.com). The framework was developed at the MPIA within the framework of the control software for the LBT interferometer LINC-NIRVANA and the LBT laser guide star system ARGOS, but may also be used, due to its flexibility, for other astronomical instruments. The systems architecture was designed to decrease the development time of large SOA-based systems like astronomical instrument control software. The advantages of this new framework are the combination of online instrument data handling and validation with the ability to integrate user defined data manipulation, which can be executed during instrument operation. As an example of this advantage the developer/astronomer may include just-in-time data pipelining functionality into the system.

Nice Instrument Control Environment

This is the bottom layer of TwiceAsNice, a modern object-oriented toolkit that enables you to build distributed applications with minimal effort. Nice allows you to focus your efforts on your application logic, and it takes care of all interactions with low-level network programming interfaces. With Nice, there is no need to worry

Fig. IV.5.1: ARGOS Laser user interface currently used in the lab.



Credit: MPIA / Florian Briegel

about details such as opening network connections, serializing and de-serializing data for network transmission, or retrying failed connection attempts. The basic architecture of Nice is a distributed memory resident database composed of arbitrary data. These data structures can be simple types (int, double, string), vectors or complex ones like images. The in-memory database is part of every application using Nice to support concurrent processing, synchronization and remote exchange with other distributed applications operating on arbitrary hierachical data, e.g: configuration, process status, data collected at runtime. Especially the development of graphical user interfaces is simplified by virtue of a design tool which connects the data structures with graphical widget elements. Also all the internal processing logic is in the non-graphical backend, so that multiple instances of the same graphical user interface can be used in parallel on several computer work stations.

BASDA Applications Services Devices Architecture

For realistic distributed systems, even the most sophisticated data synchronisation mechanism is useless without additional infrastructure. Basda provides a rich set of devices, services, applications:

Devices: The bottom layer defines a common interface for basic functionality. Functional interfaces to various hardware devices are classified and categorised in groups to eliminate hardware dependency, e.g: motor control, input/output hardware, ...

Services: The Service part is located in the middle layer of the hierarchy and implements hardware independent functionality. It provides a mechanism for synchronous and asynchronous remote method invocation and dispatch. Every service has also an internal statemachine for interlocking to prevent conflicting execution of commands.

Applications: The topmost layer consists of various standard programs, as there are:

- Standard Graphical User Interfaces for engineering tasks in the lab (see Fig. IV.5.1)
- Web-based advanced monitoring, alerting, and visualization system based on the open source solution Zabbix (www.zabbix.com).

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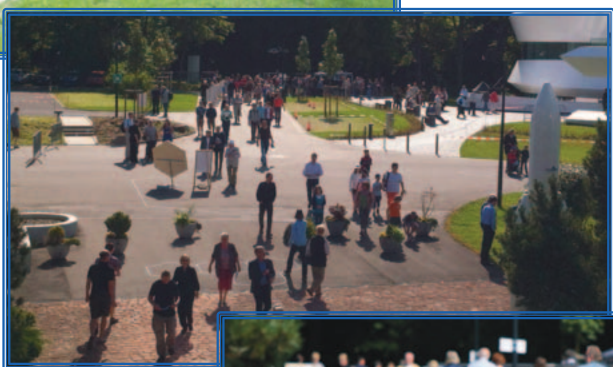
V People and Events

V.1 Looking back at 2012

A wide variety of events took place on the MPIA campus during 2012, making it difficult to narrow down the selection for inclusion in this summary report. In particular, the Haus der Astronomie (HdA), hosted a large number of events in the first year of its regular operation after its inauguration in December 2012. We therefore include HdA and other public outreach activities mainly in Chapter V.2 of this report.

Credit: HdA / Markus Pössel

Credit: MPIA / Doris Anders



Credit: MPIA / Axel M. Quetz

Credit: HdA / Markus Pössel

Fig. V.1.1: A huge crowd gathered at the entrance gate on the open house day in the morning waiting for admission. Everybody recieved a leaflet with detailed descriptions of all stations.

Without doubt, the MPIA Open House on July 22nd was the highlight of the year. As in 2005 and 2009, thousands of guests from the surrounding region visited the Königstuhl and its facilities. The striking new Haus der Astronomie building was clearly a magnet for attention, and almost all areas of the campus, both inside and outside (thanks to perfect weather) were open to the visitors. Nearly the entire staff of MPIA manned the forty individual stations, explaining the Institute's activities and answering questions.

The Open House visitors received a sense of the enormous technical challenges involved in constructing high-tech cameras and spectrographs for modern telescopes. In addition, they learned how large observatories, such as the Very Large Telescope (VLT) and the Large Binocular Telescope (LBT) use adaptive optics and interferometry to surpass the image quality of even a space telescope. On the other hand, they were made aware that the mission of current and future space-based facilities, such as Herschel and JWST, are completely complementary to earthbound telescopes, doing the type of astronomy that is simply not possible from the surface of our planet. The visitors also had the chance to experience how astronomers actually observe and how they analyse the huge amount of data that modern telescopes and instruments deliver. The synergy of these experiments with theoretical calculations was made clear, as was the importance of computer simulations in both answering and defining the astrophysical investigations we pursue.

As with previous Open House days, the Institute offered a special program for children, providing both entertainment and education on astronomical topics. In addition, a continuous series of lectures, this time offered in English as well as German, allowed direct contact between active research-

Fig. V.1.2: During the open house day several dozen of stations were prepared for the visitors which were besieged all day.

ers and the public. This was complemented by a non-stop series of videos on a variety of astronomy topics. Our neighbours on the Königstuhl, the Landessternwarte (State Observatory), contributed to the effort, offering guided tours of their historical telescope facilities, and our Max Planck colleagues from the nearby Nuclear Physics institute gave insight into their astronomy-related projects.

In addition to the Open House, we repeated the very popular Girl's Day (April 26) and the successful Sunday morning public lecture series (Astronomie am Sonntag Vormittag). The MPIA also took part in supervising schoolchildren during a practical training module of the International Science School Heidelberg (ISH) in July and August. The ISH is a student exchange project of the city of Heidelberg in collaboration with its partner cities. In addition to participating in educational activities, the MPIA is a member of the ISH scientific council. Some of the authors of this article also organized a major meeting on the topic "Public Outreach in Astronomy" (see www.mpia.de/homes/jaeger/index.htm) in conjunction with the annual conference of the German Astronomical Society (Astronomische Gesellschaft or AG) in Hamburg in September. MPIA staff participated in the wider AG conference as well, through organizational support, scientific presentations, splinter meetings, and teacher training.

The MPIA continued its program of guided tours through the Institute, thanks to the generous involvement of students and staff. School and college groups accounted for more than half of these tours, and there were a number of VIP visits.

Meetings, Scientific Conferences and Special Guests at MPIA Campus

As mentioned in the previous paragraph, a number of visits of special guests took place in 2012. The guests included:,

- a group of experts and instructors from the metal processing industry (May 8)
- members of the Industrie und Handelskammer (IHK, May 22 / Sept. 19)
- a group led by the Lord Mayor (Oberbürgermeister) of Heidelberg (July 5)

- the ZONTA-Club (September 18)
- a group from the Japanese-German Summer School (September 20)
- Supporting Members of the Max-Planck Society (October 1)
- the Board of Trustees (December 3)

Once again, the institute held its Internal Symposium (November 28). This all-day event provides an opportunity for staff, postdocs, and students to provide an overview of all aspects of Institute research. In addition, 2012 saw the introduction of welcome events for new students and postdocs.

As in previous years, MPIA scientists organized local and external conferences or participated significantly in the organization and management of other meetings.

This included four workshops at Ringberg Castle: 50 Years of Brown Dwarfs: from Theoretical Prediction to Astrophysical Studies (October 21–24), EPoS 2012 – The Early Phase of Star Formation (July 1–6), The Dark Energy quest: when theory meets simulations (June 24–29), and Dynamics meets kinematic tracers (April 11–14).

And as in recent years, the IMPRS Summer School took place at the Max Planck House Heidelberg (September 10–14). This time, the workshop was about Computational Astrophysics: Physical Foundations & Numerical Techniques.

We also held several conferences and meetings at MPIA and HdA. Major events included the MPIA Summer Conference 2012 – Characterizing & Modelling Extrasolar Planetary Atmospheres – Theory & Observation (July 16–19, MPIA), .Astronomy 4 (July 9–11, HdA),

The Milky Way: Stars, Gas, Dust and Magnetic Fields in 3D (June 18–20, HdA/MPIA),

Disc Galaxy Formation in a cosmological context (May 14–18, MPIA), 3rd Califa Busy Week (May 11–15, HdA/MPIA).

Klaus Jäger, Thomas Henning,
Markus Pössel, Axel M. Quetz,
Hans-Walter Rix, Mathias Voss

V.2 Haus der Astronomie – Center for Astronomy Education and Outreach

For our Center for Astronomy Education and Outreach, Haus der Astronomie (HdA; literally "House of Astronomy"), 2012 was the first full year of operations in our new, galaxy-shaped building. Our threefold mission: To communicate the fascination of astronomy to the general public, to support astronomy education, and to foster the exchange of knowledge between scientists.

Haus der Astronomie is an unusual institution at the interface between science and the public. After moving into our new building in late 2011, this was the first year HdA could show its full potential – from developing and producing materials and resources for the public or for use in schools to the more than 10 000 people who visited the HdA building for guided tours, workshops, public talks or scientific conferences (not counting an additional 5000 on the Open Day) and our participation in external events.

The partners and the team

Haus der Astronomie is the result of a partnership between the Klaus Tschira Foundation, which has financed and built the spectacular HdA building, the Max Planck Society operating the HdA (via MPIA), and the City of Heidelberg as well as the University of Heidelberg supporting our operations with staff positions.

By 2012, we had assembled a team of staff members experienced in the various areas of education and outreach: Markus Pössel as the HdA's Managing Scientist (funded by Max Planck Society) had been with the center since 2009. Olaf Fischer (funded by the City of Heidelberg's Foundation for Youth and Science), our resident specialist for high-school astronomy, had moved to the HdA in late 2009. Carolin Liefke (funded by the Klaus Tschira Foundation and Baden-Württemberg's Ministry of Science and Research), whose focus areas include student research and university teaching for future physics teachers, has been with us since spring 2010. Cecilia Scorza, who specializes in middle school astronomy education and astronomy for younger children, joined us in 2009; since early 2011, she works at HdA as a project scientist funded by the Special Research Pro-

Fig. V.2.1: Exterior view of the galaxy-shaped HdA building from the South.

Credit: HdA / Markus Pössel

Credit: HdA / Markus Pössel

Fig. V.2.2: The HdA's central auditorium is equipped with a digital planetarium system. Here, visitors can take virtual journeys into space – in this example, in September 2012, we have travelled outside our Milky Way galaxy and are looking back. The planetarium also allows for the projection of astronomical images and visualizations.

gram SFB 881 "The Milky Way System". Jakob Staude, one of the driving forces behind the HdA project as a whole, continues to accompany and advise us. Natalie Fischer, who is now the National Project Manager for the EU-UNAWE project, which aims to bring astronomy to young, disadvantaged children, joined us in spring 2011. Organizational support has been provided since summer 2012 by our new secretary Sigrid Brümmer.

Once more, we were supported by two teachers (Gymnasium and Realschule), on loan from Baden-Württemberg's Ministry of Education: Alexander Ludwig and Tobias Schultz, who spent 50 % of their time in the HdA, the other 50 % in their respective schools. The psychologist Anita Mancino, who worked with us for the first half of 2012, as well as student assistants completed our roster.

Astronomy for the public

In the area of outreach, we continued to combine „classic" astronomical PR, online outreach and public events. In particular, we expanded our work as German node of the ESO Science Outreach Network, where our contributions include providing German translations of all ESO press releases and serving as a contact for German media. This year, the HdA also hosted special events celebrating ESO's 50th anniversary (Liefke / Pössel).

As far as public events go, this year's highlight was without a doubt the Open Day on the Königstuhl, with nearly 5000 visitors on the MPIA Campus, all of which were eager to take a look at the brand-new HdA building (cf. chapter V.1). In addition to presenting our own work, HdA also provided a children's program with hands-on workshops for the Open Day and advised and supported MPIA scientists with their own exhibits and demonstrations.

On a more regular basis, we offer talks for the general public, chiefly as part of our monthly lecture series "Fascinating Astronomy" (17 talks; organization: Liefke) and, in the summer, under the heading of "Sunday a.m. Astronomy" (4 talks; organization: Pössel), with a total attendance of more than 2000.

Guided tours of Haus der Astronomie as well as the surrounding astronomical institutes were offered both by MPIA students and by HdA staff for more than 120 groups, with a total attendance of nearly 4000.

We also participated in this year's edition of "Explore Science", the Klaus Tschira Foundation's five-day family science festival, held in late June and attended by more than 56 000 visitors, with hands-on stations about geometric methods for measuring stellar distance (parallax), the geometry of telescopes, and the length scales of our Solar System.

Credit: HdA / Markus Pössel

Fig. V.2.3: (*top*) The HdA cooperates with a network of partner schools from all parts of Germany – in the development of educational resources as well as in the asteroid search project. Here, on October 25, 2010, new partner teachers are welcomed in the Haus der Astronomie's central Klaus Tschira Auditorium.

Fig. V.2.4: (*bottom*) The central auditorium of the HdA, the Klaus Tschira Auditorium, seats 100 and features a digital planetarium system. It is regularly used for events for the general public – notably for our series of public talks, but also for guided tours through the astronomical institutes on Königstuhl, as here in September 2012.

Credit: HdA / Markus Pössel

Credit: HdA / Markus Pössel

Fig. V.2.5: South African teachers, astronomers and communicators in one of the workshop rooms of Haus der Astronomie at an event in the framework of the German-South African Year of Science 2012/2013.

Additional events included information booths, complete with sidewalk astronomy activities, at the "Lange Nacht der Museen" (literally the "Long Night of the Museums") at the Planetarium Mannheim, and an "Ask an astronomer" event with Junges Theater im Zwinger3 (part of Heidelberg's Theater; N. Fischer). HdA staff also gave more than a dozen public talks in various locations throughout Germany.

We also kicked off activities in what we hope will prove to be two major areas of growth in the coming year: video productions and astronomical visualization. As of mid-2012, we have production capacity for brief, internet-based HD videos. Our first field test, a video accompanying a press release by MPIA's Remco van den Bosch, gathered a respectable 26 000 views on YouTube to date. Further productions are in the making, including a series of videos demonstrating simple astronomically-themed hands-on experiments (funded by the W. E. Heraeus foundation) and a movie commissioned by the German SOFIA Institute (DSI) in Stuttgart.

Scientific Exchange

To foster scientific exchange, the Haus der Astronomie serves as a meeting place, with the central auditorium and the workshop rooms suitable for hosting meetings and conferences for up to 80 participants. In terms of larger meetings in 2012, a notable example was the first of what is set to become an annual event of MPIA Summer Conferences in July, with more than 100 scientists converging on the HdA under the banner of "Characterizing & Modeling Extrasolar Planetary Atmospheres: Theory & Observation", organized locally by Lisa Kaltenegger and Thomas Henning.

Of particular interest also to HdA staff was ".astronomy 4" (spoken as „dotastronomy"), the fourth in a series of international conferences on astronomy and new media, organized locally by Sarah Kendrew, Markus Pössel, and Tom Robitaille, which featured talks and "unconference sessions" on topics ranging from visualization to internet-based data mining, Citizen Science and astronomical crowdsourcing, seamless astronomy, VO tools and making the most of Twitter.

Additional conferences included the interdisciplinary 48th Heidelberg Meeting on Image Processing (organized by the Heidelberg Collaboratory for Image Processing [HCI]), a meeting of the EChO Science Consortium, a meeting of scientists, educators and students from South Africa and Germany as part of the German-South African year of science 2012/2013, locally organized by Cecilia Scorza, the CALIFA busy week, the annual meeting of the Europlanet Forum, the ASTRA-Workshop "The Milky Way: Stars, Gas, Dust and Magnetic Fields in 3D" and, most appropriate regarding the building's shape, the conference "Disk galaxy formation in a cosmological context", co-organized by Andrea Macciò and Volker Springel (HITS). These and numerous smaller meetings amply prove the attraction of the HdA building to, and its usefulness for, Heidelberg astronomers and their external colleagues.

Astronomy for schools and kindergardens

On the educational side, our flagship remains „Wissenschaft in die Schulen!" (literally „Science into the schools!", abbreviated WIS) in cooperation with Spektrum der Wissenschaft publishing, and in particular the popular astronomy magazine Sterne und Weltraum. HdA senior staff member Olaf Fischer, in charge of WIS-Astronomy, and his team of (mostly external) authors created 14 sets of curricular materials – regularly one per month – for teachers to use in bringing cutting-edge astronomy into their classrooms. Each set is directly linked to an article or news item in a current issue of Sterne und Weltraum. The HdA's activities for WIS-Astronomy are kindly supported by the Reiff Foundation for Amateur Astronomy.

The development of hands-on experiments remains another mainstay of our work. This year saw the production of a first prototype of the Milky Way Kit that contains both hands-on experiments, models that show the size scale of the Milky Way, and many exercises for the classroom (Scorza), as well as an extension of the Mars Kit with additional educational materials (Scorza, Ludwig).

Many of these new resources were presented at teacher trainings and distributed in whole Germany via our HdA-network of partner schools in Germany. Translations into Spanish and English of selected resources were distributed to our cooperation partners in Colombia, Chile, and South Africa.

We also reached out directly to pupils and pre-school children, offering a total of 96 workshops at the HdA for various age groups with a total of more than 2000 participants. Such workshops usually involve hands-on activities, make use of our digital planetarium, and are used to field-test newly developed materials.

External events for children of various ages included astronomy courses for the Hector Kinderakademie (N. Fischer), the Deutsche Schülerakademie (O. Fischer), and JuniorAkademie Baden-Württemberg in Adelsheim (Liefke).

Reaching out to communicators and educators

As every science communicator knows, there are few ways of communicating science that are more effective than infusing teachers and educators with a passion for cutting-edge research, which they then pass on to their students. Our activities in training teachers – and aspiring teachers – as well as educators span the whole spectrum from initial teacher education to in-service training.

Fig. V.2.6: Participants of the conference ".Astronomy 4 – Astronomy and the New Media" in the Klaus Tschira Auditorium in Haus der Astronomie in July 2012. The conference aims to bring together an international community of astronomy researchers, developers, educators and communicators to showcase and build upon the many existing web-based projects in astronomy and astrophysics, from outreach and education to research tools and data analysis.

Credit: HdA / Markus Pössel

Pre-service training included two seminars at the University of Heidelberg ("Nobel Prizes in Astronomy and Astrophysics" and "Life of Stars", Liefke/O. Fischer), while N. Fischer held two lectures on "Basic Astronomy in School" at Heidelberg's University of Education (Pädagogische Hochschule). Olaf Fischer and Cecilia Scorza (co-)advised on a total of six "Staatsexamensarbeiten", the research-oriented thesis aspiring teachers need to write as a requirement for their degree. The students working on these theses are proving a significant asset to HdA – in a role similar to that of PhD students at research institutes – as their thesis work complements existing classroom material.

In-service teacher training in the HdA itself included a total of nine different courses for middle and high school teachers, three training sessions with kindergarten teachers and two workshops for elementary school teachers. A particular highlight was the teacher training that was part of our German-South African cooperation project (see above).

HdA staff also participated in more than a dozen external teacher training activities as far apart as Saarland, Thuringia, and Hamburg. This year's mobile teacher training, supported by the Reiff Foundation, took place in Saxonia (Leipzig, Dresden, Bautzen; O. Fischer/Schultz/Scorza). Special mention needs to be made of the teacher training "A Driver's licence for Telescopes" in Adelsheim (O. Fischer/Liefke) qualifying teachers for the use of small telescopes in school, which also serves a qualification for teachers who want to take advantage of the HdA's telescope lending program.

Research with high-school students

A key component of science literacy is first-hand research experience for high-school students. To this end, we continued our collaboration with the International Astronomical Search Collaboration (IASC) on the IASC-Pan-Starrs asteroid search (high-school students searching for asteroids in Pan-Starrs image data, with a realistic chance of discovering previously unknown main belt asteroids; Liefke), supporting a total of 11 German high-school groups participating in two search campaigns.

A promising area of growth is remote observing, using telescopes that can be controlled via the Internet (Liefke). This year, we started a collaboration with L. Kurtze, the German point-of-contact for the Faulkes Telescope Project, in a pilot project that gives a limited number of German schools access to the two remotely operated 2 meter Faulkes Telescopes. Further activities with remote telescopes for educational purposes focus on the 60 cm ROTAT telescope operated by the Foundation Interactive Astronomy and Astrophysics, Tübingen.

Another opportunity for high-school students to experience astronomical research and, ideally, work on their own projects, are HdA internships. Some of these are part of regular career orientation (such as the BoGy internship program), or of programs for the benefit of particularly talented/interested students (collaboration with the Hector Seminar; Liefke). Our largest internship program remains the three-week International Summer Research Internship, which combines participants of the International Summer Science School Heidelberg with those who have applied directly to HdA for a collaborative research experience (Pössel).

Keeping connected: networking

Internationally, our main collaborations are in the framework of the EU-UNAWE network (that is, with our counterparts in Italy, the Netherlands, the United Kingdom, South Africa and Spain) as well as with Chile (in cooperation with the Heidelberg University's Center for Astronomy and its Centre of Excellence in Chile). Recently, Cecilia Scorza has also been active in Colombia, Venezuela, Ecuador, Peru and Bolivia, helping to set up regional IAU nodes for the Office of Astronomy for Development.

Key strands of our network are tied to specific persons: Olaf Fischer and Cecilia Scorza are members of the Schulkommission (School's committee) of Astronomische Gesellschaft, and Fischer served as the committee's chairman this year. Cecilia Scorza is the German coordinator for the European Association for Astronomy Education and for the EU-UNAWE program, as well as a member of IAU commission 46, "Astronomy Education and Development" and an advisor to the IAU's Office of Astronomy for Development for Latin America. Markus Pössel is a member of the Astronet II Task 5.3 Working Group on outreach matters, which supports the European Commission in the planning of future infrastructure for astronomy.

Conclusion

All in all, 2012 gave us a good taste of what an institution like the HdA – with a dedicated and experienced team of outreach professionals, numerous supporters and collaborators, and a custom-built, well-equipped building – can achieve. Haus der Astronomie as an institution has definitely arrived.

Markus Pössel, Natalie Fischer,
Olaf Fischer, Carolin Liefke,
Alexander Ludwig, Anita Mancino,
Tobias Schultz, Cecilia Scorza,
Jakob Staude, Thomas Henning,
Hans-Walter Rix, Klaus Jäger,
Mathias Voss, Frank Witzel

V.3 Honours, Grants and Awards

ERC Grants and the Heinz Meier-Leibnitz Prize for MPIA Scientists

In 2012, MPIA scientists received two of the most important grants for scientific research in Europe awarded from the European Research Council (ERC).

The ERC was set up in 2007 and is a European funding organisation. The main goal of ERC is to encourage excellent research in Europe through competitive funding. Within its funding program, the ERC supports young top researchers with its ERC Starting grants and top senior research leaders with the ERC Advanced Grants.

Within this framework, ***Hans-Walter Rix*** received an ERC Advanced Grant for his research project "How the Milky Way Built Its Disk" (2.5 Million € for five years) while ***Fabian Walter*** was awarded with an ERC Starting grant for his project "Cosmic Dawn – The Emergence of Black Holes and Galaxies in the Universe" (1.5 Million € for five years).

A very important *"…recognition for scientific achievements and as incentive for early-career researchers to continue to pursue a scientific career"* (citation from the related DFG press release) is the Heinz Maier-Leibnitz Prize which has been awarded annually since 1977 by the German Science Foundation (DFG).

Fig. V.3.1: *Hans Walter-Rix*

Credit: MPIA

Credit: MPIA / Fabian Walter

Fig. V.3.2: *Fabian Walter*

As one of the six prize winners in 2012, ***Lisa Kaltenegger*** received the award in the presence of DFG-president Matthias Kleiner and Federal minister Annette Schavan on May 23 in Berlin.

The prize is named after the physicist and former President of the DFG Heinz Maier-Leibnitz. Following the result of a survey carried out by the scientific magazine "Bild der Wissenschaft at the most renowned scientific institutions, the Heinz Maier-Leibnitz Prize belongs to the three most important German scientific prizes. The award includes a prize money of 16 000 € provided by the Bundesministerium für Bildung und Forschung (German Federal Ministry of Education and Research (BMBF)).

Credit: HdA / Markus Pössel

Fig. V.3.3: *Lisa Kaltenegger*

Ernst Patzer Prize

The annually presented Ernst Patzer Prize was donated by the art-lover and philosopher Ernst Patzer and established by his widow. It is intended to support junior scientists. The Foundation awards its prizes to young researchers at the MPIA and other institutes in Heidelberg and wishes to support science and research particularly in the field of astronomy.

The Ernst Patzer Prizes are honouring the best publications produced in the course of doctoral studies or in the following postdoc phase. The publications must have been published in a refereed journal. The selection committee consists of two scientists from MPIA and one additional external scientist from Heidelberg.

This year's prize winners were:

Jacqueline Hodge, Postdoc at MPIA for her paper "Evidence for a clumpy rotating gas disk in a submillimeter galaxy at $z = 4$" (ApJ, 2012, 760, 11),

Paola Pinilla, IMPRS PhD student at the Center for Astronomy of Heidelberg University (ZAH), for her publication "Ring shaped dust accumulation in transition disks" (A&A, 2012, 545, A81), and,

Jochen Tackenberg, postdoc at MPIA, for his paper "Search for starless clumps in the ATLASGAL survey (A&A 2012,540, A113).

The prize winners were honored during the Patzer Colloquium which took place on November 30 in the MPIA lecture hall where the prize winners gave a 30 minutes presentation of their work.

Further Awards

Dimitrios A. Gouliermis received a research budget from the German Science Foundation (DFG) for his project on "The legacy census of stellar clusters in the An-

Fig. V.3.4: Jochen Tackenberg, Jacqueline Hodge, Paola Pinilla.

Credit: MPIA / Henrik Beuther

Credit: MPIA / Doris Anders

Fig. V.3.5: *Ferdinand Brezinski*

dromeda galaxy achieved with the Hubble Space Telescope". Another DFG research budget was given to Dmitry A. Semenov within the priority program "The first 10 million years of the Solar System – a Planetary Materials Approach" (SPP 1385, SE 1962/1-2.)

Furthermore, ***Ian Crossfield*** received the Robert Doxsey Travel Prize of the American Astronomical Society, ***Siddarth Hedge*** was honored for the "Best Poster" at the 12th European Workshop on Astrobiology (EANA 12) in Stockholm, and ***Viki Joergens*** received the "Baden-Württemberg Zertifikat für Hochschuldidaktik der Universität Heidelberg".

Since 2007 the Max Planck Society has been awarding up to 20 apprentices with the Apprenticeship Prize for excellent performance on the job and at school as well as for social involvement during the training period. For very good marks in his final year of training in the precision mechanics workshop at MPIA ***Ferdinand Brezinski*** received the Apprenticeship Prize for metal work as well as special mention from the vocational school. The Chamber of Crafts Mannheim has invited him to participate in a competition between the top journeymen of the guilds.

Klaus Jäger, Martin Kürster, Axel M. Quetz

Staff

Directors: Henning, Rix (Managing Director)

Scientific Coordinator: Jäger
Public Outreach/Haus der Astronomie: Pössel (Head)
Administration: Voss (Head)
MPIA Observatories: Gredel

Scientists: Afonso (until 14.6.), Andrae, Bailer-Jones, Astraatmaja (since 1.9.), Balog, Bertram, Betremieux, Beuther, Bik, Borelli, Bouwman, Brandner, Brieva, Da Cunha (since 1.11.), De Bonis, Deacon, Decarli, Döllinger, Dorner (since 16.7.), Feldt, Fendt, Fried, Gässler, Glauser (since 1.3.), Goldman, Graser, Gredel, Hayfield (until 14.8.), Hennawi, Herbst, Hippler, Hofferbert, Holmes, Hormuth (since 16.7.), Hughes (maternity protection and parental leave since 29.9.), Ilgner (until 31.1.), Inskip (maternity protection until 15.8.), C. Jäger, K. Jäger, Jahnke, Kainulainen (since 1.3.), Kaltenegger, Kendrew (since 15.10.) Kim Dae-Won (since 1.7.), Klaas, Klahr, Köhler, Krasnokutsky (until 14.5.), Krause, K. Kreckel, Kürster, Launhardt, Leipski, Lenzen, Li Hua-Bai, Linz, Liu Chao (until 16.3.), Macciò, Marien (until 31.7.), Martin, Meisenheimer, Möller-Nilsson, Morales-Häfelin (since 1.8.), Morganson, F. Müller, Mundt, Nielbock, Pavlov, Peter, Pitann (since 22.10.), Pössel, Pott, Ragan (since 1.3.), Robitaille, Rodriguez, Rouillé (since 1.9.), Sandstrom, Scheithauer, Schinnerer, Schlafly (since 1.8.), Schreiber, Seidel, Semenov, K. Smith, Surville (since 1.3.), Stutz (since 1.3.), Tabatabaei (maternity protection and parental leave since 7.7.), Trowitzsch, Tsalmantza (until 31.8.), van Boekel, van de Ven, Wachter, (from 1.9.),Walter, Worseck (from 1.11.), Zsom (until 29.2.), Zhukovska

Postdocs: Adamo, Benisty, Bergfors (until 31.7.), Biller, Bonnefoy, Brangier (until 31.8.), Chauvin (until 30.4.), Cisternas (until 28.2.), Collins, Crighton, Crossfield (since 15.7.), Da Cunha (until 31.10.), Deen, Dutton, Fanidakis, Gennaro (until 30.6.), Groves, Harrington (since 15.7.), Hodge, Johnston, Kainulainen (until 28.2.), Karovicova, Kendrew (until 14.10.), Kopon (since 1.11.), Krasnokutskiy, Kulkarni, Lee K. G., Lee R. (until 14.8.), Lusso, Lyubenova, Mancini, Martinez-Delgado, Meidt, Miguel, Mordasini, Nikolov (until 31.8.), Norris (since 1.9.), Olofsson, Pacifici (10.4. until 9.9.), Ragan (until 28.2.), Rakic (until 31.8.), Rubin, Schlieder, Stinson, Stutz (until 28.2.), Uribe (until 30.6.), van den Bosch R., van der Wel, Venemans (bis.31.10.), Watkins, Xue Xiangxiang (until 31.10.), Yang Yujin (until 30.9.), Zhang Xianyu (since 1.6.), Zimmerman, Zsom

PhD Students: Albertsson, Arrigoni Battaia, Bañados Torres, Bergfors, Besel, Bialas (from 1.11.), Bianchini (from 1.9.), Bihr (from 1.10.), Boley, Büdenbender, Caldu Primo, Ciceri (from 1.7.), Cielo, Chang Yu-Yen, Chang Jiang, Chen Guo (until 31.8.), Cologna, Colombo, Cubillos (from 15.7.), De Rosa, Dittrich, Dittkrist, Dopcke (until 14.9.), Feng Fabo, Feng, Siyi, Flock (until 30.6.), Follert (until 31.3.), Fu Qiang, Gerner, R. Hanson, Hegde, Golubov (until 31.10.), Grootes (until 30.9.), Jäger M., Jin Sheng, Kalinova, Kannan, Kapala, Khrykin (from 1.9.), Koepferl (from 15.10.), Kurokawa (until 11.9.), Kudryavtseva (until 30.11.), Läsker, Lenius (from 16.1.), Lippok, Lu Chia-Chun (until 30.6.), Lobo Gomes (from 1.5.), Mayer, Malygin, Marleau (from 1.9.), Manjavacas, Maseda (from 15.8.), Mohler, Morales Häfelin (1.4. – 1.8.), A. Müller (until 31.8.), Nikolic, Nugroho (until 31.10.), Obermeier (from 15.11.) Penzo, Pitann, Potrick, Querejeta (from 1.9.), Raettig, Ramkumar (until 31.10.), Rochau, Rorai, Sabri, K. B. Schmidt (until 31.8.), Schnülle, Schulze-Hartung, Singh, Steglich, Stepanovs, Sturm, Sun, Tackenberg, Trifonov, Tsatsi (from 1.10.), Uribe, Valente (until 29.2.), Van der Laan (until 31.10.), Walther (from 1.9.), Wu Shiwei (from 1.9.), Venemans (from 1.11.), Yan Zhaojun, Yang Pengqian, Zhang Lan (until 31.8.), Zhang Miaomiao (until 31.8.), Zhang Xianyu (until 31.5.), Zsom (until 29.2.)

Diploma and Master Students (FH): Beutel (since 1.5.), Fraß (until 31.8.); Hernitschek (since 1.9.); Hirsch (until 25.2.); Maseda (until 14.8.); Panduro (until 29.2.); Qian (since 15.10.); Shurkin (until 30.9.); Strehlow (until 12.4.); Wouter (until 30.6.)

Bachelor Students: Dieng (since 1.10.); Knodt (9.8. – 31.10.); Kozlikin (15.8. – 14.11.); Neumeier; Salm (since 1.9.); Samland (1.5. – 31.7.); Zhorschel (1.8. – 15.10.)

Interns: Abel; Baldauf; Brezinski; Ehret, S. (until 31.8.); Kugler; Lechner; Mayer (since 1.9.); Schend (since 1.9.); Sennhenn (since 1.9.); Specht; Till

Student Assistants: Bihr (from 1.10.); Ciceri (since 1.7.); Haude (until 31.10.); Neu (since 1.9.); Reppin (since 1.4.); Rohnacher (since 1.9.)

Student Apprentice: Krambs (since 1.8.); Plenz (16.7. – 14.9.); Sellentin (15.9. – 31.10.)

Public Outreach / Haus der Astronomie: N. Fischer, O. Fischer, Liefke, Ludwig, Mancino (until 31.6.), Schultz, Scorza, Staude; Student Assistants: Haude, Neu (since 1.9.), Rohnacher (since 1.9.), Suijkerbuijk Garcìa (1.5. – 31.12.)

Technical Departments: Kürster (Head)
Mechanics Design: Rohloff (Head), Baumeister (Deputy), Ebert, Huber, Münch, Rochau

Precision Mechanics Workshop: Böhm (Head), W. Sauer (until 31.1., Deputy) Meister (since 1.2., Deputy), Heitz, Maurer, Meister, Meixner, Stadler; Azubis, Praktikanten, Student Assistants: Abel, Baldauf, Brezinski, Ehret, S. (until 31.8.), Kugler, Mayer (since 1.9.), Schend (since 1.9.), Sennhenn (since 1.9.), Specht

Electronics: Mohr (Leitung); Ramos (Deputy); Adler, Alter, Ehret, Klein, Lehmitz, Mall, Ridinger, Wrhel; Trainees, Student Assistants: Dieng (since 1.10.), Neumeier

Instrumentations-Software: Briegel (Head), Storz (Deputy), Berwein, Borelli, Kittmann Leibold, Mathar (since 1.9.), Möller-Nilsson, Neumann, Pavlov, Trowitzsch; Azubis, Praktikanten, Student Assistants: Zhorschel (1.8. – 15.10.)

Engineering and Project Management: Marien (until 31.7., Head), Bizenberger (Head since 1.8.), Bizenberger (Deputy until 31.7.), Bertram (Deputy since 1.8.), De Bonis, Gässler, Graser, Hermann (since 1.10.), Laun, Meschke, Naranjo, Peter

Administrative and Technical Service Departments:

Administration: Voss (Head); purchasing dept.: Wolf, Anders; finances dept.: Kourschil (since 1.11.), Mantwill-Aue (until 30.9.), Anders, Zähringer; staff dept.: Apfel, Baier, Hölscher, Schleich; reception: Beckmann; trainees: Lechner, Till

Library: Dueck

Data Processing: Piroth (Deputy until 31.7.2012, Head since 1.8.2012), Binroth (since 1.8.2012), Hiller, Richter

Photographic Lab: Anders

Graphic Artwork: Quetz (Head), Meißner, Müllerthann

Secretaries: Cuevas-Alonso (since 1.10.2012) Janssen-Bennynck (until 31.10.2012), Koltes-Al-Zoubi (parental leave), Seifert, Witte-Nguy

Technical Services and Cafeteria: F. Witzel (Head), Nauß (Deputy), Behnke, Douffet (since 1.3.2012), Drescher, Jung, Krämer, Lang, B. Witzel, E. Zimmermann

Scientific Advisor: Friedrich Huisken

Former Staff Members Acting for the Institute: Christoph Leinert, Dietrich Lemke, Jakob Staude

Guests: Adrian Glauser, ETH Zürich, 9. – 13. Jan.; Nadia Kostogryz, Astron. Obs. NAS, 9. – 30. Jan.; Henning Oetjen, Univ. Oldenburg, 10. Jan – 1. Apr.; Hans M. Günther, Harvard-Sm Center, 11. – 13. Jan.; Brad Peterson, Ohio State Univ., 15. – 19. Jan.; Diego Fustes, Univ. de la Coruna, 15. Jan. – 17. Apr.; Markus Schoeller, ESO, 16. Jan.; Luciano Casarini, Univ. Trieste, 17. – 28. Jan.; Thomas de Boer, Kapteyn Inst., 22. – 25. Jan.; Roloef de Jong, AIP Potsdam, 23. – 24. Jan.; Hendrik Hildebrandt, Univ. Brit. Columbia, 25. Jan.; Adrian Glauser, ETH Zürich, 25. – 27. Jan.; Christian Wolf, Univ. Exeter, 25. – 30. Jan.; Sebastian Wolf, Univ. Kiel, 26. – 29. Jan.; Frederique Motte, Saclay, 30. – 31. Jan.; Nick Wright, CfA, 30. Jan – 5. Feb.; Muhammad Bin Asad Khan, Univ. Göttingen, 31. Jan.; Ian Crossfield, UCLA, 31. Jan. – 4. Feb.; Jonathan Foster, CfA, 31. Jan – 5. Feb; Elisabeth Adams, CfA, 31. Jan – 5. Feb.; Leslie Rogers, MIT, 1. – 5. Feb.; Amanda Heiderman, Univ. Texas, 1. – 22. Feb.; Daniel Asmus, Univ. Kiel, 2. – 3. Feb.; Rebecca Grellmann, USM Munich, 5. – 6. Feb.; Witold Maciejewski, Liverpool Univ., 5. – 15. Feb.; Bastian Körtgen, Univ. Köln, 6. – 7. Feb.; Riccardo Smareglia, INFA, 6. – 9.Feb.; Cristina Knapic, INFA, 6. – 9. Feb.; Clare Dobbs, Univ. Exeter, 8. – 11. Feb.; Miguel Quererjeta, UCM, 12. Feb.; Tri Astraatmadja, Leiden Inst. 12. – 13. Feb.; Rebecca Martin, StScl Baltimore, 12. – 14. Feb.; Rok Roskar, Univ. Zürich, 13. – 15. Feb.; Chris Brook, Univ. Madrid, 13. – 16. Feb.; Danilo Marchesini, Tufts Univ., 13. – 17. Feb.; Adrian Glauser, ETH Zürich, 13. – 17. Feb.; Amelia Bayo, ESO, 15. – 16. Feb.; Emma Samll, Liverpool Univ., 20. – 21. Feb.; Hans Zinnecker, NASA AMES, 20. – 25. Feb.; Ian Dobbs-Dixon, Univ. Washington, 23. Feb. – 3. Mar.; Agnieszka Rys, IAC, 24. Feb – 21.Mar.; Mathias Zechmeister, Göttingen, 26. – 28. Feb.; Alessandri Brunelli, INFA, 27. Feb. – 3. Mar.; Günter Thummes, Univ. Giessen, 28. Feb.; Herve Bouy, CSIC/INTA, 28. – 29. Feb.; Vincenzo Antonuccio, INFA, 5. – 13. Mar.; Alexander Karim, Durham, 7. – 12. Mar.; Derek Kopon, Steward Obs., 8. – 9. Mar.; James Di Francesco, NRC Hertzberg, 9. – 18. Mar.; Nicolas Martin, Strasbourg Obs., 12. – 14. Mar.; Guinevere Kaufmann, MPA, 12. – 21. Mar.; Michael Perryman, Univ. Bristol, 13. – 15. Mar.; Peter Strittmatter, Univ. Arizona, 15. Mar.; Fontana Adriano, INFA, 15. Mar.; Christian Thalmann, Uni Amsterdam, 18. – 21. Mar.; Jacopo Farinato, INFA, 18. – 23. Mar.; Luca Marafatto, INFA, 18. – 23. Mar.; Maria Bergomi, INFA, 18. – 28. Mar.; Böker, Torsten, ESA/ESTEC, 19. – 23. Mar.; Gordon Richards, Drexel Univ., 19. – 30. Mar.; Alex Hobbs, ETH Zürich, 21. – 23. Mar.; Nikolai Voshchinnikov, State Univ. St. Petersburg, 22. Mar. – 19. Apr.; Jacopo Farinato, INFA, 25. – 30. Mar.; Valentina Viotto, INFA, 25. – 30. Mar.; David Sanders, IfA, 28. – 31. Mar.; Agnieszka Rys, IAC, 31. Mar. – 31. May; Marie Martig, Swinburne Univ., Strasbourg Obs., 2. – 4. Apr.; Anika Schmiedecke, Univ. Köln, 3. – 5. Apr.; Jashua Adams, Carnegie Obs. 3. – 9. Apr.; Camilla Pacifici, Institut d'Astrophysique de Paris, 10. Apr. – 10. Sep.; Alexis Matter, MPIfR Bonn, 12. Apr.; John Jardel, Univ. Texas, Austin, 14. – 21. Apr.; Mark Den Brok, Kapteyn Institute, 15. – 27. Apr.; Stefanie Wachter, Caltech, 17. – 23. Apr.; Joseph Harrington, Univ. Central Cal., 17. – 24. Apr.; Paul Molliere, Univ. HD, 18. Apr. – 31. Aug.; M. P. Cornejo Perez, Explora, Chile, 23. Apr. – 11. May; P. C. Castro Perez, Univ. Tec. Chile, 23. Apr. – 11. May; Maryam Habibi, Univ. Bonn, 24. – 26. Apr.; Andrea Stolte, Univ. Bonn, 24. – 26. Apr.; Ben Moster, MPA, 25. – 27. Apr.; Tatiana Vasyunina, Univ. Verginia, 27. Apr. – 14. May; Hanni Lux, Nottingham

Univ., 30. Apr. – 3. May; Marc Kuchner, NASA, 1. – 3. May; Igor Zinchenkov, Russ. Acad. Sci., 1. – 6. May; Jose Caballero, Center Astrobiol. Madrid, 2. – 5. May; Josep Colome Ferrer, ICE-CSIC, 2. – 5. May; Xi Kang, Purple Mount. Obs., 2. – 10. May; Longlong Feng, Purple Mount. Obs., 2. – 10. May; Concepcion Cardenas, IAA, 2. – 24. May; Paulina Francuz, Univ. Wroclaw, 2. May – 30. Sep.; Florian Rodler, ICE, 7. – 9. May; Marina Galvagni, Univ. Zürich, 7. – 13. May; Elodie Choquet, Univ. Porto, 8. May; Alvaro Orsi, Catolica Chile, 8. – 11. May; Nicolas Martin, Strasbourg Obs., 9. – 11. May; Rachel Somerville, Rutgers Univ. 13. – 18. May; Julyanne Dalcanton, Univ. Washington, 13. – 18. May; Alexander Wolszczan, Penn. State Univ., 17. May – 18. June; Adam Myers, Univ. Wyoming, 17. May – 13. Aug.; Greg Rudnick, Univ. Kansas, 18. May – 27. July; Fred Lo, NARO, 20. May – 23. June; Mark Den Brok, Kapteyn Inst., 20. May – 31. July; Richard Bielby, Durham Univ., 21. – 24. May; Dan Taranu, Univ. Toronto, 23. – 25. May; Doug Potter, Univ. Zürich, 23. – 25. May; Bradley Peterson, Ohio State Univ., 28. May – 6. June; Yuan-Sen Ting, Univ. Singapore, 28. May – 26. Aug.; Marijn Franx, Leiden Obs., 29. May – 1. June; Laurent Loinard, UNAM, 29. – 30. May; Jacopo Farninato, NAF Padua, 29. May – 8. June; Valentina Viotto, NAF Padua, 29. May – 8. June; Maria Bergomi, NAF Padua, 29. May – 8. June; David Hogg, NYU, 2. – 7. June; Dennis Zaritzky, Univ. Arizona, 2. – 29. June; Ann Zabludoff, Univ. Arizona, 2. – 29. June; Stefano Zibetti, INAF Florence, 3. – 8. June; Nicolas Martin, Strasbourg Obs., 4. – 7. June; Y.–H. Chu, Univ. Illinois, 5. – 8. June; J. Abreu Mendez, IAC, 5. – 10. June; Tom Megeath, Univ. Toledo, 6. – 8. June; Neal Turner, JPL, 6. June – 31. Aug.; Rosie Chen, MPI Radio Astron., 7. – 8. June; K. Dezker French, Univ. Arizona, 8. – 20. June; Steen Hansen, Dark Cosm. Center, 17. – 23. June; Myriam Benisty, Inst. Astro. Grenoble, 17. June – 14. July; Malcom Walmsley, INAF Florence, 18. June – 15. July; Antonella Natta, INAF Florence, 18. June – 15. July; Andreas Schulze, Peking Univ. 21. June; Ranjan Gupta, Univ. Pune, 24. – 27. June; Adam Ginsburg, Univ. Colorado 24. June – 1. July; Julyanne Dalcanton, Univ. Washington, 24. June – 22. July; J. Xavier Prochaska, UC Santa Cruz, 24. June – 19. Aug.; Carmelo Arcidiacono, INAF, 25. – 29. June; Antonio Cucciara, UC Santa Cruz, 25. June – 2. July; Michele Fumagalli, UC Santa Cruz, 25. June – 6. July; Nico Röck, H. Hessen Gym., 25. June – 13. July; Phil Marshall, Oxford, 1. – 5. July; Sebastian Lopez, Univ. Chile, 1. – 5. July; Timothée Vaillant, Inst.Planet. Grenoble, 1. – 14. July; Vincenzo, Antonuccio,Catania Obs., 1. – 31 July; Sarah Rugheimer, Harvard, 1. July – 1. Aug.; David Hogg, NYU, 1. July – 31. Aug.; Sarah Ballard, Harvard, 2. – 4. July; Karrie Gilbert, Univ. Washington, 2. – 4. July; Alex Hubbard, AMNH, 2. July – 31. Oct.; Adrian Whelan, NYU, 3. – 13. July; D. Foreman-Mackey, NYU, 3. July – 8. Aug.; Andras Zsom, MIT, 4. – 21 July; Christy Tremonti, Univ. Wisconsin, 6. July – 4. Aug.; Ran Wang, Univ. Arizona, 7. – 11. July; Alyssa Goodman, Harvard-Smithsonian, 7. – 13. July; Massimo Dotti, Univ. Milano, 8. – 13. July; Gabor Worseck, UC Santa Cruz, 8. – 20. July; Nicolas Martin, Strasbourg Univ. 9. – 11. July; Derek Kopon, Steward Obs., 9. – 11. July; Simone Weinmann, Univ. Leiden, 9. – 13. July; Tatiana Vasyunina, Univ. Virginia, 9. – 13. July; James Kasting, Penn. State Univ., 9. – 18. July; Dan Weisz, Univ. Washington, 9. July – 3. Aug.; Alex Lazarian, Univ. Wisconsin, 10. July; Cliff Johnson, Univ. Washington, 10. – 22. July; Morgan Fouesneau, Univ. Washington, 10. – 22. July; Emily Rice, Coll Staten Island, 12. July; Chris Beaumont, Harvard-Smithsonian, 12. – 13. July; Michelle Borkin, Harvard Univ., 12. – 13. July; Phil Hinz, Univ. Arizona, 12. – 13. July; Bradley Peterson, Ohio State Univ., 14. – 19. July; Jasmina Belcic, UCF, 15. – 23. July; Rosita Paladino, INAF, 15. – 24. July; Jo Bovy, IAS Princeton, 15. July – 15. Aug.; Gisella De Rosa, Ohio State Univ., 16. – 19. July; Sarah Seager, MIT, 16. – 20. July; D. Karl Gordon, STSCI, 16. – 21. July; Sebastian Danielasche, Tokyo Inst., 19. – 27. July; Sacha Hony, CEA, 23. – 25 July; Jacopo Farinato, INAF, 23. – 27. July; Randolf Klein, USRA/NASA, 23. July – 3. Aug.; Valentina Viotto, INAF, 24. – 27. July; Erwin De Blok, Univ. of Cape Town, 28. July – 19. Aug.; Andreas Schruba, Caltech, 30. July – 3. Aug.; Kozlikin, Univ. HD, 1. – 14. Aug.; Tom Broadhurst, Univ. Bilboa, 2. Aug.; Adi Zitrin, Univ. HD, 2. Aug.; Cara Battersby, Univ. Colorado, 5. – 8. Aug.; Julya Marin, CAHA, 5. – 18. Aug.; F. Juan Lopze, CAHA, 5. – 18. Aug.; Nicolas Martin, Strasbourg Univ., 6. – 8. Aug.; Rok Roskar, Univ. Zürich, 6. – 9. Aug.; David Mykytyn, NYU, 6. – 10. Aug.; Bradley Frank, Univ. Cape town, 6. – 10. Aug.; Lucie Metenier, ESO Garching, 8. – 10. Aug.; Jasmina Blecic, UCF, 8. – 26. Aug.; Glemmys Farrar, NYU, 9. – 10. Aug.; Stacy Kim, CIT, 13. – 21 Aug.; Jessy Jose, IIA, Bangalore, 13. – 14. Aug.; Pieter van Dokkum, Yale Univ., 21 – 22. Aug.; Athanasia Tsatsi, Univ. Athens, 26. Aug. – 1. Sep.; Andras Zsom, MIT, 26. Aug. – 1. Sep.; Jean-Philippe Bernard, CNRS Toulouse, 27. – 31. Aug.; John Tobin, NRAO, 27. Aug. – 5. Sep.; Yasunori Hori, NARO, 29. – 30 Aug.; Shoichi Oshino, NARO, 29. – 30. Aug.; Chris Ormel, UC Berkeley, 29. – 31. Aug.; Jerome Pety, IRAM, 3. – 7. Sep.; Benjamin Johnson, IAP, 5. – 7. Sep.; James Allen, Univ. Sydney, 5. – 7. Sep.; Caterina Ubach, Swinburne Univ. 9. – 13. Sep.; Osupengo Moralo, Nord-West-Univ., 9. – 19. Sep.; Papi Lekwene, Nord-West-Univ., 9. Sep. – 10. Oct.; Andreas Herzog, Ruhr Univ., 10. – 11. Sep.; Nicolas Martin, Strasbourg Univ., 10. – 12. Sep.; Agnes Kospal, Konkoly Univ., 10. – 22. Sep.; Peter Abraham, Konkoly Univ., 10. – 22. Sep.; Chikako Yasui, Tokyo Univ. 10. Sep. – 9. Nov.; Bertram Bitsch, OCA, 12. Sep.; Alexander Wolszczan, Penn. State Univ., 13. – 15. Sep.; Petri Vaisanen, South Africa Obs., 13. – 15. Sep.; Nate Bastian, LMU, 17. – 18. Sep.; Iraklis, Konstantopoulos, Austral. Astro. Obs., 17. – 18. Sep.; Amy Bonsor, IPAG, 19. – 20. Sep.; Ralf Schoenrich, MPA, 24. – 25. Sep.; Nicola Da Rio, ESA, 24. – 25. Sep.; Kshiziz K. Mallick, Mumbai Univ., 1. – 14. Oct.; Antonio Rodriquez A., UNED Madrid, 1. Oct. – 24. Dec.; Charles Finn, Durham Univ., 3. – 10. Oct.; Elodie Thilliez, Obs. Paris, 4. – 5. Oct.; Nicolas Martin, Strasbourg Univ., 8. – 11. Oct.; Benjamin Leavens, Strasbourg Univ. 8. – 11. Oct.; Alessandro Gardini, Univ. Oslo, 9. – 12. Oct.; Gabriella De Lucia, INAF, 11. Oct.; Laszlo, Konkoly Univ., 15. – 18. Oct.; Carlton Baugh, Durham Univ., 16. – 19. Oct.; Kevin Croxall, Univ. Toledo, 21. – 27. Oct.; Caroline Bot, Obs. Strasbourg, 22. Oct.; Jose Caballero, Univ. Madrid, 24. – 26. Oct.; Trent, Dupuy, Harvard-Smithsonian, 26. – 29. Oct.; Thomas Müller, MPE, 29. – 30. Oct.; Jan Philipp Ruge, Univ Kiel, 29. – 31. Oct.; Natalie Batahlha, NASA AMES, 29. – 31. Oct.; Tatiana Vasyunina, Univ. Virginia, 29. Oct. – 4. Nov.; Nicolas Tejos, Durham Univ., 3. – 10. Nov.; Charles Finn, Durham Univ. 3. – 10. Nov.; Nicolas Martin, Strasbourg Obs., 5. – 8. Nov.; Benjamin Leavens, Strasbourg Obs., 5. – 8. Nov.; Mauricio Cisternas, IAC, 5. – 9. Nov.; Camilla Pacifici, Yonsei Univ., 5. – 16. Nov.; Jens Helmig, CAHA, 12. – 17. Nov.; Eric Herbst, Ohio State Univ., 13. – 17. Nov.; Nadia Kostogryz, Mayn Astron. Obs., 17. – 30. Nov.; Sarah Rugheimer, Harvard Univ., 17. Nov. – 1. Dec.; Ralf Kaiser, Univ. Hawaii, 19. – 21. Nov.; Grainne Costigan, ESO Garching, 20. – 21. Nov.; Harald Lesch, Univ Munich, 23. – 24. Nov.; Eric Herbst, Ohio State Univ., 24. – 28. Nov.; Jenny Greene, Princeton Univ., 25. – 28. Nov.; Stephanie Juneau, CEA Saclsy, 29. – 30.–Nov.; Jeffrey Linsky, Univ. Colorado, 2. – 4. Dec.; Markus Arzt, Univ. Virginia, 2. – 7. Dec.; Peter Barthel, Kapteyn Inst., 3. – 4. Dec.; Pece, Podigachoski, Kapteyn Inst., 3. – 4. Dec.; Nicolas Martin, Univ. Strasbourg, 3. – 5. Dec.; Benjamin Leavens, Univ. Strasbourg, 3. – 5. Dec.; Christian Obermeier, Univ. Munich, 5. – 6. Dec.; Constanze Roedig, Johns Hopkins Univ., 9. – 12. Dec.; Jane Ryon, Univ. Wisconsin, 9. – 19. Dec.; Nicola Amorisco, DARK Copenhagen, 9. – 19. Dec; Jay Gallagher, Univ. Wisconsin, 9. – 20. Dec.; Maryam Modjaz, NYU, 10. – 12. Dec.; Michele Fumagalli, Carnegie Obs., 16. – 19. Dec.

Short-term Scholarships: Antonuccio (14.6. – 27.7.), Burtscher (1.6. bis 31.12.), Dalcanton (23.6. – 21.7.), El-Kork (27.6. – 6.8.), Fedele (3.7. – 30.7.), Jin (1.12.), Kostogryz, Mayn Astronomical Observatory of NAS of Ukraine (1.8. – 30.9.), Lang (2.7. – 2.8.), Natta (15.6. – 15.7.), Panic (15.5. – 30.6.), Pavlyuchenkov (15.4. – 14.5.), Richards (1.8. – 31.8.), Roccatagliata (3.7. – 30.7.), Segura (1.7. – 31.7.), Simcoe (27.6. – 29.7.), Smith (6.6. – 4.8.), Toth (1.7. – 31.8.), Walmsley (15.6. – 15.7.), Wang Wei (1.9. – 30.9.), Weaver (1.1. – 4.2.), Weisz (28.6. – 26.7.)

Due our regular international meetings and workshops further guests visited the institute, not listed here individually.

Calar Alto Observatory Almeria, Spain

Astronomy Coordination: Thiele (until 30.11.)
Telescope Technology and Data Processing: W. Müller

Departments

Department: Planet and Star Formation
Director: Thomas Henning

Infrared Space Astronomy: Oliver Krause, Zoltan Balog, Jeroen Bouwman, Örs Hunor Detre, Adrian Glauser, Ulrich Grözinger, Martin Hennemann, Ulrich Klaas, Hendrik Linz, Friedrich Müller, Markus Nielbock, Silvia Scheithauer, Jürgen Schreiber, Amy Stutz

Star Formation: Henrik Beuther, Angela Adamo, Tobias Albertson, Amelia Bayo, Simon Bihr, Arjan Bik, Markus Feldt, Siyi Feng, Thomas Gerner, Katharine Johnston, Jouni Kainulainen, Ralf Launhardt, Rainer Lenzen, Hua-Bai Li, Nils Lippok, Johan Olofsson, Sarah Ragan, Dimitry Semenov, Jin Shen, Amy Stutz, Roy van Boekel, Shiwei Wu, Sarolta Zahorec, Sun Zhao, Svitlana Zhukovska

Brown Dwarfs/Exoplanets: Reinhard Mundt, Beth Biller, Mickaël Bonnefoy, Wolfgang Brandner, Simona Ciceri, Ian Crossfield, Patricio Cubillos, Niall Deacon, Joseph Harrington, Bertrand Goldmann, Viki Joergens, Luigi Mancini, Elena Manjavacas, Christian Obermeier, Victoria Rodrìguez, Maren Mohler-Fischer, Neil Zimmerman, Taisiya Kopytova

Theory (SP): Hubertus Klahr, Moritz Beutel, Benjamin Damrau, Kai-Martin Dittkrist, Karsten Dittrich, Tristen Hayfield, Alexander Horn, Svenja Jacob, Simon Legrand, Aiara Lobo Gomes, Mykola Malygin, Christoph Mordasini, Natalie Raettig, Johannes Reppin, Kai Philipp Salm, Florian Schiessler, Vinzent Steinberg, Clement Surville, Gabriel-Dominique Marleau

Laboratory Astrophysics: Cornelia Jäger, Abel Brieva, Daniele Fulvio, Walter Hagen, Serge Krasnokutsky, Karsten Potrick, Gael Rouillé, Toulou Sabri

Frontiers of Interferometry in Germany (FrInGe): Thomas Henning, Uwe Graser, Ralf Launhardt

Adaptive Optics: Wolfgang Brandner, Casey Deen, Markus Feldt, Stefan Hippler, Sarah Kendrew, Maria Lenius, Pengqian Yang

MPG Research Group: "Star Formation throughout the Milky-Way Galaxy": Thomas Robitaille, Amanda Heidermann, Christine Koepferl, Esteban Morales

Emmy-Noether-Group: "Spectral fingerprints of the first detectable habitable planets": Lisa Kaltenegger, Siddarth Hegde, Yamila Miguel, Yan Yves Betremieux

Department: Galaxies and Cosmology
Director: Hans-Walter Rix

Galaxy Dynamics: Hans-Walter Rix, Balasubramanian Ramkumar, Kasper Borello Schmidt, Yu-Yen Chang, Josef Fried, Nina Hernitschek, Nicolas Martin, Michael Maseda, Qian Qian, Edward Schlafly, Xiangxiang Xue, Lan Zhang

Milky Way and Local Group: Coryn Bailer-Jones (inclusive the GAIA project group), Tri Astraatmaja, Dae-Won Kim, Fabo Feng, Richard Hanson, Chao Liu, Kester Smith, Paraskevi Tsalmantza

Galaxy Evolution: Fabian Walter, Eduarodo Bañados Torres, Anahi Caldu Primo, Elisabete Da Cunha, Roberto Decarli, Jacqueline Hodge, Maria Kapala, Eric Morganson, Karin Sandstrom, Bram Venemans

High Definition Astrometry: Thomas Herbst, Matthieu Brangier, Roman Follert, Joshua Schlieder

Jet Physics of Active Galactic Nuclei: Christian Fendt, Somayyeh Sheiknezami, Kathleen Shurkin, Deniss Stepanovs

Active Galactic Nuclei: Klaus Meisenheimer, Matthias Jäger, Christian Leipski

Extragalactic Star Formation: Eva Schinnerer, Paolo Bianchini, Dario Colombo, Annie Hughes, Kathryn Kreckel, Sharon Meidt, Mark Norris, Miguel Querejeta, Bianca Ray Avilani, Fatemeh Tabatabaei, Tessel van der Laan

Coevolution of Galaxies and Black Holes: Knud Jahnke (Emmy-Noether-Group "Probing the coeval evolution of massive galactic bulges and black holes", EUCLID Projekt Group), Mauricio Cisternas, Dading Hadi Nugroho, Katherine Inskip, Robert Singh, Rory Holmes, Felix Hormuth, Gregor Seidel, Stefanie Wachter

Inter- and Circum-galactic Medium: Joe Hennawi, (MPG Research Group "Entstehung von Galaxien"), Fabrizio Arrigoni Battaia, Neil Crighton, Ilya Khrykin, Girish Kulkarni, Khee-Gan Lee, Elisabeta Lusso, Gabriele Mayer, Olivera Rakic, Alberto Rorai, Gabor Worseck

Structure and Dynamics of Galaxies: Glenn van de Ven, Paolo Bianchini, Alex Büdenbender, Vesselina Kalinova, Roland Läsker, Mariya Lyubenova, Sladjana Nikolic, Robert Singh, Wilma Trick, Athanasia Tstasi, Remco van den Bosch, Laura Watkins, Akin Yildirim

Galaxy Formation in a Dark Universe: Andrea Macciò (MPG Research Group "Galaxienbildung im Dunklen Universum"), Jiang Chang, Salvatore Cielo, Aaron Dutton, Nikolaos Fanidakis, Jakob Herpich, Rahul Kannan, Wouter Karman, Camilla Penzo, Greg Stinson, Athanasia Tstasi

Instrumentation: Thomas Herbst, Bernhard Dorner, Josef Fried, Roman Follert, Patrick Fopp, Joshua Schlieder, Zhaojun Yan, Xianyu Zhang; Jörg-Uwe Pott, Michael Boehm, Qiang Fu, Iva Karovicova, Alexander Keck, Kirsten Schnuelle

Postdoctoral Fellows: Michelle Collins, Brent Groves, David Martinez-Delgado, Kate Rubin, Arjen van der Wel, Yujin Yang

Teaching Activities

Winter Term 2011/2012

H. Beuther, H, Klahr, H.-W. Rix: Einführung in die Astronomie und Astrophysik III (Obligatory Seminar)
N. Crighton: Python for astronomers (block course)
C. Dullemond: Numerische Gas- und Flüssigkeitsdynamik (Lecture/Exercise), Mathematische Methoden in der Physik I (Lehramt) (Lecture/Seminar)
C. Dullemond, J. Hennawi: Cosmology (Lecture/Exercise/Seminar)
Chr. Fendt, K. Meisenheimer, G. Van de Ven: Seminar zu aktuellen Forschungsthemen (IMPRS 1) (with R. Klessen (ITA), S. Glover (ITA), A. Koch (LSW))
Th: Henning: Physik der Sternentstehung (Oberseminar)
S. Hippler: Experiment F36 "Wellenfrontanalyse" of the Advanced Practicals for Physicists (Practical, with R. Singh)
V. Joergens: Extrasolare Planeten und Braune Zwerge (Lecture/Seminar)
H. Klahr: Numerical Practical (Practical), Physik und numerische Methoden zu Akkretionsscheiben und Planetenentstehung (Lecture)
H. Klahr, Chr. Mordasini: Universelle Kompetenz Numerik (UKNUM) (Seminar)
K. Meisenheimer: Institute Colloquium of MPIA and LSW (Colloquium, with S. Wagner (LSW/ZAH))

Summer Term 2012:

C. Bailer-Jones: Statistische Methoden (Computer course/Lecture);
H. Beuther, V. Joergens: Von Sternen zu Planeten (Masterseminar)
N. Crighton: Python for astronomers (ESAC, Madrid, Spain, block course)
Chr. Fendt: Seminar on current research topics (IMPRS 1, with S. Glover (ITA), Koch, van de Ven)

Chr. Fendt: Astronomie für Nicht-Physiker (Lecture, with A. Just (ARI))
Chr. Fendt, R. Mundt: Einführung in die Astronomie und Astrophysik III (Lecture, with J. Krautter (LSW/ZAH)
D. A. Gouliermis: Experimentalphysik II (Exercises for Bachlor students)
J. Hennawi: ENIGMA IGM/CGM JC (Seminar)
Th. Henning, H.-W. Rix: Advanced seminar on current research topics (IMPRS 2, with J. Heidt (LSW/ZAH))
Th. Henning: Astromineralogie (Seminar, with H.-P. Gail (ITA/ZAH), C. Dullemond (ITA/ZAH), A. Pucci (KIP), M. Trieloff (Institut für Geowissenschaften))
Th. Henning: Physics of Star Formation (Oberseminar)
S. Hippler: Supervision of experiment F36 "Wellenfrontanalyse", Advanced Practicals for Physicists (Practicals)
H. Klahr: Physics and Numerics of Accretion Disks and Planet Formation (Seminar); Theory of Planet and Star Formation (Seminar)
D. Lemke: Ballonastronomie (Universität Stuttgart, Lecture)
K. Meisenheimer: Institute Colloquium of MPIA and LSW (Colloquium, with S. Wagner (LSW/ZAH))
K. Meisenheimer: Exercises for Experimentalphysik II
H.-W. Rix: Galaxy Coffee (Oberseminar)
D. A. Semenov: Molecular Astrophysics: from lab to theory to observations (Lecture, with H. Kreckel (MPIfK))
K. Smith: Nordic-Baltic summer school (Moletai, Lithauen, Lecture)

Winter Term 2012/2013:

C. Bailer-Jones, A. Maccio: Experimentalphysik I (Exercises, with others)
H. Beuther, H. Linz: Radio- und Millimeterastronomie (Lecture)
Chr. Fendt, K. Meisenheimer: Seminar on current research topics (IMPRS 1, with S. Glover (ITA), L. Kaltenegger, K. Meisenheimer)
Chr. Fendt: Übungsgruppe Optik & Quantenphysik (PEP3) (Exercises)
D. A. Gouliermis: Giant Star-Forming Regions (Lecture)
J. Hennawi: ENIGMA IGM/CGM JC (Seminar)
Th. Henning: Physics of Star Formation (Oberseminar)
V. Joergens: Extrasolare Planeten und Braune Zwerge (Lecture)
K. Jahnke: Experimentalphysik I (Exercises)
L. Kaltenegger: Astronomisches Kolloquium (Colloquium, with C. Dullemond (ITA/ZAH))
L. Kaltenegger: Seminar zur Astrobiologie und Astrobiophysik II (Seminar, with M. Hausmann (KIP))
H. Klahr: Einführung in die Astronomie und Astrophysik III (Seminar, with F. Bigiel (ITA/ZAH), J. Krautter (LSW/ZAH))
H. Klahr: Numerical Practicals (Practicals)
H. Klahr: Übungen zur Experimentalphysik I (Exercises, with others)
K. Meisenheimer: Supervision of experiment PEP2 (Ex.-Phys. II)
K. Meisenheimer: Institute Colloquium of MPIA and LSW (Colloquium, with S. Wagner (LSW/ZAH))
H. Mutschke, C. Jäger: Laboratory Astrophysics (Lecture)
S. Nikolic: Theoretical Astrophysics (Exercises)
H.-W. Rix: Cosmology (Lecture, with S. Glover (ITA), J. Hennawi, A. Maccio)
Th. Robitaille: Experimentalphysik III (Exercise)
J. Tackenberg: Experiment F30 "CCD Photometry with the 70cm telescope" of the Advanced Practicals for Physicists (Practicals)
G. Van de Ven: Galaxies (Lecture/Exercise)

Service in Committees

Coryn Bailer-Jones: Manager of the Subconsortium "Astrophysical Parameters" (CU8) in the GAIA Data Processing and Analysis Consortium; member of GAIA Data Processing and Analysis Consortium Executive
Henrik Beuther: Head of the galactic panel of the IRAM program committee; comittee member of the MPG APEX program; member of the German SOFIA Science Working Group (GSSWG)
Beth Biller: member of HUBBLE Telescope review panel on Planets and Star Formation; LOC member of the "Characterizing & Modeling Extrasolar Planetary Atmospheres – Theory & Observation" MPIA summer conference 2012, MPIA, 16.–19. July.
Wolfgang Brandner: member of OPTICON Transnational access time allocation committee; member of ESO Observing Programme Committee; Panel member of the ESO Phase A review for ERIS; member of PhD Advisory Committee (MPIA); member of PS1 Science Council
Ian Crossfield: SOC member of PSF-Retreat
Christian Fendt: Referee at the DAAD selection procedure, programm to promote foreign PhD students
Dimitrios A. Gouliermis: member of the IMPRS evaluation committee
Roland Gredel: Chair of OPTICON Board; Chair of MPIA STAC; member of ELT Project Science Team; member of CTA Site Selection Committee; member of the OPTICON working groups Telescope Director's Forum, Enhancement & Outreach and NEON observing schools
Brent Groves: Postdoc representative
Thomas Henning: Chair of the Astronomy Department of the Leopoldina; member of the ESO Council; member of the scientific board of the Thüringer Landessternwarte Tautenburg; member of board of the Hungarian Research Centre for Astronomy and Earth Sciences; member of awarding comittee of the Stern-Gerlach price; member of the appointments committee of the Dutch Academy

Professorship Programme; member of the MPA Director appointments committee; head of the ERC panel for Advanced Grants "Universe sciences"

Friedrich Huisken: member of the program comittee of the international conference "International Symposium on Rarefied Gas Dynamics (RGD)", Romanian conference series on Laser and Optics "ROMOPTO"

Cornelia Jäger: Board member of the DFG Priority Program "The Physics of the Interstellar Medium", member of Management Group of the EU Initial Training Network (ITN) "LASSIE – Laboratory Astrochemical Surface Science in Europe", member of SOC of the conference "The 5th meeting on Cosmic Dust", Kobe, Japan, 6.–10.8., member of the organization group of the EU Initial Training Network (ITN) "LASSIE-Laboratory Astrochemical Surface Science in Europe"

Klaus Jäger: Board member of the Astronomische Gesellschaft (press officer); member of the scientific board of the International Summer Science School Heidelberg (ISH), assistance in the Rat Deutscher Sternwarten (RDS), the LBT Beteiligungsgesellschaft (LBTB), member of the comittee to prepare the union of the RdS and the AG, the plannings group web site "Astronomie in Deutschland", the supporting society of the "Haus der Astronomie", the supporting society of the Planetarium Göttingen and the supporting society Planetarium Mannheim

Viki Joergens: member and co-head of the ESO observing program committee panels

Lisa Kaltenegger: member of the Executive Council of the NASA Extrasolar Planet Analysis Group (ExoPAG)

Sarah Kendrew: member of the IAU Office for Astronomy and Development Task Force on Astronomy and the Public; member of MPIA Strategic Time Allocation Committee

Andrea Macciò: Chair of the MPIA computer comittee

Nicholas Martin: member of the Pan-STARRS 1 Science Consortium Science Council; co-head of the Pan-STARRS 1 Science Consortium Key Project 5

Klaus Meisenheimer: member of the LN internal review board

Maren Mohler-Fischer: students representative (until 31.11.)

Markus Nielbock: member and representative of the HERSCHEL Calibration Steering Group PACS ICC; member of the HERSCHEL/PACS Instrument Control Centre; member of the HERSCHEL Pointing Working Group

Sarah Ragan: MPIA postdoc representative

Hans-Walter Rix: member of the PS1 Science Consortium; board member od the LBT Beteiligungsgesellschaft; member of the NIRSPEC Science Team; member of DFG Fachkollegien; member of the Humboldt selection board

Karin Sandstrom: Referee at the NASA Astrophysics Data Analysis Program

Eva Schinnerer: member of the NRAO Users Committee; member of the ALMA Cycle 1 review; member of the Jansky Fellows Selection Comittee

Roy van Boekel: member of the Belgian VLTI Time Allocation Committee

Glenn van de Ven: member of the LINC-NIRVANA Science Team

Further Activities

Activities by Groups

On Sunday, July 22nd, the MPIA threw open its doors and more than 6500 visitors took up this invitation to visit the Institute on top of the Königstuhl (Organisation: Jäger, Pössel, Quetz, Voss, Witzel, Wolf, Meidt and many others).

The MPIA released 14 presse releases. Several radio and television interviews habe been given (Klaus Jäger, Markus Pössel, Axel M. Quetz and others).

The series of 4 lectures "Astronomie am Sonntag Vormittag" in June and July was organized by Markus Pössel, Klaus Jäger and Axel M. Quetz.

The Girls' Day at April 26th was organized by Vianak Naranjo and many staff members were involved.

The Board of Trustees met on December 3rd (Organisation: K. Jäger, Voss).

The practical for school pupils on October 22. – 26. was organized by Klaus Meisenheimer supported by Silvia Scheithauer, Maren Mohler-Fischer and Klaus Jäger.

Over the year, 1300 visitors in 45 groups were taken on a tour of the Institute (Axel M. Quetz, Markus Pössel, Vesselina Kalinova, Iva Karovicova, Silvia Scheithauer, Hendrik Linz, Markus Nielbock and others). Another two dozen request had to be refused due to capacity reasons.

Following the release of his book "Im Himmel über Heidelberg" Dietrich Lemke held several astronomical tours through the City of Heidelberg.

Vianak Naranjo was equal opportunity officer at the MPIA (until 31.11.). She was followed by Mariya Lyubenova (since 1.12). Deputy is Katharine Johnston.

Karsten Dittrich (until October), Maren Mohler (until October), Simon Bihr (since October), Michael Maseda (since October) and Taisiya Kopytova (since October) were students representatives in 2012 at the MPIA.

Referees for Scientific Journals:

Angela Adamo (A&A, ApJ, MNRAS);

Coryn Bailer-Jones (A&A, ApJ, Nature, Statistical Analysis and Data Mining);

Henrik Beuther (A&A, ApJ, MNRAS, Science, Nature);

Arjan Bik (A&A, ApJ, MNRAS);

Beth Biller (ApJ, MNRAS);
Wolfgang Brandner (A&A, ApJ, MNRAS);
Neil Crighton (ApJ, MNRAS);
Ian Crossfield (MNRAS);
Robert Decarli (ApJ, ApJ Letters, MNRAS);
Aaron Dutton (A&A, ApJ);
Christian Fendt (ApJ, MNRAS, Space Science Reviews);
Roland Gredel (A&A, ApJ, MNRAS);
Brent Groves (ApJ);
Thomas Henning (A&A, ApJ, MNRAS);
Stefan Hippler (MNRAS);
Jaqueline Hodge (ApJ, PASP);
Friedrich Huisken (Advanced Materials, Nanotechnology, Science, NanoLetters, Applied Physics Letters, Journal of Applied Physics, Chemical Physics Letters, Chemical Reviews, Journal of Chemical Physics, Journal of Physical Chemistry, Journal of Nanoparticle Research, Computational Materials Science);
Katherine Inskip (A&A, MNRAS);
Cornelia Jäger (ApJ, Journal of Non-Crystalline Solids, Carbon, A&A);
Knud Jahnke (MNRAS);
Jouni Kainulainen (A&A);
Lisa Kaltenegger: (ApJ, ApJL, Astrobiology, Icarus, A&A);
Sarah Kendrew (ApJ);
Rainer Köhler (A&A, AJ, ApJ);
Kathryn Kreckel (MNRAS);
Martin Kürster (A&A, ApJ, MNRAS);
Dietrich Lemke ("Journal of Astronomical Instrumentation", World Scientific (Associated Editor));
Andrea Macciò (ApJ, JCAP, MNRAS);
Nicholas Martin (A&A, ApJ, ApJ Letters);
Sharon E. Meidt (Discovery Grants, NSERC (National Sciences and Engineering Research Council of Canada));
Klaus Meisenheimer (AJ, ApJ);
Christoph Mordasini (ApJ, MNRAS);
Christoph Olczak (A&A, MNRAS);
Jörg-Uwe Pott (A&A, ApJ);
Sarah Ragan (A&A, ApJ);
Hans-Walter Rix (A&A, ApJ, MNRAS);
Thomas Robitaille (A&A);
Karin Sandstrom (A&A);
Eva Schinnerer (ApJ, ApJ Letters);
Eddie Schlafly (MNRAS);
Kasper Borello Schmidt (ApJ);
Dmitry A. Semenov (A&A, ApJ);
Greg Stinson (A&A, ApJ, MNRAS);
Roy van Boekel (A&A, ApJ);
Glenn van de Ven (A&A, ApJ, MNRAS, Science);
Bram Venemans (A&A, ApJ);
Fabian Walter (ApJ, ApJ Letters, MNRAS);
Neil Zimmerman (PASP).

Referees for Research Grants:
Coryn Bailer-Jones (DFG);
Henrik Beuther (ERC, DFG, ANR);
Arjan Bik (Expert referee of a Korean time observing proposal for the CFHT);
Wolfgang Brandner (ERC; FWF (Wissenschaftsfont); Research Executive Agency (European Commission));
Elisabete da Cunha (NASA Astrophysics Data Analysis Program);
Christian Fendt (DFG, DAAD);
Brent Groves (FWO);
Thomas Henning (DFG, Humboldt Foundation, NWO, ERC, Swedish Science Foundation, GIF, NSF);
Stefan Hippler (Italian Ministry of Education, University and Research (MIUR));
Friedrich Huisken (DFG, EU (Marie-Curie), Fund on supporting scientific research in Austria;
Knud Jahnke (DFG; Daimler und Benz Stiftung (Studienprogramm für Postdoktoranden und Juniorprofessoren, member of selection committee); ASTRON;
Lisa Kaltenegger (NSF, DFG, NASA, Royal Society, DLR);
Martin Kürster (OPTICON proposal);
Girish Kulkarni (Giant Metrewave Radio Telescope (GMRT), India);
Luigi Mancini (Croatian Science Foundation);
Klaus Meisenheimer (ERC, NWO (Netherlands Organization for Scientific Research));
Jörg-Uwe Pott (ANR (French National Research Agency));
Hans-Walter Rix (DFG, EU, NOVA, AvH, MPG, Israeli Science Foundation);
Karin Sandstrom (NASA Astrophysics Data Analysis Program 2012);
Eva Schinnerer (NSERC);
Glenn van de Ven (NWO (Nederlandse Organisatie voor Wetenschappelijk Onderzoek));
Fabian Walter (ERC Advanced Grant).

Individual Activities

Angela Adamo organized the monthly meetings of the splinter section "Clustered star formation" of the PSF department.

Fabrizio Arrigoni Battaia organized the weekly meeting "Galaxy Coffee" of the GC department (since October).

Katharine Johnston organized the Journal Club of the PSF department.

Klaus Jäger wrote articles, gave interviews and advised TV and radio broadcaster, print media and news agencies. He participated in the SWR documentary "Sterngucker – von Heidelberg ins Weltall" on astronomical research in Heidelberg. Other activities: draft, production and presentation of "AstroViews", the video cast of "Sterne und Weltraum" (together with Uwe Reichert, editorial desk of "Sterne und Weltraum"); composing and production of music for astronomical presentations (Planetarium Mannheim, Haus der Astronomie, television contibutions on astronomical subjects); publication of press releases for MPIA, AG, RDS and LBT; participation in the annual report and website of the MPIA; participation in planning and in events of the HdA; VIP tours with lectures at HdA/MPIA; organisation of the “Visitor Colloquium” at MPIA (with Meidt, Klahr); participation in the “Lange Nacht der Museen” in Planetarium Mannheim on April 21st including presentation and soundtrack of the film “Reise zum Mond”; conception of a German website for the LBT for the general public; participation in contributions to the design of the new “Science Tunnel” of the MPG.

Knud Jahnke presented the MPIA at the “Lange Nacht der Museen” in Planetarium Mannheim on April 21st.

Sarah Kendrew was interviewed for the magazine “Sky at Night” as well as for the science television show “Nano” of the broadcaster ZDF.

Markus Nielbock is member of the Astronomieschule e.V., Heidelberg and the “Initiativkreis Horizontastronomie im Ruhrgebiet e.V.”

Christoph Olczak practiced his position as mentor of the “Mentoringprogramm für StudienanfängerInnen der Physik”.

Jörg-Uwe Pott was co-founder and co-organizer of the Framework Programme FP7 OPTICON activity “Future of optical Interferometry in Europe”.

Axel M. Quetz participated in the annual reports of the MPIA und was member of the editorial team which created the 52nd volume of the astronomical magazine “Sterne und Weltraum”.

Thomas Robitaille organized the Python workshop at the MPIA.

Kasper Borello Schmidt organized the monthly Heidelberger discussion forum on gravitational lenses “LiHD – Lensing in Heidelberg”.

Glenn van de Ven organized the weekly “Galaxy Coffee” og the GC department.

Compatibility of Science, Work, and Family

A good compatibility of job and family for employees is a very important matter to the MPIA. The institute supports men and women in all cases equally. To attract top scientists and the best employees from all over the world, MPIA has set the goal to offer both excellent research conditions as well as an excellent environment for a healthy balance between work and private life. Below all the solutions at MPIA are listed.

What is offered at MPIA?

- Flexible design of working time and location in special life situations (e.g. child care hours, care time, dual career situations)
- Access to a total of 21 places for Max-Planck Institutes in Heidelberg in daycare for children from 8 weeks to 6 years
- A Room for Child care
- A Baby-Office
- Support at Conferences
- Care offers during holidays via “Bündnis für Familie Heidelberg”
- Dual Career Program
- Inclusion of the topic in the recruitment process
- Contact Support Programs during temporary withdrawal from the profession in special situations
- Special support for parental leave for fathers
- Support for new employees by the International Office at accommodation, search for suitable schools and childcare facilities.
- Mediation service for families via “Besser betreut” in childcare, elder care and household services.

What is in the planning?

- Childcare places on Königstuhl mountain in cooperation with the MPI for Nuclear Physics (MPIK)
- Expansion of the Dual-Career-Program
- Employee survey on Job and Family
- Thematic leadership workshops in cooperation with the Heidelberg Research Network
- Round table for interested staff for the exchange and development of other concepts to improve the compatibility of science, work and family.

How do we communicate our activities?

- Internal communication by means of
  - Mayling lists
  - Information board „Job and Family“
  - Works meeting
  - Inclusion of the topic „Job and Family“ into the yearly employee interview in individual departments.
- External communication by means of
  - Information Board during the Open House
  - Information about our activities for new candidates in the recruitment process
  - Topic „Dual Career“ on the MPIA-Webpage
  - Other events of information

Networking and cooperation

- “Bündnis für Familie”
- Activities in the workshops “Dual Career” and “Compatibility of Job and Family”
- Cooperations with Heidelberg University, the Medical Center of the University, DKFZ, EMBL, SRH-Hochschule, City of Heidelberg, and Pädagogische Hochschule.
- Business Network “Metropolregion Rhein-Neckar”
- Erfolgsfaktor Familie.

Text: Ingrid Apfel

Working Council

The members of the working council met on 50 meetings in the MPIA and with the other workings councils of the Heidelberg MPIs on March 22nd at the MPI for Nuclear Physics, and on November 15th at the MPI for Medical Research.

Cooperation with Industrial Companies

3B Scientific GmbH, Hamburg
AAT ASTON GmbH, Nürnberg
abcdruck GmbH, Heidelberg
ADDITIVE GmbH, Friedrichsdorf
Adept Scientific, Frankfurt
Adolf Pfeiffer GmbH, Mannheim
ADR S.A., Thomery
advanced microoptic systems gm, Saarbrücken
Agilent Technologies GmbH & Co. KG, Böblingen
AGIS Industrie Service GmbH & Co. KG, Viersen
AIM Infrarot Module GmbH, Heilbronn
Air Liquide GmbH, Pfungstadt
Aktobis AG, Rodgau
Alexandre Bürkle GmbH & Co. KG, Freiburg
Alfred Kärcher Vertriebs-GmbH, Winnenden
Allectra GmbH, Schönfliess
Allied Vision Technologies GmbH, Stadtroda
ALMA driving elements GmbH, Schollbrunn
ALPHA Übersetzungen, Heidelberg
Alternate Computer Versand, Linden
Alumeco Deutschland GmbH, Augsburg
Aluminium-Service GmbH, Freigericht
Aqua Technik Gudat, Neulußheim
Arena RKD GmbH, Berlin
Argenta Elektronik, Solingen
Ariapura GmbH, Strullendorf
ARM Germany GmbH, Grasbrunn
Arno Barthelmes EK, Zella-Mehlis/ Thüringen
Arnulf Betzold GmbH, Ellwangen
AS Scientific Products Ltd., Abingdon, Oxon
asknet AG, Karlsruhe
Astrium GmbH, Friedrichshafen
Astroleuchten.de, Vaihingen/Enz
AstroMedia-Versand, Neustadt in Holstein
Astro-Shop Eric-Sven Vesting e.K., Hamburg
Astro-Theke, Randersacker-Lindenbach
Austerlitz Electronic GmbH, Nürnberg
Autohaus Krauth GmbH & Co. KG, Meckesheim
B+S Express Transport GmbH, Weinheim
Baader Planetarium GmbH, Mammendorf
Baier Digitaldruck, Heidelberg
Baker & Harrison, München
Bechtle ÖA direkt GmbH, Neckarsulm
Beck-Seminare, Heidelberg
Bernhardt Nutzfahrzeuge GmbH, Heidelberg
Berr-Reisen GmbH, Bruckmühl
Binder Elektronik GmbH, Sinsheim
Blitz Button+Wagner Werbung GmbH, Dielheim
Börsig GmbH, Neckarsulm
Bremer und Leguil GmbH, Duisburg
Brick Box, Schönebeck-Sachsen Anhalt
Bruker Optik GmbH, Leipzig
Brunos Copyshop, Heidelberg
buch.de internetstores AG, Münster
Bürklin OHG, Oberhaching
Büro & Technik GmbH, Zwickau
Bürodesign Nejedly GmbH, Darmstadt
Büromarkt Böttcher AG, Jena
Büro-Mix GmbH, Mannheim
Buster Altöl GmbH, Mannheim
C. Otto Gehrckens GmbH & Co. KG, Pinneberg
C. BRUNO BAYHA GmbH, Tuttlingen
CADFEM GmbH, Grafing
CAMTEC POWER Supplies GmbH, Pfinztal
CANCOM NSG GmbH, Jettingen-Scheppach
Carbon Vision GmbH, Unterschleißheim
Carl Roth GmbH & Co. KG, Karlsruhe
Carl Zeiss, Jena
Cassidian Optronics GmbH, Oberkochen
Celexon GmbH & Co. KG, Emsdetten
Christiani Dr.-Ing. P. GmbH, Konstanz
Chroma Systems Solutions, Lake Forest,CA
City PC GmbH, Alsbach
Colordruck Kurt Weber GmbH, Leimen
comgroup GmbH, Konstanz
Compuland GmbH & Co. KG, Wilhelmshaven
COMTRONIC GmbH, Heiligkreuzsteinach
Com-Unic GmbH & Co. KG, Heidelberg
Conatex Didactic Lehrmittel GmbH, Kirkel
Conrad Electronic GmbH, Wernberg-Köblitz
Conrad Electronic SE, Hirschau
Cornelsen Experimenta GmbH & Co., Berlin
Cryomech Inc., Syracruse
Cryophysics GmbH, Darmstadt
Cryovac GmbH, Troisdorf
CrysTec GmbH, Berlin
CTS GmbH, Hechingen
Custom Scientific Inc., Phoenix, Arizona
Cyberport GmbH, Dresden
Datron AG, Mühltal
Dehn + Söhne GmbH + Co. KG, Neumarkt
Dehner GmbH & Co. KG, Rain am Lech
Deininger Schweißtechnik GmbH, Mannheim
Dekra Akademie GmbH, Mannheim

DELL-Computer GmbH, Frankfurt
DELTA-V GmbH, Wuppertal
DeMaCo Holland B.V., Noord-Scharwoude
Der Dekoladen LTD, Mannheim
Deti GmbH, Meckesheim
Deufol Südwest GmbH, Walldorf
Dicronite U.T.E. Pohl GmbH, Iserlohn
Digi-Key Corporation, AB Enschede
Antonio Lenzen, Dipl. Cinematographer, Heidelberg
Dipl.-Ing. Ulf Mikolajczak, Oldenburg
Discipulus Reisebusunternehmen GmbH, Heidelberg
Distrelec Schuricht GmbH, Bremen
Dobmeier-Haushaltswaren GmbH, Wiesau
DPS Vakuum, Großrinderfeld
DPV Elektronik Service GmbH, Eppingen
Dr. Bernhard Humburger, Bad-Wimpfen
Drahtwaren-Driller, Freiburg
DREEBIT GmbH, Dresden
Drucker Druck, Bietigheim
Druckerei & Verlag Steinmeier GmbH, Deiningen
Druckerwerkstatt - Torsten Dobritzsch e.K., Maintal
Dürkes & Obermayer GmbH, Edingen-Neckarhausen
DVS Dekont Vakuum Service GmbH, Erfurt
E. Strauss GmbH & Co., Biebergemünd
E.L.A.S. GmbH, Oberhausen
EC Motion GmbH, Erkelenz-Keyenberg
Edmund Optics GmbH, Karlsruhe
EDP Sciences, Les Ulis Cedex A France
Edwards GmbH, Kirchheim
eibtron.com GmbH, Plauen
EKZ. Bibliotheksservice GmbH, Reutlingen
Elektrometall Schwanenmühle GmbH, Schwanenmühle
Elektro-Steidl, Weinheim
ELMA Electronic GmbH, Pforzheim
Elried Markierungssysteme GmbH, Oberhaching
ELV Elektronik, Leer
Enpar Sonderwerkstoffe GmbH, Gummersbach
EPHY-MESS GmbH, Wiesbaden-Delkenheim
Ergo2Work BV, LD Nijmegen
esd electronic system design GmbH, Hannover
ESO - European Southern, Garching
Essenpreis Haustechnik GmbH, Östringen
ESSKA GmbH, Hamburg
E-T-A Elektrotechnische Apparate GmbH, Altdorf
Euro Composites S. A., Echternach
EUROstor GmbH, Filderstadt
Exelis Visual Information Solutions GmbH, Gilching
Faber Industrietechnik GmbH, Mannheim
Farnell GmbH, Oberhaching
Fels Fritz GmbH Fachspedition, Heidelberg
Ferrotec GmbH, Unterensingen
Feuer und Eis Touristik GmbH, Weissach am Tegernsee
Fioretto-Straßenmarkierung, Mannheim
Fire-Check GmbH, Wiesenbach
Fischer Elektronik GmbH & Co., Lüdenscheid
FKW Kilgenstein Wiesen GmbH, Wiesen
FlowCAD EDA-Software Vertrieb, Feldkirchen
Foto Walser GmbH & Co KG, Burgheim
fotoversand24.de, Schwerin
Franco-Tech Postbearbeitung GmbH, Oberursel
Fraunhofer Institut, Jena
Freudenberg Filtration, Weinheim
Friedrich Wolf GmbH, Heidelberg
G&G GmbH, Neuss
Gabler Werbeagentur GmbH, München
Gebr. Reinfurt GmbH & Co. KG, Rimpar
Gebrüder Kassel GmbH, Mannheim
Gehlen verpackungen GmbH & Co., Karlsruhe
Geier Metall-u.Stahlhandel GmbH, Mannheim
General Dynamics, Cullman
GEODIS Logistics Deutschland GmbH, Heppenheim
Getränkefachhandel H. Fein, Heidelberg
GIMA GmbH, Bergisch-Gladbach
Gleich Service-Center Nord GmbH, Kaltenkirchen
Glenair Electric GmbH, Oberursel
Glenair Electronic GmbH, Bad Homburg
GMT-Aufzug-Service GmbH, Forst
Go 2 a service GbR, Berlin
Gößl + Pfaff GmbH, Karlskron
Götz-Gebäudemanagement West GmbH, Regensburg
GRAVIS Computervertr. GmbH, Berlin
Grothues Elektrotechnische Geräte, Leimen
Gruppe 3 GmbH, Unterföhring
Gummispezialhaus Körner GmbH, Eppelheim
Güniker + Heck GmbH, Mannheim
Günter Jacobi GmbH, Griesheim
Gutekunst + Co. KG, Metzingen
Gutekunst Stahlverformung KG, Pfalzgrafenweiler
Gutfleisch GmbH, Heidelberg
GVL Cryoengineering GmbH, Stolberg
Haarländer GmbH, Roth
Hach GmbH, Pfungstadt
Häfele GmbH, Schriesheim
Hafner´s Büro, Stuttgart
Hagemeyer Deutschland GmbH & Co. KG, Heidelberg
Hahn & Kolb GmbH, Stuttgart
Halle Bernhard Nachfl. GmbH, Berlin
Hamamatsu GmbH, Herrsching
Harmonic Drive AG, Limburg a.d. Lahn
Hebmüller SRS Technik, Neuss
Heimann Sensor GmbH, Dresden
Heinrich Klar Schilder-u. Etikettenfabrik GmbH, Wuppertal
Heitec AG, Erlangen
Helioworks Inc., Santa Rosa
HELUKABEL GmbH, Hemmingen
Herrmann, Stefan, Barbing
Hifi & Foto Koch GmbH, Düsseldorf
Hilti Deutschland GmbH, Heidelberg
HIWIN GmbH, Offenburg
HM GmbH, Ubstadt Weiher
Hoerner & Sulger GmbH, Schwetzingen
Hoffmann Qualitätswerkzeuge GmbH & Co., Göppingen
Hofmaier GmbH&Co.KG, München
Hohmann Elektronik GmbH, Germering
Hommel Hercules Werkzeughandel GmbH & Co. KG, Viernheim
Hormuth GmbH, Heidelberg
HSD - Part of Computacenter AG & Co. oHG, Berlin
Huber + Suhner GmbH, Taufkirchen
HUG SCHILDER GmbH,
Hummer + Rieß GmbH, Nürnberg
Hupkens Industrial Models, NK Maastricht

HZT Hebe und Zurrtechnik, Menden
IGEFA Handelsgesellschaft mbH & Co. KG, Ahrensfelde/OT Blumberg
Igus GmbH, Köln
Ing. H. Tafelmaier Dünnschicht-Technik GmbH, Rosenheim
Ingenieurbüro M. Steinbach, Jena
Ingenieurbüro Schlossmacher, Unterschleissheim
INGENTI GmbH, Idstein
Initial Textil Service GmbH, Reutlingen
Inmac GmbH, Mainz-Kastel
INNEO Solutions GmbH, Ellwangen
Institut für Luft u. Kältetechn gGmbH, Dresden
Intercon Spacetec, Augsburg
Invent, Braunschweig
IOP Publishing Ltd., Bristol
item Industrietechnik GmbH, Freiburg
IXXAT Automation GmbH, Weingarten
JACOB Elektronik, Karlsruhe
Jacobi Eloxal GmbH, Altlussheim
JANSSEN PRECISION ENGINEERING, AG Maastricht-Airport NL
JECOSYS Redlich-IT GmbH, Jena
Jehier S.A., Chemille
JENOPTIK Optical Systems GmbH, Jena
Jungheinrich Katalog GmbH & Co., Hamburg
Kai Ortlieb Buchbinderei, Eppelheim
KAISER + KRAFT, Stuttgart
Kälte Wärme Klima, Lauffen/N.
KANYA Deutschland GmbH, Marktredwitz
Kartonfritze Carl Evers oHG, Berlin
Kaufmann, Horst W., Crailsheim-Wittau
KA-WE GmbH, Schwetzingen
KAYSER-THREDE GmbH, München
KBS, Sinsheim
Keithley Instruments GmbH, Germering
Kemper GmbH, Vreden
Kerb-Konus-GmbH, Amberg
KFK Verzinkerei GmbH, Sinsheim
KGW - ISOTHERM GmbH, Karlsruhe
Klar Heinrich GmbH, Wuppertal
Kniel GmbH, Karlsruhe
Koch + Schröder GmbH, Neuss
KOCO MOTION GmbH, Dauchingen
Koenen GmbH, Ottobrunn-Riemerling
Kohlhammer W. Druckerei, Stuttgart
Konecranes GmbH, Viernheim
KONEKRANES GmbH, Langenhagen
Konica Minolta, Heusenstamm
KORTH KRISTALLE GmbH, Altenholz
Kroschke GmbH, Braunschweig
Kugler GmbH, Salem
Kurschildgen GmbH, Bergisch Gladbach
L. + H. Hochstein GmbH + Co., Heidelberg
L. Meili & Co. GmbH, Hanau
Labelident GmbH, Schweinfurt
Bez. Schornsteinfegermeister Lainer Andreas, Neckargemünd
Landefeld GmbH, Kassel-Industriepark
Lapp Kabel GmbH, Stuttgart
Lascar Electronics P & V GmbH, Eutingen
Laser-Zentrum-Hannover, Hannover
Laub GmbH + Co., Elztal-Dallau
LB Display, Bad Füssing
Leha-Technik, Remscheid
Lehmanns Fachbuchhandlung GmbH, Heidelberg
Lemo Elektronik GmbH, München
LEONI Fiber Optics GmbH, Neuhaus-Schierschnitz
LIGHT TEC, Hyères
Lista GmbH, Bergneustadt
Lochbühler GmbH, Mannheim
LTN Servotechnik GmbH, Otterfing
LTT Labortechnik Tasler GmbH, Würzburg
Lutz Langer GmbH, Wilhelmshaven
LWS-Technik GmbH & Co., Heilbronn
Maas International GmbH, Bruchsal
Mädler GmbH, Stuttgart
Malteser-Hilfsdienst e.V., Wiesloch
Manja Geier, Werda
Massmann, Hamburg
MBF Filmtechnik GmbH, Frankfurt
mdf-Verpackungen Dietmar Franz e.K., Kürten
Medtronic GmbH, Düsseldorf
Megware Computer GmbH, Chemnitz-Röhrsdorf
Melitta Systemservice GmbH & Co., Minden-Dützen
Melles Griot, Bensheim
MEN Mikro Elektronik GmbH, Nürnberg
MENZEL Metallchemie GmbH, Kuchen
Metallbau GLAWION GmbH, Eberswalde
Metalux Metallveredelungs GmbH, Altlussheim
MFM Hofmaier GmbH & Co. KG, München
MICROSTAXX GmbH, München
Mietfix.de, Heidelberg
Mittelrheinische Treuhand GmbH, Mainz
MKelectronics, Mengen
MKS Instruments Deutschland GmbH, München
MNRAS Journal Team at Blackwel, Edinburgh
Mouser Electronics, München
msscientific Chromatographie GmbH, Berlin
Müller Otto GmbH, Bammental
Mura, Metallbau, Viernheim
Murrplastik-System-Technik, Oppenweiler
Music Store, Köln
MWR/Christian Wirth, Rimbach
Nadella GmbH, Nufringen
NANOTEC - Electronic GmbH, Landsham
National Instruments GmbH, München
Nature Publishing Group Ltd., London
Neolab Laborbedarf, Heidelberg
neoLab Migge Laborbedarf, Heidelberg
Netzsch-Gerätebau GmbH, Selb
Neubert-Glas GbR, Geschwenda
Neumann Rupert Druckerei, Heidelberg
Newport -Electronics GmbH, Deckenpfronn
Newport Spectra-Physics GmbH, Darmstadt
Nibler W. GmbH, Walldorf
Nies Elektronic GmbH, Frankfurt
Nimax GmbH - Astroshop.de, Landsberg
Nollenberger KFZ-Meisterbetrieb, Heidelberg
norelem Normelemente KG, Markgröningen
novotek GmbH, Magstadt
Oculum-Verlag GmbH, Erlangen
Oerlikon LEYBOLD VAKUUM GmbH, Köln
Office discount GmbH, Neufahrn bei München
office24 GmbH, Darmstadt
Office-Profishop, Mönchengladbach
Omega Optical Inc., Brattleboro
OPITEC Handel GmbH, Giebelstadt
ORBITEAM SW-GmbH, Bonn
Otto Ganter GmbH & Co. KG, Furtwangen
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Oxford University Press, Oxford OX2 6 DP
Palettensystemtechnik GmbH, Bad-Oeynhausen
Peak System Technik GmbH, Darmstadt
PFEIFFER VACUUM GmbH, Asslar
Pfister BÜRO MIT MASS UND SYSTEM, Leimen/St.Ilgen
Phoenix Contact GmbH & Co., Blomberg
Physik Instrumente (PI), Karlsruhe
PI micos, Eschbach
Piezosystem Jena GmbH, Jena
Pilz GmbH & Co. KG, Ostfildern
PLANSEE, Saint Pierre en Faucigny
Plus Online GmbH, Mühlheim a.d.Ruhr
POG - Präzisionsoptik Gera GmbH, Gera
Polytec GmbH, Waldbronn
powerBridge Computer Vertriebs GmbH, Burgwedel
PRO MEDIA CONCEPT GmbH, Konstanz
Pro-Com Datensysteme GmbH, Eislingen
Profimess GmbH, Bremerhaven
ProfiOffice GmbH, Kriftel
Promostore Merchandising, Essen
Qioptiq Photonics GmbH & Co. KG, Göttingen
Radiant Zemax Europe Ltd, Stansted
Raiffeisen Lagerhaus EG Meckes, Bammental
Rainbow Symphony Store, Reseda
Rala GmbH & Co., Ludwigshafen
ratioform Verpackungs GmbH, Groß Gerau
redcoon GmbH, Aschaffenburg
REEG GmbH, Wiesloch
Reichelt Elektronik, Sande
Reichelt-Chemietechnik GmbH, Heidelberg
Reifen Stoll, Wiesenbach
Rhein-Neckar-Verkehr GmbH, Mannheim
Richard Wirth e.K. Gebäudereinigung, Heidelberg
Ringfeder Power Transmission GmbH, Krefeld
Rittal GmbH + Co. KG, Herborn
RMG Metallfachhandel GmbH, Ladenburg
Robemetall GmbH, Rockenberg
Roger Senden-RSP Technology, BV Delfzijl
Roth Carl GmbH & Co. KG, Karlsruhe
RS Components GmbH, Mörfelden-Walldorf
Rufflar Brandschutz + Lagertechnik, Laudenbach
SAMTEC Germany, Germering
Sanitär Raess GmbH, Heidelberg
SAUTER-Cumulus GmbH, Freiburg
Schäfer Fritz GmbH, Neunkirchen
Schäfer-Shop GmbH, Betzdorf
Schairer Ophthal-Technik GmbH, Stuttgart
Schenker Deutschland AG, Mannheim-Rheinau
Scherer Kabel GmbH, Walzbachtal
Schlosserei Gaub H., Eppelheim
Schmidt Mess- und Regeltechnik, Spiesheim/Rhh.
Schneider Günther GmbH, Sandhausen
Schrauben-Jäger AG, Karlsruhe
Schroff GmbH, Straubenhardt
Schulz H.u.G. Ingenieure, Heidelberg
SCHUPA Schumacher GmbH, Walldorf
Schweickert Elektrotechnik GmbH, Nußloch
SDMS technologies, Saint-Romans/France
SE Spezial-Electronic AG, Bückeburg
Security@work GmbH, Schorndorf-Schlichten
Service+Planungsbüro GbR cuttershop.com, Wolfratshausen
Shirtinator AG, München
Siemens AG, Mannheim
Sigma-Aldrich Chemie GmbH, Taufkirchen bei München
Soemtec-Werbeträger, Kölleda
Solarcontrol, Heidelberg
SparxSystems Software GmbH, Wien
Spectron Gas Control Systems G, Frankfurt
Spektrum der Wissenschaft GmbH, Heidelberg
SPIE Journals Department, Washington 98225-0010 USA
Spiess Elektro Markt GmbH, Rauenberg
Springer-Feinwerktechnik, Jena
Stäubli Tec Systems GmbH, Bayreuth
Stegmeier,Heinz GmbH, Fridingen/Do.
StoCretec, Kriftel
Strähle Raum-Systeme GmbH, Waiblingen
Streicher Maschinenbau GmbH & Co, Deggendorf
Studiohintergrund.de, Krostitz
Subal GmbH, Wien
SVB-Spezialversand, Bremen
Swagelok Karlsruhe, Forst
synoTECH GmbH, Hückelhoven
Systerra Computer GmbH, Jena
Tautz Druckluft + Sandstrahltechnik, Mannheim
TBA Hibinger, Worms
TC Direct GmbH, Mönchengladbach
Technik Direkt, Würzburg
Telemeter Electronic GmbH, Donauwörth
Teleskop-Service Ransburg GmbH, Putzbrunn-Solalinden
Testo GmbH & Co., Lenzkirch
THALES CRYOGENICS, Eindhoven
The MathWorks GmbH, Ismaning
The University of Chicago Press, Chicago, Illinois
Theile Büro-Systeme, Speyer
ThermaSOL Systems GmbH, Denzlingen
Thomann Profi Equipment, Burgebrach
Thorlabs GmbH, Dachau
ThyssenKrupp Plastics GmbH, Mannheim
Till Schrauben GmbH, Riedstadt-Goddelau
Tischer Gastro, Heidelberg
Ton in Ton, Wischhafen
Topcart International GmbH, Erzhausen
Torsten Dobritzsch e.K., Maintal
Total Walther GmbH, Ratingen
TransMIT Prof. Dr. Thummes, Gießen
transtec AG, Tübingen
Trinos Vakuum-Systeme GmbH, Göttingen
Trioptics GmbH, Wedel
Tucson Optical Research Corp., Tucson
TÜV Süd Industrie Service GmbH, Mannheim
TÜV-Rheinland-Industrieservice, Stuttgart
Tydex J. S. Co., St. Petersburg
U-Form-Verlag, Solingen
UHT Umschlag- und Hafentechnik, Eberswalde
UKP GmbH, Mainz
Ultra Präzision Messzeuge GmbH, Aschaffenburg
VAT Deutschland GmbH, Grasbrunn
VCU GmbH, Mettlach
Verlag für Lehrmittel Pößneck, Pößneck
Verlag Vopelius Jena e.V., Jena
Verlagsgruppe Weltbild GmbH, Augsburg
vhf camfacture AG, Ammerbuch

Volker Röhrs Versandbuchhandlung, Stelle
Völkner GmbH, Nürnberg
W. Sell Computer-Dienst, Wiesbaden
Wagner Vertriebs GmbH, Haltern am See
Walter Bautz GmbH, Griesheim
Watterott electronic GmbH, LEINEFELDE
Webcraft GmbH, Gottmadingen
Wegertseder GmbH, Ortenburg
Werbeartikel Wagner, Dielheim
Westfalen AG, Münster
Wiesemann u. Theis GmbH, Wuppertal
Wilhelm & Missal OHG, leimen
Willi Stober GmbH & Co. KG, Karlsruhe
Winkler GmbH & Co. KG, Viernheim
Witzenmann Rhein-Ruhr GmbH, Xanten
Wollschläger GmbH & Co. KG, Mannheim
Würth Elektronik eiSos GmbH & Co. KG, Waldenburg
Zeidler OHG, Heidelberg
Zimmermann Elektronik Vertriebs GmbH, Darmstadt
Zöllig GmbH, Hirschberg

Conferences, Scientific, and Popular Talks

Conferences Organized

Conferences Organized at the institute / HdA:

ARGOS consortium meeting, MPIA, 11.–12. Jan. (Gässler)
MIRI Software developer meeting, MPIA, 6.–8. Mar. (Schreiber)
CAHA-Time Allocation Committee, MPIA, 25.–26. Apr. (K. Jäger, Janssen-Bennynck)
“Disc Galaxy Formation in a Cosmological Context”, SFB 881 – MPIA workshop, HdA, 14.–18. May (Macciò, Stinson, Dutton, Cielo, Fanidakis, Karman, Kannan)
NIRSPEC Meeting, MPIA, 31. May (Rix)
“3rd CALIFA Busy Week”, HdA, 11.–15. June (Jahnke, van de Ven, Lyobenova, Singh, Kalinova, Meidt)
“The Milky Way: Stars, Gas, Dust and Magnetic Fields in 3D”, Astra Workshop, HdA, 18.–20. June (Bailer-Jones)
dotAstronomy 4, “Networked Astronomy and the New Media”, HdA, 9.–11. July (Robitaille, Pössel, Kendrew)
PHAT Team Meeting, MPIA, 16.–18. July (Rix)
“Characterizing & Modeling Extrasolar Planetary Atmospheres – Theory & Observation”, MPIA summer conference 2012, July 16.–19. July (Henning, Kaltenegger, Betremieux, van Boekel)
LINC-NIRVANA Consortium Meeting at MPIA, 22.–23. Oct. (Kürster, Schinnerer, Norris)
LBT Board Meeting, MPIA, 28.–31. Oct. (Rix)
MPIA-External Retreat, MPIA, 27. Nov. (K. Jäger, Rix, Henning, Cuevas, Witte-Nguy)
MPIA-Kuratorium, MPIA, 3. Dec. (K. Jäger, Rix, Henning, Cuevas, Witte-Nguy)

Other Conferences Organized or Supported:

Ringberg Conference on “Transport Processes and Accretion “Planets around Stellar Remnants”, Observatorio de Arecibo, Puerto Rico, 23.–27. Jan. (Henning, Kaltenegger)
New Quests in Stellar Astrophysics III. Puerto Vallarta, Mexiko, 12.–16. Mar. (Kaltenegger)
LINC-NIRVANA Consortium Meeting, MPIfR, Bonn, Germany, 15.–16. Mar. (Kürster)
UK-Germany National Astronomy Meeting, NAM2012, Manchester, UK, 27.–30. Mar. (Henning, K. Jäger)
“Dynamics meets Kinematic Tracers”, Ringberg Castle, Germany, 10.–14. April (van de Ven, van den Bosch, Watkins, Buedenbender)
European Geophysical Union, Vienna, 22.–27. Apr.
“CU8: Astrophysical Parameters #10” GAIA DPAC CU8 plenary Meeting, Liege, La Coruña, Spain, 3.–4. May (Bailer-Jones)
“The Dark Energy quest when theory meets simulations”, Ringberg Castle, Germany, 24.–29. June (Macciò, Penzo)
“Disks, accretion, and outflows of brown dwarfs”, Splinter session at “Cool Stars, Stellar Systems and the Sun 17”, Barzelona, Spain, 24.–29. June (Joergens, Henning)
IPAG Science Meeting, Grenoble, France, 25.–28. June (Henning)
“The Early Phase of Star Formation”, EPoS 2012, Ringberg Castle, Germany, 1.–6. July (Steinacker, Stutz, Ragan, Tackenberg, Beuther, Henning, Linz)
“Galactic Scale Star Formation – Observation meets Theory”, Institute of Psychology, Heidelberg, Germany, 30. July–3. Aug. (Ragan)
GC Staff Retreat, Schloss Heinsheim, Germany, 7.–8. Sept. (Witte-Nguy, Rix)
“Computational Astrophysics – Physical Foundations & Numerical Techniques”, IMPRS Summer School, Heidelberg, Germany, 10.–14. Sept. (Fendt, Springel (HITS), Klessen (ITA/ZAH))
“The Interstellar Medium in High Redshift Galaxies Comes of Age”, NRAO Workshop, Charlottesville, USA, 13.–15. Sept. (Walter)
“VLT – Upcoming VLT instrumentation”, Splinter Session on “The Bright and the Dark Sides of the Universe”, AG Annual Meeting, Hamburg, Germany, 24.–28. Sept. (Feldt)
“The Bright and the Dark Sides of the Universe”, AG Annual Meeting, Hamburg, Germany, 24.–28. Sept. (Contribution of the organisation and outreach activities of the conference, organisation of the workshop “Public Outreach in der Astronomie” on 26. Sept.) (K. Jäger, Pössel)

"LBT – Science with the Large Binocular Telescope", Splinter Meeting at the AG Annual Meeting, Hamburg, Germany, 27.–28. Sept. (Gredel)
"The Physics of the interstellar medium", ISM-SPP School, DFG Priority Program 1573, Freising, Germany, 1.–5. Oct. (Henning)
"Signs of planetary formation and evolution", 1st ITA-MPIA/Heidelberg-IPAG Conference, Grenoble, France, 8.–9. Oct. (Feldt, Brandner, Henning)
"50 Years of Brown Dwarfs: from Theoretical Prediction to Astrophysical Studies", Ringberg Castle, Germany, 21.–24. Oct. (Joergens, Brandner, Henning, Schlieder, Zimmerman, Bergfors, Lenius, Kozlikin)
"Galaxy formation and Cosmology" Nanjing, China, 24.–26. Oct. (Macciò)
"GAIA and Exoplanets: GREAT Synergies on the Horizon", GREAT-ESF Workshop, Turin, Italy, 5.–7. Nov. (Mordasini)
8th Planet and Star Formation-Retreat, Höchst, 12.–14. Nov. (Zhukovska, Mordasini, Bik, Crossfield, van Boekel)
GC Department Retreat, Lobbach, Germany, 19.–21. Nov. (Collins, Watkins, Rix, Witte-Nguy)

Conferences and Meetings Attended,
Scientific Talks and Poster Contributions

Angela Adamo: "AAS 219th Meeting", Meeting of the American Astronomical Society, Austin, USA, 8.–13. Jan. (Poster); "370 Years of Astronomy in Utrecht", Noordwijkerhout, The Netherlands, 2.–5. Apr. (Lecture); "An Odyssey in the Galaxy Archipelago", Stockholm, Sweden. 6.–9. June (Lecture); "Galactic Scale Star Formation – Observation meets Theory", Institute of Psychology, Heidelberg, 30. July–3. Aug. (Lecture)
Fabrizio Arrigoni Battaia: "Gas Flows in Galaxies", STSci May Symposium, Baltimore, USA, 7.–10. May (Poster); "The Baryon Cycle", Center for Galaxy Evolution, Irvine, USA, 14.–16. June (Poster); GC Department Retreat, Lobbach, Germany, 19.–21. Nov. (Lecture)
Coryn Bailer-Jones: GAIA Research for European Astronomy Training meeting, Heidelberg, Feb. (Lecture); GAIA Research for European Astronomy Training meeting, Madrid, Spain Mar. (Lecture); MPG LeadNet meeting, Berlin, May (Lecture); European Astrobiology Network Meeting, Stockholm, Sweden, Oct. (Lecture); GAIA Research for European Astronomy Training meeting, Bordeaux, France, Dec. (Lecture)
Zoltan Balog: "HERSCHEL Calibration Workshop", ESAC Villafranca, Spain, 18.–20. Jan.; HERSCHEL Data Processing Workshop 2012, ESAC Villafranca del Castillo, Spain, 20.–24. Feb.; "From Atoms to Pebbles: HERSCHEL's view of Star and Planet Formation", HERSCHEL Conference, Grenoble, France, 20.–23. Mar.; HIPE2012 Forum at ESAC, Madrid, Spain, 9.–11. Oct.; "PACS ICC meeting #41", ESAC Villafranca, Spain, 5.–7. Nov. (Lecture)
Eduardo Bañados: "The Epoch of Reionization: Theory – Simulations – Observations", Collège Doctoral Européen (CDE) Boulevard de la Victoire, Strasbourg, France, 23.–27. Apr. (Poster); "Growing-up at high redshift: from proto-clusters to galaxy clusters", European Space Astronomy Centre (ESAC) ESA, Villanueva de la Cañada, Madrid, Spain, 10.–13. Sep. (Lecture)
Amelia Bayo: "50 Years of Brown Dwarfs: from Theoretical Prediction to Astrophysical Studies", Ringberg Castle, Germany, 21.–24. Oct. (Poster)
Carolina Bergfors: "Cool Stars, Stellar Systems and the Sun 17", Barcelona, Spain, 24.–29. June (Poster); "Characterizing & Modeling Extrasolar Planetary Atmospheres – Theory & Observation", MPIA summer conference 2012, MPIA Heidelberg, 16.–19. July (Poster)
Yan Betremieux: "Characterizing & Modeling Extrasolar Planetary Atmospheres – Theory & Observation", MPIA summer conference 2012, MPIA Heidelberg, 16.–19. July; "Working with Exoplanet Light Curves", 2012 Sagan Exoplanet Summer Workshop, California Institute of Technology, Pasadena, USA, 23.–27. July; 8th Planet and Star Formation-Retreat, Höchst, Germany, 12.–14. Nov. (Lecture); ISSI meeting, Bern, Switzerland, 10.–12. Dec., 2012
Henrik Beuther: "From Atoms to Pebbles: HERSCHEL's view of Star and Planet Formation", HERSCHEL Conference, Grenoble, France, 20.–23. Mar. (Review-Lecture); "The Early Phase of Star Formation", EPoS 2012, Ringberg Castle, Germany, 1.–6. July (Review-Lecture); "The Milky Way: Stars, Gas, Dust and Magnetic Fields in 3D", Astra Workshop, Haus der Astronomie, Heidelberg, 18.–20. June (Lecture) "Galactic Scale Star Formation – Observation meets Theory", Heidelberg, 20. July–3. Aug. (Lecture);
Arjan Bik: "370 Years of Astronomy in Utrecht", Noordwijkerhout, The Netherlands, 2.–5. Apr. (Lecture); "The Labyrinth of Star Formation", Orthodox Academy of Crete (OAC), Chania, Greece, 18.–22. June (Lecture); "The Formation and Early Evolution of Stellar Clusters", Sexten, Italy, 23.–27. July (Lecture); Annual Meeting of the Astronomische Gesellschaft, Hamburg, 27.–28. Sep. (Lecture)
Beth Biller: Observing Planetary Systems II, ESO, Santiago de Chile, Chile, 5.–8. Mar. (Lecture); "Cool Stars, Stellar Systems and the Sun 17", Barcelona, Spain, 24.–29. June (Lecture); "Characterizing & Modeling Extrasolar Planetary Atmospheres – Theory & Observation", MPIA summer conference 2012, MPIA Heidelberg, 16.–19. July (Lecture)
Wolfgang Brandner: PanSTARRS-1 Science Consortium Meeting, Honolulu, Hawaii 3.–6. Jan.; ETIS Science Team Meeting: CEA Saclay, France, 10.–11. May (Lecture); SPHERE Science Team Meeting, Grenoble, France, 25.–29. June (Lecture); European Week of Astronomy, GREAT Plenary Meeting, Rom, Italy, 2.–6. July (Lecture); "Characterizing & Modeling Extrasolar

Planetary Atmospheres – Theory & Observation", MPIA summer conference 2012, MPIA Heidelberg, 16.–19. July (Lecture); "Galactic Scale Star Formation – Observation meets Theory", Institute of Psychology, Heidelberg, 20. July–3. Aug. (Poster); PanSTARRS-1 Science Consortium Meeting, Durham, UK, 13.–16. Aug.; "ESO@50 – the first 50 years of ESO", ESO Garching, Germany, 3.–7. Sep. (Poster); "Signs of planetary formation and evolution", 1st ITA-MPIA/Heidelberg-IPAG Conference, Grenoble, France, 8.–9. Oct. (Lecture); "50 Years of Brown Dwarfs: from Theoretical Prediction to Astrophysical Studies", Ringberg Castle, Germany, 21.–24. Oct. (Lecture); 8th Planet and Star Formation-Retreat, Höchst, Germany, 12.–14. Nov. (Lecture)

Alex Büdenbender: "Galaxy Modelling with a GAIA mock catalogue", GREAT ESF WGA1 Workshop, Barcelona, Spain, 29. Feb.–2. Mar.; "Dynamics meets Kinematic Tracers", Ringberg Castle, Germany, 10.–14. Apr. (Lecture); GREAT ITN School on galaxy modelling, Besancon, France, 15.–20. Oct.

Yu-Yen Chang: 5th HGSFP Winterschool 2012, Obergurgl, Austria, 21.–25. Jan. (Poster); IMPRS Retreat, Kyllberg, Germany, 26. Mar. (Lecture); "Cosmic Assembly Near-infrared Deep Extragalactic Legacy Survey", CANDELS 2012 Team Meeting, Santa Cruz, USA, 13. Sep. (Lecture); "What Will it Look Like to Observe with JWST/NIRSPEC", Third ELIXIR School, Noordwijk, The Netherlands, 26.–27. Sep.; ELIXIR Final Team Meeting, Leiden, The Netherlands, 13. Nov. (Lecture)

Michelle Collins: "First light and faintest dwarfs: Extreme Probes of the Cold Dark Matter Paradigm", KITP, Santa Barbara, USA, 13.–17. Feb. (Poster); UK-Germany National Astronomy Meeting, NAM2012, Manchester, UK, 27.–30. Mar. (Lecture); "The Great Andromeda Galaxy", Workshop, Princeton, USA, 18.–20. June (Poster); GC Department Retreat, Lobbach, Germany, 19.–21. Nov. (Lecture)

Neil Crighton: "The Baryon Cycle", Center for Galaxy Evolution, Irvine, USA, 14.–16. June (Poster)

Ian Crossfield: "Characterizing & Modeling Extrasolar Planetary Atmospheres – Theory & Observation", MPIA summer conference 2012, MPIA Heidelberg, 16.–19. July (Lecture); "Hot Planets and Cool Stars", RoPACS conference, MPE Garching, Garching, Germany, 12.–16. Nov. (Lecture)

Elisabete da Cunha: UK-Germany National Astronomy Meeting, NAM2012, Manchester, UK, 27.–30. Mar. (Lecture); 3D-HST Team Meeting, New Haven, USA, 15.–19. Oct. (Lecture)

Robert Decarli: "Interacting Galaxies and Binary Quasars: A Cosmic Rendezvous", Trieste, Italy, 2.–5. Apr. (Lecture)

Casey Deen: "Cool Stars, Stellar Systems and the Sun 17", Barcelona, Spain, 24.–29. June

Karsten Dittrich: XXVIIIth IAU General Assembly, Beijing, China, 20.–31. Aug. (Lecture and Poster – IAUS 293); "Planet Formation and Evolution 2012" 8th Conference on Formation and Evolution of Planetary Systems, Munich, Germany, 3.–7. Sep. (Lecture); "The first 10 million years of the solar system", Paneth Colloquium and DFG SPP 1385 workshop, Nördlingen, Germany, 9.–12. Oct. (Lecture)

Aaron Dutton: "Galaxy formation and Cosmology" Nanjing, China, 24.–26. Oct. (Lecture)

Nikolaos Fanidakis: "Disc Galaxy Formation in a Cosmological Context", SFB 881 – MPIA workshop, Haus der Astronomie, Heidelberg, 14.–18. May; Ringberg AGN Workshop, Ringberg Castle, Germany, 3.–5. Dec.

Markus Feldt: UK-Germany National Astronomy Meeting, NAM2012, Manchester, UK, 27.–30. Mar.

Wolfgang Gässler: ARGOS consortium meeting, OAA, Florence, Italy, 9.–11. May; ARGOS consortium meeting, Prien, Germany, 8.–9. Sep.

Thomas Gerner: "The Labyrinth of Star Formation", Orthodox Academy of Crete (OAC), Chania, Greece, 18.–22. June (Poster); "The astrochemical universe unveiled with HERSCHEL", European Week of Astronomy and Space Science 2012 (EWASS 2012), Pontificia Università Lateranense, Rom, Italy, 1.–6. July (Poster)

Dimitrios A. Gouliermis: "The Labyrinth of Star Formation", Orthodox Academy of Crete (OAC), Chania, Greece, 18.–22. June (Lecture); "The Formation and Early Evolution of Stellar Clusters", Sexten, Italy, 23.–27. July (Lecture); "30 Doradus: The Starburst Next Door", Space Telescope Science Institute, Baltimore, USA, 17.–19. Sep. (Lecture)

Brent Groves: "Galaxy Surveys using Integral Field Spectroscopy: Achievements and Opportunities", 9th Potsdam Thinkshop, 10.–13. Sep. (Lecture)

Richard Hanson: "Galaxy Modelling with a GAIA mock catalogue", GREAT ESF WGA1 Workshop, Barcelona, Spain, 29. Feb.–2. Mar.; MPIA Student Workshop, Bar-sur-Seine, France, 7.–10. May (Lecture); Summer School in Statistics for Astronomers VIII, State College, PA, USA, 4.–8. June; "The Milky Way: Stars, Gas, Dust and Magnetic Fields in 3D", Astra Workshop, Haus der Astronomie, Heidelberg, 18.–20. June (Lecture); European Week of Astronomy, GREAT Plenary Meeting, Rom, Italy, 2.–6. July (Lecture); GC Department Retreat, Lobbach, Germany, 19.–21. Nov.

Siddarth Hedge: 5th HGSFP Winterschool 2012, Obergurgl, Austria, 21.–25. Jan. (Poster); European Geosciences Union General Assembly 2012, EGU, Vienna, Austria, 22.–27. Apr. (Poster); "Characterizing & Modeling Extrasolar Planetary Atmospheres – Theory & Observation", MPIA summer conference 2012, MPIA Heidelberg, 16.–19. July (Poster); "Planet Formation and Evolution", Munich, Germany, 3.–7. Sept. (Poster); "Planet Formation and Evolution 2012", 8th Conference on Formation and Evolution of Planetary Systems, Munich, Germany, 3.–7. Sep. (Lecture); "12th European Workshop on Astrobiology" (EANA 12), AlbaNova University Centre, Stockholm, Sweden, 15.–17. Oct. (Lecture and Poster)

Thomas Henning: "Planets around Stellar Remnants", Observatorio de Arecibo, Puerto Rico, 23.–27. Jan.; "50

Years of Brown Dwarfs: from Theoretical Prediction to Astrophysical Studies", Ringberg Castle, Germany, 21.–24. Oct.; "Characterizing & Modeling Extrasolar Planetary Atmospheres – Theory & Observation", MPIA summer conference 2012, MPIA Heidelberg, 16.–19. July; "The Physics of the interstellar medium", ISM-SPP School, DFG Priority Program 1573, Freising, Germany, 1.–5. Oct. (keynote lecture); IPAG Science Meeting, Grenoble, France, 25.–28. June

Stefan Hippler: SPIE conference on Astronomical Telescopes and Instrumentation, Amsterdam, The Netherlands, 1.–6.July; GRAVITY Consortium Meeting, Grenoble, France, 13.–14. Feb.; GRAVITY Adaptive Optics Final Design Review-Lecture Meeting, ESO Garching, Germany, 26.–28. Mar.; GRAVITY Pulse Tube Cryocooler Progress Meeting, MPIA Heidelberg, 19. Apr.; METIS Science Team Meeting: CEA Saclay, France, 10.–11. May; GRAVITY Pulse Tube Cryocooler Progress Meeting, MPIA Heidelberg, 7. Aug.; GRAVITY Pulse Tube Cryocooler Progress Meeting, Univ. of Gießen, Germany, 24. Oct.; GRAVITY Cryostat Integration Meeting, ESO Garching, Germany, 13.–14. Dec.

Jaqueline Hodge: UK-Germany National Astronomy Meeting, Manchester, UK, 27.–30. Mar. (Lecture); GC Department Retreat, Lobbach, Germany, 19.–21. Nov. (Lecture)

Annie Hughes: "Galactic Scale Star Formation – Observation meets Theory", Institute of Psychology, Heidelberg, 20. July–3. Aug. (Poster); "The Early Phase of Star Formation", EPoS 2012, Ringberg Castle, Germany, 1.–6. July (Poster); Heritage Team Meeting, First Presbyterian Flint, Tokyo, 21. May (Lecture)

Cornelia Jäger: UK-Germany National Astronomy Meeting NAM2012, Manchester, UK, 27.–30. Mar.; Workshop "Silicon in Space", Loveno di Menaggio, Italy, 16.–19. May; The 5th meeting on Cosmic Dust, Kobe, Japan, 6.–10. Aug.

Klaus Jäger: "The Bright and the Dark Sides of the Universe", AG Annual Meeting, Hamburg, Germany, 24.–28. Sep. (2 Lectures, 1 Poster); "Wissen-schafft-Stadt", Internationale Bauausstellung (IBA), Stadthalle Heidelberg, 4.–5. Oct. (Poster/booth)

Viki Joergens: Margarete-von-Wrangell Seminar, Stuttgart, Germany, 7. Mar.; "Cool Stars, Stellar Systems and the Sun 17", Barcelona, Spain, 24.–29. June (Lecture); "50 Years of Brown Dwarfs: from Theoretical Prediction to Astrophysical Studies", Ringberg Castle, Germany, 21.–24. Oct. (Poster); 8th Planet and Star Formation-Retreat, Höchst, Germany, 12.–14. Nov. (Lecture)

Katharine Johnston: UK-Germany National Astronomy Meeting, NAM2012, Manchester, UK, 27.–30. Mar. (Lecture); "The Labyrinth of Star Formation", Orthodox Academy of Crete (OAC), Chania, Greece, 18.–22. June (Poster); 8th Planet and Star Formation-Retreat, Höchst, Germany, 12.–14. Nov. (Lecture)

Jouni Kainulainen: "Florida Star and Planet Formation Days", University of Florida, Gainesville, USA, 10.–11. Feb. (Lecture); "The Early Phase of Star Formation", EPoS 2012, Ringberg Castle, Germany, 1.–6. July (Poster); "Galactic Scale Star Formation – Observation meets Theory", Institute of Psychology, Heidelberg, 20. July–3. Aug. (Poster); "The Bright and the Dark Sides of the Universe", Annual Meeting of the Astronomische Gesellschaft 2012, Hamburg, Germany, 24.–28. Sep. (Lecture); 8th Planet and Star Formation-Retreat, Höchst, Germany, 12.–14. Nov. (Lecture)

Maria Kapala: "The Great Andromeda Galaxy", Workshop, Princeton, USA, 18.–20. June (Poster); "Galactic Scale Star Formation – Observation meets Theory", Institute of Psychology, Heidelberg, 20. July–3. Aug. (Poster); "The Panchromatic HUBBLE Andromeda Treasury" Team meeting, University of Washington, USA, 12.–16. Nov. (Lecture)

Sarah Kendrew: "AAS 219th Meeting", Meeting of the American Astronomical Society, Austin, USA, 8.–13. Jan.; UK-Germany National Astronomy Meeting, NAM2012, Manchester, UK, 27.–30. Mar. (Lecture); EU OPTICON workshop on Disruptive technology for astronomy, Marseille, France, 17.–18. Apr.; MIRI Day, London, UK, 9. May (Lecture); SPIE conference on Astronomical Telescopes and Instrumentation, Amsterdam, The Netherlands, 1.–6. July (Poster); "Galactic Scale Star Formation – Observation meets Theory", Institute of Psychology, Heidelberg, 30. July–3. Aug. (Lecture)

Ulrich Klaas: "HERSCHEL Calibration Workshop", ESAC Villafranca, Spain, 18.–20. Jan. (Lecture); EChO Mid-term Review-Lecture, ESTEC, Noordwijk, The Netherlands, 19. June (Lecture)

Hubert Klahr: "Planet Formation and Evolution 2012", 8th Conference on Formation and Evolution of Planetary Systems, Munich, Germany, 3.–7. Sep. (Lecture)

Rainer Köhler: "SOFIA Community Day", 3rd German SOFIA Workshop 2012, MPIfR Bonn, Germany, 6.–7. Feb.; "50 Years of Brown Dwarfs: from Theoretical Prediction to Astrophysical Studies", Ringberg Castle, Germany, 21.–24. Oct. (Poster)

Taisiya Kopytova: "Signs of planetary formation and evolution", 1st ITA-MPIA/Heidelberg-IPAG Conference, Grenoble, France, 8.–9. Oct. (Lecture); "50 Years of Brown Dwarfs: from Theoretical Prediction to Astrophysical Studies", Ringberg Castle, Germany, 21.–24. Oct. (Poster); 8th Planet and Star Formation-Retreat, Höchst, Germany, 12.–14. Nov. (Lecture)

Kathryn Kreckel: "Metals in 3D: New insights from Integral Field Spectroscopy", Instituto de Astrofìsica de Andalucìa – CSIC, Granada, 18.–20. Apr.; "Galactic Scale Star Formation – Observation meets Theory", Institute of Psychology, Heidelberg, 30. July–3. Aug. (Poster)

Martin Kürster: "Hot Planets and Cool Stars", RoPACS conference, MPE Garching, Garching, Germany, 12.–16. Nov.

Girish Kulkarni: "Interacting Galaxies and Binary Quasars: A Cosmic Rendezvous", Trieste, Italy, 2.–5. Apr.

(Lecture); “Probing the high redshift universe”, 39th COSPAR Scientific Assembly, Mysore, India, 17.–18. July (Lecture)

Rainer Lenzen: ESA meeting (EcHO), ESTEC, Noordwijk, NL, “EChO Optical Concept”, 50 Jahre ESO: HdA, Heidelberg, “Zehn Jahre NACO: Von der Planung zu ersten aufregenden Ergebnissen”

Huabai Li: “Magnetic fields in different phases of the ISM”, Splinter Session in “The Bright and the Dark Sides of the Universe”, Annual Meeting of the Astronomische Gesellschaft 2012, Hamburg, Germany, 24.–28. Sep.

Hendrik Linz: “HERSCHEL Calibration Workshop”, ESAC Villafranca, Spain, 18.–20. Jan.; “From Atoms to Pebbles: HERSCHEL’s view of Star and Planet Formation”, HERSCHEL Conference, Grenoble, France, 20.–23. Mar.; PACS ICC meeting #40, MPE Garching, Germany, 28.–30. Mar.; “The Early Phase of Star Formation”, EPoS 2012, Ringberg Castle, Germany, 1.–6. July (Poster); PACS ICC meeting #41, ESAC Villafranca, Spain, 5.–7. Nov.; 8th Planet and Star Formation-Retreat, Höchst, Germany, 12.–14. Nov.

Nils Lippok: “The Bright and the Dark Sides of the Universe”, Annual Meeting of the Astronomische Gesellschaft 2012, Hamburg, Germany, 24.–28. Sep. (Poster)

Mariya Lyubenova: “Stellar populations across Cosmic Times”, IAP-SUBARU Joint International Conference, IAP, Paris, France, 25.–29. June (Poster); “Galaxy Surveys using Integral Field Spectroscopy: Achievements and Opportunities”, 9th Potsdam Thinkshop, 10.–13. Sep. (Lecture); “Astrophysical Applications of Gravitational Lensing”, XXIV Canary Islands Winter School of Astrophysics, Puerto de La Cruz, Tenerife, Spain, 4.–16. Nov. (Lecture); “4th CALIFA Busy Week”, Granada, Spain, 20.–23. Nov.

Luigi Mancini: “GAIA and exoplanets: Great Synergies on the Horizon”, Great-ESF Workshop, Turin, Italy, 5.–7. Nov. (Lecture); “Characterizing & Modeling Extrasolar Planetary Atmospheres: Theory & Observation”, MPIA summer conference 2012, MPIA Heidelberg, 16.–19. July

Nicholas Martin: PanSTARRS-1 Science Consortium Meeting, Durham, UK, 13.–16. Aug. (Lecture); “The Bright and the Dark Sides of the Universe”, Annual Meeting of the Astronomische Gesellschaft 2012, Hamburg, Germany, 24.–28. Sep. (Lecture)

Sharon E. Meidt: “AAS 219th Meeting”, Meeting of the American Astronomical Society, Austin, USA, 8.–13. Jan. (Poster); “Gas Flows in Galaxies”, STSci May Symposium, Baltimore, USA, 7.–10. May (Lecture); “3rd CALIFA Busy Week”, Haus der Astronomie Heidelberg, 11.–15. June (Lecture); “Galactic Scale Star Formation – Observation meets Theory”, Institute of Psychology, Heidelberg, 20. July–3. Aug. (Lecture); “Molecular Gas, Dust, and Star Formation in Galaxies”, IAU Symposium 292, Beijing, China, 20.–24. Aug. (Lecture); “Calibration of star-formation rate measurements across the electromagnetic spectrum” SpS8, Beijing, China, 27.–30. Aug. (Lecture); “The Physics of Star Formation and its Role in Galaxy Evolution” Workshop, Trieste, Italy, 16.–18. Oct. (Poster); “The Interstellar Medium in High Redshift Galaxies Comes of Age”, NRAO Workshop, Charlottesville, USA, 13.–15. Sep. (Seminar); Rutgers University, New Brunswick, USA, Nov. (Seminar); University of Maryland, College Park, USA, Nov.

Maren Mohler-Fischer: “Planet Formation and Evolution 2012”, 8th Conference on Formation and Evolution of Planetary Systems, Munich, Germany, 3.–7. Sep. (Lecture); “Signs of planetary formation and evolution”, 1st ITA-MPIA/Heidelberg-IPAG Conference, Grenoble, France, 8.–9. Oct. (Lecture)

Esteban Morales: “The Labyrinth of Star Formation”, Orthodox Academy of Crete (OAC), Chania, Greece, 18.–22. June (Poster); “Galactic Scale Star Formation – Observation meets Theory”, Institute of Psychology, Heidelberg, 20. July–3. Aug. (Poster); “PSF Seminar” MPIA Heidelberg, 7. Nov. (Lecture); 8th Planet and Star Formation-Retreat, Höchst, Germany, 12.–14. Nov.

Christoph Mordasini: “Planet Formation and Evolution 2012”, 8th Conference on Formation and Evolution of Planetary Systems, Munich, Germany, 3.–7. Sep. (Lecture)

Eric Morganson: “Key Project 10: Active Galactic Nuclei and High Redshift Quasars”, PanSTARRS-1 Science Consortium Meeting, Honolulu, Hawaii, 3.–6. Jan. (Lecture); “Key Project 10: The First $z=6$ Quasar in PS1 Stacked Data and QSO Variability”, PanSTARRS-1 Science Consortium Meeting, Durham, UK, 13.–16. Aug. (Lecture)

Markus Nielbock: “HERSCHEL Calibration Workshop”, ESAC Villafranca, Spain, 18.–20. Jan. (Lecture); HERSCHEL Data Processing Workshop 2012, ESAC Villafranca del Castillo, Spain, 20.–24. Feb. (Lecture); “From Atoms to Pebbles: HERSCHEL’s view of Star and Planet Formation”, HERSCHEL Conference, Grenoble, France, 20.–23. Mar. (Poster); PACS ICC meeting #40, MPE Garching, Germany, 29.–30. Mar. (Lecture); HERSCHEL Calibration Steering Group Meeting #31, KUL Leuven, Belgium, 26. June (Lecture); “The Bright and the Dark Sides of the Universe”, AG Annual Meeting, Hamburg, Germany, 24.–28. Sep. (Lecture and Poster); PACS ICC meeting #41, ESAC Villafranca, Spain, 5.–7. Nov. (2 Lectures); 8th Planet and Star Formation-Retreat, Höchst, Germany, 12.–14. Nov. (Lecture); HERSCHEL Calibration Steering Group Meeting #32, ESAC, Spain, 13. Dec. (Lecture)

Sladjana Nikolic: “Supernovae Illuminating the Universe: from Individuals to Populations”, MPA/ESO/MPE/Excellence Cluster Universe Conference, Garching, Germany, 10.–14. Sep. (Poster)

Christoph Olczak: “A window to the formation of the Milky Way: Dynamics, observational and numerical astrophysics of dense stellar systems”, Aspen, USA, 20. May–9. June (Lecture); “Stereology, Spatial Statistics and Stochastic Geometry" (S^4G), 7th International Conference, Prague, Czech Republic, 25.–28. June (Lecture); "The Orion Nebula: A Laboratory for the Study of Star Formation and Gaseous Nebulae", 2nd NCAC Symposium, Warsaw, Poland, 16.–18. July (Lecture), Aarseth N-body Meeting, Bonn, Germany, 3.–5. Dec. (Lecture)

Camilla Penzo: Summer School on Cosmology, Italian Institute for Nuclear Physics (INFN), Trieste, Italy, 16.–27. July; "Computational Astrophysics – Physical Foundations & Numerical Techniques", IMPRS Summer School, Heidelberg, 10.–14. Sep.; GC Department Retreat, Lobbach, Germany, 19.–21. Nov.

Diethard Peter: SPIE conference on Astronomical Telescopes and Instrumentation, Amsterdam, The Netherlands, 1.–6. July (Poster)

Jörg-Uwe Pott: SPIE Amsterdam 2012, The Netherlands, 2.–6. June (mehrere Lectures und Poster)

Sarah Ragan: "APEX2012", Science with the Atacama Pathfinder Experiment, Ringberg Castle, Germany, 12.–15. Feb. (Lecture); "From Atoms to Pebbles: HERSCHEL's view of Star and Planet Formation", HERSCHEL Conference, Grenoble, France, 20.–23. Mar. (Poster); UK-Germany National Astronomy Meeting, NAM2012, Manchester, UK, 27.–30. Mar. (Lecture and Poster); "The Early Phase of Star Formation", EPoS 2012, Ringberg Castle, Germany, 1.–6. July (Poster); "Galactic Scale Star Formation – Observation meets Theory", Institute of Psychology, Heidelberg, 20. July–3. Aug. (Lecture); Apples to Apples workshop, ESO, Munich, Germany, 21.–23. Nov. (Lecture)

Hans-Walter Rix: European Academy of Science and Arts, Salzburg; Meeting Rat Deutscher Sternwarten, Potsdam, Germany, March 22, 2012; KINGFISH Meeting, Annapolis, USA, 25.–27. Mar.; "Dynamics meets Kinematic Tracers", Ringberg Castle, Germany, 10.–14. Apr.; LBT Board Meeting, Tucson, USA, 17.–18. Apr.; EUCLID Meeting, Noordwijk, The Netherlands, April 27, 2012; "EUCLID Mission Conference 2012", University of Copenhagen, Copenhagen, Denmark, 15.–16. May; "Stars without Borders: Radial Migration in Spiral Galaxies", Workshop, Medana, Slovenia, 21.–24. May; "Galaxies: Insight Out", Leiden University, Leiden, The Netherlands, 2.–5. July; "Astro Imaging Workshop", Valchava, Switzerland, 15.–17. Aug.; 3D-HST Team Meeting, New Haven, USA, 15.–19. Oct.; PHAT collaboration Meeting, Washington, USA, 5.–9. Sep.; CAHA-EC-Meeting, 12. Nov.

Thomas Robitaille: "The Labyrinth of Star Formation", Orthodox Academy of Crete (OAC), Chania, Greece, 18.–22. June (Lecture); "The Early Phase of Star Formation", EPoS 2012, Ringberg Castle, Germany, 1.–6. July (Lecture); "Networked Astronomy and the New Media", dotAstronomy 4, Haus der Astronomie, Heidelberg, 9.–11. July (Lecture); "Galactic Scale Star Formation – Observation meets Theory", Institute of Psychology, Heidelberg, 20. July–3. Aug. (Poster)

Victoria Rodriguez-Ledesma: "Cool Stars, Stellar Systems and the Sun 17", Barcelona, Spain, 24.–29. June (Lecture)

Karin Sandstrom: "Disc Galaxy Formation in a Cosmological Context", SFB 881 – MPIA workshop, Haus der Astronomie, Heidelberg, 14.–18. May (Lecture); "Galactic Scale Star Formation – Observation meets Theory", Institute of Psychology, Heidelberg, 20. July–3. Aug. (Lecture)

Silvia Scheithauer: EChO Consortium Meeting, MPIA Heidelberg, 11.–12. Jan.; "MIRI Acceptance Day" meeting, (JWST MIRI instrument delivery to NASA), London, UK, 8.–9. Feb.; MIRI European Consortium Meeting, Cologne, Germany, 19.–21. Sep.; 8th Planet and Star Formation-Retreat, Höchst, Germany, 12.–14. Nov.; MIRI Test Team Meeting, Goddard Space Flight Center, Greenbelt, USA, 6.–7. Dec.

Eva Schinnerer: "The Physics of Feedback Processes and their Role in Galaxy Evolution Aspen Center for Physics", Aspen Meeting, Aspen, USA, 10. June–1. July (Lecture); "Galactic Scale Star Formation – Observation meets Theory", Institute of Psychology, Heidelberg, 20. July–3. Aug. (Lecture)

Eddie Schlafly: "AAS 219th Meeting", Meeting of the American Astronomical Society, Austin, USA, 8.–13. Jan. (Poster); PanSTARRS-1 Science Consortium Meeting, Durham, UK, 13.–16. Aug. (Lecture)

Joshua Schlieder: "Cool Stars, Stellar Systems and the Sun 17", Barcelona, Spain, 24.–29. June (Poster); "50 Years of Brown Dwarfs: from Theoretical Prediction to Astrophysical Studies", Ringberg Castle, Germany, 21.–24. Oct. (Lecture)

Kasper Borello Schmidt: 3D-HST Team Meeting, New Haven, USA, 15.–19. Oct. (Lecture); "The Spatial Extent of Star Formation in 3D-HST Mergers at $z \sim 1.5$" 3D-HST Meeting, Videocon MPIA, Heidelberg, 7.–9. May (Lecture); "Quasar Variability – Selection of and Physics in Quasars", "The Physics of Astronomical Transients", Conference, Aspen Center for Physics, Aspen, CO, USA, 22.–27. Jan. (Lecture); "Quasar Variability – Selection of and Physics in Quasars", "AAS 219th Meeting", Meeting of the American Astronomical Society, Austin, USA, 8.–13. Jan. (Lecture)

Juergen Schreiber: PACS Software developer workshop, KU Leuven, Belgium, 15.–16. Feb.; PACS Spectrometer pipeline and ICC meeting at MPE Garching, Germany, 27.–30. Mar. (Lecture); PACS Spectrometer pipeline meeting at MPE Garching, Germany, 25.–26. June; MIRI Software developer meeting at KU Leuven, Belgium, 16.–19. Oct.; PACS Spectrometer pipeline and ICC meeting at ESAC, Villafranca, Spain, 6.–8. Nov.

Dmitry A. Semenov: "Astrochemistry at Intermediate and Warm Temperatures", Tallinn, Estonia, 29. May– 2. June (Invited Lecture); "Signs of planetary formation and evolution", 1st ITA-MPIA/Heidelberg-IPAG Conference, Grenoble, France, 8.–9. Oct. (Lecture)

Robert Singh: "3rd CALIFA Busy Week", Haus der Astronomie Heidelberg, 11.–15. June (Lecture); "4th

CALIFA Busy Week", Granada, Spain, 20.–23. Nov. (Lecture); "Galaxy Surveys using Integral Field Spectroscopy: Achievements and Opportunities", 9th Potsdam Thinkshop, 10.–13. Sep. (Poster)

Martin Steglich: UK-Germany National Astronomy Meeting NAM2012, Manchester, UK, 27.–30. Mar.

Juergen Steinacker: IPAG seminar, Grenoble, France, 27. Feb. (Lecture); "The Milky Way: Stars, Gas, Dust and Magnetic Fields in 3D", Astra Workshop, Haus der Astronomie, Heidelberg, 18.–20. June (Lecture); "The Early Phase of Star Formation", EPoS 2012, Ringberg Castle, Germany, 3. July (Lecture); "Signs of planetary formation and evolution", 1st ITA-MPIA/Heidelberg-IPAG Colloqium, Grenoble, France, 8. Oct. (Lecture);

Greg Stinson: "The Baryon Cycle", Center for Galaxy Evolution, Irvine, USA, 14.–16. June (Lecture)

Amelia Stutz: HOPS team meeting, Tucson USA, 9.–13. Feb. (Lecture); "From Atoms to Pebbles: HERSCHEL's view of Star and Planet Formation", HERSCHEL Conference, Grenoble, France, 20.–23. Mar. (Lecture); "Studies of Star and Planet Forming Regions with HERSCHEL", Lorentz Center, Leiden, The Netherlands, 11.–15. June; "The Early Phase of Star Formation", EPoS 2012, Ringberg Castle, Germany, 1.–6. July (Poster);

Jochen Tackenberg: "APEX2012", Science with the Atacama Pathfinder Experiment, Ringberg Castle, Germany, 12.–15. Feb. (Lecture); "From Atoms to Pebbles: HERSCHEL's view of Star and Planet Formation", HERSCHEL Conference, Grenoble, France, 20.–23. Mar. (Poster); "The Early Phase of Star Formation", EPoS 2012, Ringberg Castle, Germany, 1.–6. July (Poster)

Roy van Boekel: EChO Consortium Meeting, MPIA Heidelberg, 11.–12. Jan. (2 Lectures); EChO Meeting, Florence Workshop 2012, Department of Physics and Astronomy, University of Florence, Florenz, Italy, 31. Jan.; EChO calibration meeting, ETH Zürich, Switzerland, 29. Feb.; EChO progress meeting, ESA ESTEC, Noordwijk, The Netherlands, 4. Apr. (2 Lectures); EChO Working Group 1 meeting, ETH Zürich, Switzerland, 2.–3. May; EChO mid-term Review-Lecture, ESA ESTEC, Noordwijk, The Netherlands, 19. June (2 Lectures); SPIE Amsterdam 2012, The Netherlands, 2.–6. June (Lecture); "Characterizing & Modeling Extrasolar Planetary Atmospheres – Theory & Observation", MPIA summer conference 2012, MPIA Heidelberg, 16.–19. July (Poster); EChO Calibration source meeting, Haus der Astronomie, Heidelberg, 6. Sept.; "The Bright and the Dark Sides of the Universe", AG Annual Meeting, Hamburg, Germany, 24.–28. Sep. (Lecture); 8th Planet and Star Formation-Retreat, Höchst, Germany, 12.–14. Nov.

Bram Venemans: UK-Germany National Astronomy Meeting, NAM2012, Manchester, UK, 27.–30. Mar. (Lecture); European Week of Astronomy, EWAS 2012, GREAT Plenary Meeting, Rome, Italy, 2.–6. July (Lecture); PanSTARRS-1 Science Consortium Meeting, Durham, UK, 13.–16. Aug.; "Science from Next Generation Imaging and Spectroscopic Surveys", ESO Workshop, ESO Garching, Germany, 15.–18. Oct.

Fabian Walter: PanSTARRS-1 Science Consortium Meeting, Honolulu, Hawaii, 3.–6. Jan.; "Exiting CO in the Local and High Redshift Universe", Lorentz Center, Leiden, The Netherlands, 27. Feb.–2. Mar.; "Disc Galaxy Formation in a Cosmological Context", SFB 881 – MPIA workshop, Haus der Astronomie, Heidelberg, 14.–18. May; "The Physics of Feedback Processes and their Role in Galaxy Evolution Aspen Center for Physics", Aspen Meeting, Aspen, USA, 10. June–1. July; "The Interstellar Medium in High Redshift Galaxies Comes of Age", NRAO Workshop, Charlottesville, USA, 13.–15. Sep. (Lecture)

Laura Watkins: "First light and faintest dwarfs: Extreme Probes of the Cold Dark Matter Paradigm", KITP, Santa Barbara, USA, 13.–17. Feb. (Poster); "Dynamics meets Kinematic Tracers", Ringberg Castle, Germany, 10.–14. Apr. (Lecture); GC Department Retreat, Lobbach, Germany, 19.–21. Nov. (Lecture)

Svitlana Zhukovska: "Galactic Scale Star Formation – Observation meets Theory", Institute of Psychology, Heidelberg, 20. July–3. Aug. (Poster); Star Formation Group Retreat, Kloster Schoental, Germany, September 17, 2012 (Lecture); "The Low-metallicity ISM: Chemistry, Turbulence and Magnetic Fields", Workshop, Göttingen, Germany, 8.–12. Oct. (Poster)

Neil Zimmerman: "Characterizing & Modeling Extrasolar Planetary Atmospheres – Theory & Observation", MPIA summer conference 2012, MPIA Heidelberg, 16.–19. July (Poster); "Signs of planetary formation and evolution", 1st ITA-MPIA/Heidelberg-IPAG Conference, Grenoble, France, 8.–9. Oct. (Lecture); "50 Years of Brown Dwarfs: from Theoretical Prediction to Astrophysical Studies", Ringberg Castle, Germany, 21.–24. Oct.

Invited Talks, Colloquia

Angela Adamo: "The Influence of Environment on Cluster Formation", "The Formation and Early Evolution of Stellar Clusters", Sexten, Italy, 23.–27. July (Lecture)

Coryn Bailer-Jones: "Patterns in astronomical impacts on the Earth: Testing the claims", Leiden Observatory, Leiden, The Netherlands, Jan. (Colloquium)

Henrik Beuther: Universität Göttingen, Germany (Colloquium)

Arjan Bik: Anton Pannekoek Instituut, University of Amsterdam, 19. Sep. (Colloquium); MPIA/LSW Hauskolloquium, MPIA Heidelberg, Germany, 23. Nov. (Colloquium); MPIA Science day, MPIA Heidelberg, Germany, 28. Nov. (Lecture)

Beth Biller: University of Colorado, Boulder, USA, Feb. (Colloquium); University of Texas, Austin, USA, Feb. (Colloquium); Southwestern Research Institute, Boulder, CO, USA, Sep. (Colloquium); "50 Years of Brown Dwarfs: from Theoretical Prediction to Astrophysical

Studies", Ringberg Castle, Germany, 21.–24. Oct. (Lecture)

Wolfgang Brandner: Physical Colloquium, Hochschule Mannheim, Germany, 18. Oct. (Colloquium)

Michelle Collins: Institute of Astronomy, Cambridge, 23. May (Seminar)

Neil Crighton: University of California Santa Cruz, California, USA, 13. June (Colloquium)

Elisabete da Cunha: CEA Saclay, France, 27. Sep. (Colloquium)

Aaron Dutton: "Gravitational Lensing in the Age of Survey Science", SnowPAC 2012, Snowbird, Utah, USA, 19.–23. Mar. (Lecture); "Disc Galaxy Formation in a Cosmological Context", SFB 881 – MPIA workshop, Haus der Astronomie, Heidelberg, Germany, 14.–18. May (Lecture); "Galaxies: Insight Out", Leiden University, Leiden, The Netherlands, 2.–5. July (Lecture); "Is the Stellar Initial Mass Function Universal?", Lorentz Center, Leiden, The Netherlands, 26.–30. Nov. (Lecture)

Nikolaos Fanidakis: TAPIR at Caltech, California AstroPhysics Including Relativity and Cosmology, California, USA, 19. Apr. (Colloquium); Seminar Theoretical Astrophysics and Computational Physics, Eberhad Karls Universität Tübingen, Germany, 5. June (Colloquium); Ringberg AGN Workshop, Ringberg Castle, Germany, 3.–5. Dec. (Lecture)

Markus Feldt: UK-Germany National Astronomy Meeting, NAM2012, Manchester, UK, 27.–30. Mar. (Lecture); "Die Suche nach Exoplaneten", Forum der Luft- und Raumfahrt München (DLR), Munich, Germany, 21. June (Colloquium)

Christian Fendt: "Graduate Education in Astronomy/Astrophysics: the Example of the International Max Planck Research Schools", BMBF German-South African Year of Science, Opening Session, Cape Town, South Africa, 16.–17. Apr. (Lecture)

Wolfgang Gässler: ARGOS consortium meeting, MPIA Heidelberg, Germany, 11.–12. Jan. (Lecture); ARGOS consortium meeting, OAA, Florenz, Italy, 9.–11. May (Lecture); ARGOS consortium meeting, Prien, Germany, 8.–9. Sep. (Lecture); SPIE conference on Astronomical Telescopes and Instrumentation, Amsterdam, The Netherlands, 1.–6. July (Lecture)

Roland Gredel: Universität Basel/Department of Chemistry, Basel, Switzerland, 28. Mar. (Lecture)

Brent Groves: Astronomisches Rechen-Institut / ZAH (Colloquium)

Siddarth Hedge: "Frontiers in exoplanetary studies", "The Bright and the Dark Sides of the Universe", AG Annual Meeting, Hamburg, Germany, 24.–28. Sep. (Lecture)

Thomas Henning: "Physics of Star Formation", Physical Colloquium, Universität Würzburg, Germany, 6. Feb. (Lecture); "A Personal View on Modern Laboratory Astrophysics", Astronomical Colloquium, Konkoly Observatory, Budapest, Hungary, 11.–12. Mar. (Lecture); "A HERSCHEL Search for Cold Dust in Brown Dwarf Disks", "From Atoms to Pebbles: HERSCHEL's view of Star and Planet Formation", HERSCHEL Conference, Grenoble, France, 20.–23. Mar. (Lecture); "Observation & Modeling", "Silicon in Space", Villa Vigoni, Italy, 16.–19. May (Lecture); "From Protoplanetary Disks to Extrasolar Planets", EMG-GK Seminar, Institut für Kernphysik, Uni Mainz, Germany, 23. May; "Laboratory Astrophysics of Cosmic Dust", UCL-MPG Science Conference, London, UK, 27. June (Lecture); Colloquium, MPI for Nuclear Physics, Heidelberg, Germany, July; "Physics and Chemistry of Cosmic Dust", "The Physics of the interstellar medium", ISM-SPP School, Freising, Germany, 1.–5. Oct. (Lecture); "From Planetary Systems to Exoplanetary Atmospheres", "Space-Based Research", Third Exploratory Round Table Conference in Shanghai on Space-Based Research, Shangai, China, 1.–3. Nov. (Lecture); "Water in Protoplanetary Disks", Laboratory Astrophysics Meeting, I. Physikalisches Institut, University of Cologne, Germany, 21.–23. Nov. (Lecture)

Jaqueline Hodge: Germany ALMA Community Days, Bonn, Germany, 5.–6. June (Lecture)

Annie Hughes: "Molecular Gas and Star Formation in M 51: Insights From PAWS", WUNA Lunch Lecture, NRAO, Charlottesville, USA, 21. Feb. (Lecture); "Giant Molecular Clouds and Star Formation in M 51", Astrophysics Colloquium, Physics Illinois, University of Illinois at Urbana-Champaign, USA, 28. Feb. (Colloquium); "The PAWS View of Giant Molecular Clouds Gas Flows and Star Formation in M 51", Australia Telescope National Facility, Sydney, Australia, 16. May (Colloquium); "Giant Molecular Clouds in Nearby Galaxies", Colloquium, International Centre for Radio Astronomy Research, Perth, Australia, 12. Jan. (Colloquium)

Friedrich Huisken: International Workshop "Silicon in Space", Villa Vigoni, Loveno di Menaggio, Italy, 16.–19. May (Lecture); 28th International Symposium on Rarefied Gas Dynamics, Saragossa, Spain, 9.–13. July (Lecture)

Cornelia Jäger: ISM-SPP school "The Physics of the Interstellar Medium", Freising, 1.–5. Oct. (Lecture); International Astronomical Union General Assembly XXVIII, SpS 16 Unexplained Spectral Phenomena in the Interstellar Medium, Peking, China, 27.–28. Aug. (Lecture); Conference on Core-Collapse Supernovae Near & Far: Understanding its Formation and Evolution, Ascona, 5.–8. Nov. (Lecture); Physical Colloquium, FSU Jena, 9. Jan. (Colloquium); Colloquium at Max Planck Institute for Astronomy, Heidelberg, 20. Jan. (Colloquium)

Knud Jahnke: Ringberg AGN Workshop, Ringberg Castle, Germany, 3.–5. Dec. (Moderator, Session Chair)

Lisa Kaltenegger: DPS, Reno, USA, 16. Oct.; "Life in the Cosmos", Smithsonian, 12. Sep.; Exo-Life, Vienna, Austria, 12. May; EGU, Vienna, Austria, 12. Apr.; UK-German National Astronomy Meeting, 12. April; New Quests in Stellar Astrophysics III. Puerto Vallarta, Mexiko, 12. Mar.; Origins of Life, Gordon Conference, Texas, USA, 12. Jan.; Planets around stellar remnants, Puerto Rico, USA, 12. Jan.; ISU, Washington D.C., USA, 3. July; ESO, Garching, Germany, 12. Dec.; MPE, Garching, Germany, 12. Nov.; LMU, Munich, Germany, 12. May; MPI für Chemie, Mayn, Germany, 12. July; Universität Wien, Vienna, 12. May; Paul Scherrer Institut, Switzerland, 12. May; DLR, Berlin, Germany, 12. Apr.; NYU, NY, USA, 12. Feb.

Sarah Kendrew: SPIE conference on Astronomical Telescopes and Instrumentation Amsterdam, The Netherlands, 1.–6. July (Invited Women in Optics, Lecture); University of Cardiff, 5. Dec. (Colloquium)

Hubert Klahr: "Role and nature of turbulence in planet formation", "New Horizons in Computational Astrophysics", AstroSim, Davos, Switzerland, 29. Jan.–3. Feb. (Lecture); "Numerical Simulations in Planetesimal Formation", NIC Zeuthen, April (Colloquium); "Role and nature of turbulence in planet formation", University of Duisburg, May (Colloquium); "Football & Planet Formation", MPIA Heidelberg, Germany, June (Colloquium); "Role and nature of turbulence in planet formation", MPI for Biophysical Chemistry, Göttingen, Germany (Colloquium); "Disk Weather: Baroclinic Instability and Vortex Amplification – From physical conditions in disks to 3D global radiation hydro simulations", "Instabilities and Structures in Proto-Planetary disks", INSU, Marseille, France, 17.–20. Sep. (Lecture); "The Fluid Dynamics of Planets and Stars", AGU Session, "Vortex Amplification in Baroclinic Disks with thermal relaxation", San Francisco, USA, 3.–7. Dec. (Lecture); "Disk Weather: various instability lead to vortices in circumstellar disks" AGU Session, "P21B. Nonlinear Processes in Exoplanet Atmospheres and Protoplanetary Disks I Posters", San Francisco, 3.–7. Dec. (Lecture)

Martin Kürster: Hauskolloquium MPIA (Colloquium)

Girish Kulkarni: Informal seminar, Paris Observatory, Paris, France; 24. May

Dietrich Lemke: "Von einem Altonaer, der auszog, die Erde zu vermessen", Arbeitskreis Astronomie-Geschichte in der Astronomischen Gesellschaft Hamburg, Germany, 24. Sep. (Lecture)

Huabai Li: "SpS4 – New era for studying interstellar and intergalactic magnetic fields", XXVIIIth IAU General Assembly, Peking, China, 20.–31. Aug.; "Magnetic fields in different phases of the ISM", Splinter Session in "The Bright and the Dark Sides of the Universe", AG Annual Meeting, Hamburg, Germany, 24.–28. Sep.

Andrea Macciò: "Dark attack 2012", Ascona, Switzerland, 16.-22. July (Review-Lecture); "Particles and the Universe", TR33 – Summer Institute, European Institute for Science and Their Applications (EISA), Corfu, Greece, 16.–22. Sep. (Review-Lecture); ITPh – Saclay, Paris, France, Apr. (Colloquium); IAP – Potsdam, Oct. (Colloquium)

Luigi Mancini: "Review: Detection and characterization of extrasolar planets", University of Sannio, Benevento, Italy, 5. June (Colloquium)

Nicholas Martin: "Dynamics meets Kinematic Tracers", Ringberg Castle, Germany, 10.–14. June (Lecture); "The Great Andromeda Galaxy", Workshop, Princeton, USA, 18.–20. June (Lecture); Center for Cosmology and Particle Physics, New York University, New York (USA), 21. June (Colloquium); School of Physics & Astronomy, University of Nottingham, Nottingham, UK, 20. Aug. (Colloquium)

Sharon E. Meidt: "How dynamical environment regulates the structure of the molecular gas and star formation in M 51", Instituto de Astrofisica de Canarias (IAC), Tenerife, Canary Islands, Spain, 4. Dec. (Colloquium)

Klaus Meisenheimer: "VLT Interferometry of dusty tori in AGN", Institute for Astronomy, Edinburgh, UK, 8. Feb. (Colloquium)

Christoph Mordasini: "Science with a Wide-field Infrared Telescope in Space", The 16th International Conference on Gravitational Microlensing, Pasadena, USA, 15. Feb. (Lecture); "Characterizing & Modeling Extrasolar Planetary Atmospheres – Theory & Observation", MPIA Summer Conference 2012, MPIA Heidelberg, Germany, 17. July (Lecture); "GAIA and Exoplanets: GREAT Synergies on the Horizon", GREAT-ESF Workshop, Torino, Italy, 6. Nov. (Lecture); Institute for advanced study IAS, Princeton, USA, 9. Feb. (Invited Colloquia); Jet propulsion laboratory JPL, Pasadena, USA, 16. Feb. (Colloquium); A. Pannekoek Institute API.Amsterdam, the The Netherlands, 15. June (Colloquium); Institut de Planétologie et d'Astrophysique de Grenoble IPAG, Grenoble, France, 22. June (Colloquium); Eidgenössische Technische Hochschule ETH, Zürich, Switzerland, 27. Nov. (Colloquium); International space science institute ISSI, Bern, Switzerland, 4. Dec. (Colloquium)

Christoph Olczak: Department of Astronomy & Astrophysics, Pontificia Universidad Catolica de Chile, Santiago de Chile, Chile, 13. Aug. (Colloquium); ESO Vitacura Office, Santiago de Chile, Chile, 14. Aug. (Colloquium)

Sarah Ragan: Universitäts-Sternwarte München, Munich, Germany, 23. May (Colloquium)

Hans-Walter Rix: Strasbourg Observatory, 9. Mar. (Colloquium); "Dynamics meets Kinematic Tracers", Ringberg Castle, Germany, 10.–14. Apr. (Lecture); EUCLID Mission Conference 2012", University of Copenhagen, Kopenhagen, Dänemark, 15.–16. Mar.; "Stars without Borders: Radial Migration in Spiral Galaxies", Workshop, Medana, Slovenia, 21.–24. May (Lecture); "Galaxies: Insight Out", Leiden University, Leiden, The Netherlands, 2.–5. July (Lecture); "Astro Imaging Workshop", Valchava, Switzerland, 15.–17. Aug. (Lecture); PHAT collaboration Meeting, Washington, USA, 5.–9. Sep. (Colloquium)

Karin Sandstrom: "The Great Andromeda Galaxy", Workshop, Princeton, USA, 18.–20. June (Lecture)

Eva Schinnerer: "Molecular Gas and Star Formation in a Spiral Galaxy as Revealed by PAWS", NRAO Charlottesville, USA, 26. Jan. (Colloquium); UK-Germany National Astronomy Meeting, NAM2012, Manchester, UK, 27.–30.

Mar. (Lecture); "A Cloud-Scale View on Molecular Gas and Star Formation in a Grand-Design Spiral Galaxy", Socorro Colloquium Series, NRAO, Socorro, USA, 25. May (Colloquium); "The Physics of Star Formation and its Role in Galaxy Evolution" Workshop, Trieste, Italy, 16.–18. Oct. (Lecture)

Dmitry A. Semenov: "Cosmic Physics", 41th winter school, Yekaterinburg, Russia, 28. Jan.–5. Feb. (Lecture); Colloquium at LERMA, Paris, France, 21. Oct.

Jürgen Steinacker: Helsinki University, Faculty of Science, Department of Physics Helsinki, Finland, 29. Nov. (Colloquium)

Greg Stinson: "Gas Flows in Galaxies", STSci May Symposium, Baltimore, USA, 7.–10. May (Lecture)

Amelia Stutz: IAA Granada, Spain, 14. Nov. (Lecture)

Glenn van de Ven: "Correlation Between Black Hole Masses and Bulge Luminosities Not Fundamental", Astrophysics Informal Seminar, Institute for Advanced Study (IAS), Princeton, USA, 21. June (Lecture); "A Mixed Origin of the Milky Way's Thick Disk", Galaxies Discussion Group, Institute for Astronomy (IoA), Cambridge, UK, 14. Sep. (Colloquium); Leiden Observatory, Leiden, The Netherlands, 18. Oct. (Colloquium); "Dynamics meets Kinematic Tracers", Ringberg Castle, Germany, 10.–14. Apr. (Review-Lecture); "Stars without Borders: Radial Migration in Spiral Galaxies", Workshop, Medana, Slovenia, 21.–24. May (Lecture); "3rd CALIFA Busy Week", Haus der Astronomie Heidelberg, Germany, 11.–15. June (Lecture); "The Great Andromeda Galaxy", Workshop, Princeton, USA, 18.–20. June; "4th CALIFA Busy Week", Granada, Spain, 20.–23. Nov. (Lecture)

Bram Venemans: Growing-up at high redshift: from proto-clusters to galaxy clusters, ESAC, Madrid, Spain, 10.–13. Sep. (Lecture)

Fabian Walter: "Galactic Scale Star Formation – Observation meets Theory", Institute of Psychology, Heidelberg, Germany, 30. July–3. Aug. (Lecture); "New Trends in Radio Astronomy in the ALMA Era", The 30th Anniversary of Nobeyama Radio Observatory, Hakone, Japan, 3.–8. Dec. (Lecture)

Svitlana Zhukovska: Workshop Silicon in Space, Villa Vigoni, Italy, 17. May (Lecture); MEGA-SAGE meeting #5, Tokyo University, Tokyo, Japan, 25. May (Lecture), ITA Colloquium, Heidelberg University, Heidelberg, Germany, 29. Nov. (Colloquium)

Talk Series

Wolfgang Brandner: Exoplaneten (teacher training), Sternwarte Sonneberg, Germany, 16.–17. Sep. (Lecture)

Lisa Kaltenegger: Hamburger Sternwarte, "Extrasolar planet search & characterization, 12. Apr. (four Lectures); Klaus Tschira Stiftung, Heidelberg, 10. and 24. Aug. (Lecture)

Popular Talks

Wolfgang Brandner: "Exoplaneten: die Suche nach Planeten um andere Sterne", "Tag der Astronomie", Haus der Astronomie, Heidelberg, Germany, 24. Mar.; "Fremde Planetensysteme: wie moderne Teleskope uns Blicke auf andere Welten ermöglichen" (Astronomie am Sonntag Vormittag), Haus der Astronomie, Heidelberg, Germany, 8. July; "Auf der Suche nach Planeten um andere Sterne" (teacher training), Haus der Astronomie, Heidelberg, Germany, 23. Sep.; "The Search for Earth-like planets (Der Südafrikanische Himmel über Germany)", Haus der Astronomie, Heidelberg, Germany, 18. Oct.

Christian Fendt: "Kosmische Düsentriebwerke: Jets von jungen Sternen und schwarzen Löchern", "Tag der Astronomie", Haus der Astronomie, Heidelberg, Germany, 24. Mar.

Roland Gredel: "Warum brauchen Astronomen ein Teleskop mit 39 m Durchmesser", anlässlich der Buchvorstellung "(Uni)Versum für Alle", Peterskirche Heidelberg, Germany, 26. Nov.

Thomas Henning: "Vom Kalten Universum zu Heißen Sternen", Planetarium am Insulaner, Berlin, Germany, 9. May; "Astrophysik im Labor – Über Fußballmoleküle, Nanodiamanten und Sternenstaub", Lecturesreihe "Faszination Astronomie", Haus der Astronomie, Heidelberg, Germany, 8. Nov.; "Extrasolare Planeten – Heiße Jupiter, Supererden und Tatooine-Systeme" Volkssternwarte Darmstadt e.V., Darmstadt, Germany, 8. Dec.; "From Protoplanetary Disks to Exoplanets", Hong Kong Space Museum, Tsim Sha Tsui, Hongkong, China, 28. Oct.

Stefan Hippler: "Der scharfe Blick ins Universum: Laser und Adaptive Optik ermöglichen glasklare Sicht ins All", "Tag der Astronomie", Haus der Astronomie, Heidelberg, Germany, 24. Mar.

Klaus Jäger: "Geheimnisvolle Quasare – der Lösung eines Rätsels auf der Spur", "Tag der Astronomie", Haus der Astronomie, Heidelberg, Germany, 24. Mar.; "Die Kartierung des Himmels – 400 Jahre Astronomie mit dem Fernrohr", Mercator-Matinee im Stadtmuseum Duisburg, Germany, 17. June; "Das Unsichtbare sichtbar machen – Highlights aus der Trickkiste astronomischer Beobachtungen", Haus der Astronomie, Heidelberg, Germany, 13. und 14. Sep.; "Wissenschaftliche Aktivitäten des MPIA und seine Verbindungen zur ESO", Festveranstaltung "50 Jahre ESO", Haus der Astronomie, Heidelberg, 5. Oct.; "Galaxien und Terabytes – Optische Astronomie mit modernen Großteleskopen", Schülerpraktikum am MPIA Heidelberg, Germany, 22. Oct.

Knud Jahnke: "Die gigantischen Schwarzen Löcher in den Zentren von Galaxien", Physikalisches Seminar, Hochschule Mannheim, Mannheim, Germany, 12. Jan.; "Durch astronomische Himmelsdurchmusterungen das Weltall verstehen", "Symposium: Signale aus dem jungen Universum, Akademie der Wissenschaften und der Literatur", Mainz, Germany, 3. May; "Das Weltraumteleskop EUCLID und die Suche nach der Dunklen Energie", Astronomie am Sonntag Vormittag, Haus der Astronomie, Heidelberg, Germany, 24. July

Lisa Kaltenegger: "Den Aliens auf der Spur", Children's university 2012, Heidelberg, 12. Apr.; "How to find signs of life in the universe?", German-American Platform, Heidelberg, 12. May; "Characterizing Extrasolar Planets", Heinz Mayer Leibnitz Preis, Lecture, 23. May; Ars Electronica Lecture "Search for other planets" ", Linz, Austria, 12. Sep.; "Search for exoplanets and Life in the universe", Planetarium Münster, 2. Oct.; "Search for other planets", MinD-Akademy, Würzburg, 3. Oct.; "Search for the second Earth", NaWik – Nationales Institut für Wissenschaftskommunikation: Eröffnungsvortrag, 12. Oct.

Dietrich Lemke: "Von Portraitlinsen zu Zerodurspiegeln – 115 Jahre Erforschung des Kosmos mit SCHOTT-Gläsern", Schott Glaswerke Mainz, 22. Mar. (Lecture); "Von der Kurpfalz in den Kosmos – Von der Sternwarte zu Satelliten-Teleskopen", Planetarium Mannheim, 29. Mar. (Lecture); "Die Vermessung der Erde – Der Struve-Meridianbogen als UNESCO-Weltkulturerbe", Sternfreunde Nordenham, Germany, 18. Oct.; "Weltraumastronomie – heute und morgen", Raumfahrt-Colloquium Aachen, Germany, 22. Nov. (Lecture)

Rainer Lenzen: "Ein geschärfter Blick ins All: Die Erfolgsgeschichte der Adaptiven Optik in der Astronomie", Universität Mannheim, Germany, 31. May

Silvia Scheithauer: "Ein Blick ins Infrarote Universum", Sommer-Kinderuniversität Bretten, Rathaus Bretten, Germany, 30. July; "Ein Blick ins Infrarote Universum", Sommer-Kinder-Akademie Bruchsal, Gymnasium Schönborn, Germany, 2. Aug.

Jochen Tackenberg: "Wir Eintagsfliegen – Kosmische Zeitskalen", "Tag der Astronomie", Haus der Astronomie, Heidelberg, Germany, 24. Mar.

Haus der Astronomie

The House of Astronomy (HdA) is a companionship facility of several astronomical institutes: the Max Planck Institute for Astronomy, which is responsible for the content management, as well as the three institutes of the Center for Astronomy of Heidelberg University (Astronomisches Rechen-Institut, Landessternwarte Königstuhl and the Institute of Theoretical Astrophysics).

Managing Scientist: Markus Pössel

Scientists: Natalie Fischer, Olaf Fischer, Carolin Liefke, Alexander Ludwig, Anita Mancino (until June 2012), Tobias Schultz, Cecilia Scorza, Jakob Staude

Student Assistants: Sophia Haude, Sebastian Neu (since Sep. 2012), Valentina Rohnacher (since Sep. 2012), Mariluz Suijkerbuijk Garcìa (May – Dec. 2012)

The House of Astronomy (HdA) is a center for astronomy education and public relations at Königstuhl. It was founded in late 2008 by the Max Planck Society and the Klaus Tschira Foundation. Other partners include the University of Heidelberg (in particular the Centre for Astronomy of Heidelberg University) and the city of Heidelberg. The Klaus Tschira Foundation is developer of the spiral galaxy-shaped building of the House of Astronomy, which opened in December 2011 ceremony. The Max Planck Institute for Astronomy is responsible for the content management of the house.

The HdA carries the fascination of astronomy to the general public and into schools, and promotes exchanges between scientists and the media and the general public. It makes astronomical discoveries understandable and as accessible as possible through simulations and in elementarizing astronomical concepts. In particular, the HdA is a forum for research and the promotion of scientific exchange, conducts educational work in the field of astronomical research (in particular through support of school projects, teacher training and the preparation of current astronomical research for the teaching of science and university education) as well as public relations and Media work in the field of astronomy and astrophysics.

Teaching Activities

Summer Term 2012:

N. Fischer: "Grundlagen der Astronomie für die Schule" (Lecture). Pädagogische Hochschule Heidelberg.

O. Fischer, C. Liefke: "Nobelpreise mit Bezug zu Astronomie und Astrophysik" (Seminar), Universität Heidelberg.

Winter Term 2012 / 2013:

N. Fischer: "Grundlagen der Astronomie für die Schule" (Lecture). Pädagogische Hochschule Heidelberg.

C. Liefke, O. Fischer: "Das Leben der Sterne" (Seminar), Universität Heidelberg.

Service in Committees

Olaf Fischer is Chairman of the Education Commission of the German Astronomical Society.

Cecilia Scorza is German coordinator of the "European Association for Astronomy Education", German Coordinator of EUNAWE program, a member of the IAU Education Commission, a member of the school committee of the Astronomical Society and member of the Office for Astronomy Development (OAD/IAU) as adviser for the section Latin America.

Jakob Staude is co-editor of "Sterne und Weltraum".

The Haus der Astronomie is the German node of the "Eso Science Outreach Network" (C. Liefke, M. Pössel).

Further Activities

Olaf Fischer supervised the development of 14 WIS units for junior high and senior grades as part of the project *Wissenschaft in die Schulen!* (cooperation with Spektrum der Wissenschaft publisher).

Olaf Fischer supervised 5 state examination theses: Stephan Fraß: "Extrasolare Planeten. Grundlagen der Suche und Charakterisierung" (Dec. 2011–June 2012); Florian Rößler: "Die Entdeckung und Untersuchung von Exoplaneten. Modellierung eines Exoplanetentransits" (May–Dec.); Christoph Müller "Lichtverschmutzung" (May–Dec.); Christopher Brinkmann: "Wirkungen von kosmischem Staub auf das Licht von Hintergrundsternen" (ab 9/2012); Anne-Carin Moessinger "Einfache Messanordnungen zur Untersuchung der Sonne" (ab 9/2012).

Cecilia Scorza co-supervised the state examination thesis of Mariluz Suijkerbuijk Garcìa with the title "Die ältesten Sterne der Milchstraße".

Cecilia Scorza developed work material for the Milkyway Box (SFB 881) and for the topic "Max-Wolf und Lichtverschmutzung in Heidelberg".

Alexander Ludwig developed work material for the Mars Box.

Natalie Fischer developed work material for elementary school pupils for the hands-on exhibition "Explore Science" and the "Tag der offenen Tür von HdA und MPIA" (April und July 2012). She was adviser for the astronomy book "*Planeten und Sterne"* of the fact book series for children of Carlsen publishers.

Carolin Liefke co-supervised the mini-research student Henning Oetjen (Mar.-April 2012).

Markus Pössel and Carolin Liefke supervised an internship (19.–30. Mar.), Liefke another internship (13.–17. Aug.), Pössel a school pupil internship (19. July–9. Aug.), a research internship (16. July–14. Sep.) ans two trainees of the *International Summer School Heidelberg* (23. July–9. Aug.).

Alexander Ludwig supervised a school pupil internship (1.–29. June).

Carolin Liefke supervised three pupils on a project for observing exoplanet transits as part of the cooperation phase of the Hector Seminar and two term paper on spectroscopy and asteroids.

Carolin Liefke supervised 8 and 11 participating German schools at the asteroid search campaigns with the Pan-STARRS-telescope PS1 (15. Mar.–20. Apr. and 12. Nov–17. Dec.)

Cecilia Scorza writes the monthly sky preview for the “Rhein-Neckar-Zeitung”.

Conferences, Scientific, and Popular Talks

HdA-Events and cooperation events at the HdA

48. Heidelberger Bildverarbeitungsforum, “Bildgewinnung und -verarbeitung quer durch das elektromagnetische Spektrum” (scientific organisation: B. Jähne [IWR]), 6. Mar.)

Lecture series *Faszination Astronomie*, 17 lectures, starting March 8 (organisation: C. Liefke)

Astronomy Day at Haus der Astronomie, 24. Mar. (M. Pössel, C. Liefke)

Compulsory units for the lecture series *Faszination Astronomie*, 3.May–11. Dec. (U. Herbstmeier)

“Disk Galaxy Formation in a Cosmological Context” (workshop with SFB 881 support; Organisatoren: A. Macciò [MPIA] und V. Springel [HITS]), 14.–18. May

“Europlanet Forum 2012” (organisation: E. Khalisi [MPIK]), 21.–22. May.

Author's meeting *Wissenschaft in die Schulen! (Astronomy)*, 15.–17. June (O. Fischer)

ASTRA-Workshop “The Milky Way: Stars, Gas, Dust and Magnetic Fields in 3D”, 18.–20. June (organisation: C. Bailer-Jones [MPIA] et al.)

Joint Lecture Series *Astronomie am Sonntag Vormittag* with MPIA and *Sterne und Weltraum*, 4 lectures, 24. June–15. July (co-organisation: M. Pössel)

“.Astronomy 4: Astronomy and New Media”, 9.–11. July (local organisors: S. Kendrew [MPIA], T. Robitaille [MPIA], M. Pössel)

“Characterizing & Modeling Extrasolar Planetary Atmospheres – MPIA Summer Conference”, 16.–19. July (organisation: L. Kaltenegger [MPIA], Th. Henning [MPIA] et al.)

“Astronomie auf dem Königstuhl” – Open house day of the MPIA and the HdA, 22. July (organisation: Jäger, Pössel, Quetz, Voss, Witzel, Wolf, Meidt and many others)

Anniversary event “50 Jahre Europäische Südsternwarte”, 5. Oct. (C. Liefke, M. Pössel)

Workshop Weekend of the German Young Researcher's Network juFORUM e.V. and the “Vereinigung für Jugendarbeit in der Astronomie VEGA e.V.” (local organisation: S. Haude), 5.–7. Oct.

Event “Der Südafrikanische Himmel über Germany” with 23 Southafrican guests, 15.–20. Oct. (organisation: C. Scorza)

MPIA pupils internship, 22.–26. Oct. (organisation: K. Meisenheimer [MPIA] et al.)

Advanced education for the “Haus der kleinen Forscher”, 24. Oct. (N. Fischer, C. Scorza)

61 workshops for elementary school and kindergarten with a total of 1286 children (N. Fischer, C. Scorza, E. Sellentin)

2 advanced education units for elementary school with a total of 37 teachers (N. Fischer)

3 advanced education units for kindergarten with a total of 36 educators (N. Fischer)

35 workshops for secondary education with a total of 791 teachers (C. Scorza, O. Fischer, T. Schultz, A. Ludwig)

4 advanced education units for secondary education with a total of 165 teachers (O. Fischer, C. Scorza)

84 guided tours by HdA staff and 41 Königstuhl guided tours by students of MPIA and LSW with a total of 4000 participants.

Reviews of / participation in external events

Advanced education kindergarten “Sonne, Mond und Sterne” as ten-part course during two semesters in cooperation with the “Forscherstation Heidelberg” (N. Fischer), 10. Jan.–27. Nov.

Courses “Wir entdecken den Sternenhimmel” with ten dates each for higher gifted elementary school pupils in cooperation with the Hector-Kinderakademie (N. Fischer), 12. Jan.–13. Dec.

Advanced education for teachers (NWT) of the Regierungspräsidium Stuttgart at the Raumfahrt-Zentrum Baden-Württemberg, Stuttgart, 26. Jan. (O. Fischer, Cecilia Scorza)

Advanced education for teachers at the Landesinstitut für Pädagogik und Medien (Saarland) in Saarbrücken-Dudweiler, subjects: “Das Sonnensystem im Klassenraum”, 3 lectures and workshop, 15. Feb. (O. Fischer)

MINT night at the Lessing-Gymnasium Lampertheim, 1. Mar. (C. Liefke, M. Pössel)

Teacher's information days at the Technoseum Mannheim 14.–15. Mar. (O.Fischer, Cecilia Scorza, Tobias Schultz)

Expert consultation-hour for children, Junges Theater im Zwinger[3] (Heidelberg) at the stage play "Sput & Nik", 22. Mar. (N. Fischer)

Mobile advanced education for teachers of the Reiff-Stiftung zur Förderung der Amateur- und Schulastronomie in Saxony: Leipzig, Dresden, Löbau, 29. Mar. –6.4 (O. Fischer, T. Schultz)

Student's days 2012 of Heidelberg University, 10.–13. Apr. (C. Liefke)

Long Night of the Museums at the Planetarium Mannheim, 21. Apr. (M. Pössel, C. Liefke)

Girls' Day at MPIA, 26. Apr. (M. Pössel, C. Liefke)

EU-UNAWE hands-on station for families, Open Days of the European Commission, Brussels, Belgium, 12. May (N. Fischer)

Course "Astronomie: Asteroiden – Gefahren aus dem All", Science Academy Baden-Württemberg, Adelsheim, 15.–17. June, 28. Aug.–6. Sep., 19.–21. Oct. (C. Liefke).

Experimentation stations "In die Raketen – fertig – los. Mathematik rund um unser Sonnensystem" for elementary school pupils (cooperation with Astronomieschule e.V.), "Mit Geometrie in die Tiefen des Alls: Astronomische Entfernungsbestimmung" and "Geometrie im Fernrohr – wie kommt das Licht im Teleskop an die richtige Stelle?" for advanced schools at *Explore Science* of the Klaus Tschira Foundation, Mannheim, 20.–24. June (N. Fischer [organisation], O. Fischer, C. Liefke, A. Ludwig, M. Pössel [organisation], T. Schultz)

Astronomy course at the Deutsche SchülerAkademie: "Nächster Halt: Mars. Auf der Suche nach Leben im Universum" 28. June–4. July (O. Fischer)

"Public Outreach in der Astronomie", meeting at the annual meeting of the AG, Hamburg, 26. Sep. (co-organisation: M. Pössel with Klaus Jäger [MPIA])

German-wide astronomical teacher advanced education in Jena: Workshop zum Thema "Exoplaneten und Lebenszonen" 24. July (O. Fischer, C. Scorza)

Holiday program (workshops in cooperation with the Astronomieschule e.V.) with 131 children, 5 dates during 27. July–9. Aug. (N. Fischer)

Astronomy fair AME, Villingen-Schwenningen, 8. Sep. (C. Liefke)

Bergsträßer Weltraumtage, Seeheim-Jugenheim, 12. Sep. (C. Liefke)

Advanced education for teachers in Sonneberg on the topic "Die Welt wird größer – Planeten bei anderen Sternen", 15.–17. Sep. (O. Fischer)

Hands-on exhibition for children at the information event Internationale Bauausstellung (IBA), Heidelberg, 4. Oct. (T. Schultz, N. Fischer, A. Ludwig)

Central advanced education for teachers in astronomy (telescope licence), Adelsheim, 10.–12. Oct. (O. Fischer, C. Liefke)

Event for children "Der Südafrikanische Himmel über Heidelberg", opening event on the German Southafrican Scientific Year 2012 at the HdA, 19. Oct. (C. Scorza, N. Fischer)

Book presentation "Universum für Alle", Peterskirche, 26. Nov. (C.Liefke)

Talks

Olaf Fischer: "Das WIS-Projekt mit dem praktischen Beispiel IR-Koffer" in the context of "Der südafrikanische Himmel über Germany", HdA, 16. Oct.; "Infrarotastronomie auch für die Schule", advanced education for teachers, AG, Hamburg-Bergedorf, 28. Sep.; "Wir suchen E.T. – den Außerirdischen", Kinderakademie Gera, 19. Sep.; "Infrarotstrahlung im Himmel und auf Erden", lecture with experiments at the exhibition "125 Jahre Physikalisch-Technische Reichsanstalt", Weida (Thuringia), 19. Sep.

Natalie Fischer: "Resources and Delivery" (with C. Scorza), EU Universe Awareness Workshop "Astronomy to Inspire and Educate Young Children", Leiden, The Netherlands, 26.–30. Mar.; "Astronomie im Kindergarten" (with G. Thimm [ZAH]), celebration event Haus der Kleinen Forscher, Stuttgart, 13. Nov.

Carolin Liefke: "Sternentstehung im Orion", Sternwarte Heilbronn, 13. Jan.; "Auf Schatzsuche am Wintersternhimmel" (for children), Starkenburg-Sternwarte Heppenheim, 2. Mar.; "Spacys Reise durch das Sonnensystem" (for children), Starkenburg-Sternwarte Heppenheim, 30. Mar.; "Frühlingshaftes am Sternhimmel", Starkenburg-Sternwarte Heppenheim, 27. Apr.; "High school students searching for asteroids", Europlanet meeting, 21. May; "Spacys Reise über die Milchstraße", Starkenburg-Sternwarte Heppenheim, 1. June; "Sommerabenteuer am Sternhimmel", Starkenburg-Sternwarte Heppenheim, 29. June; "Asteroid search and follow-up observations at German schools", Global Hands-On Universe 2012, Ifrane (Marokko), 9.7.; "High school students searching for asteroids", advanced education for teachers in the context of "Der südafrikanische Himmel über Germany", HdA, 17. Oct.; "50 Highlights aus 50 Jahren – die Europäische Südsternwarte", HdA, 30. Oct.

Markus Pössel: "Schwarze Löcher für Anfänger und Fortgeschrittene", Volkssternwarte Schriesheim, 2. Mar. und Planetarium am Insulaner, Berlin, 5. Sep.; "Das Haus der Astronomie", 1. meeting of the Gesellschaft Deutschsprachiger Planetarien, Wolfsburg, 5. May; "Eine Reise durch das beobachtbare Universum", HdA, 1. July; "Uniview: The Newbie's View", Uniview user meeting, Bochum, 18. Sep.; "Was ist eigentlich ein Schwarzes Loch?", Starkenburg-Sternwarte Heppenheim, 27. Nov.; Weihnachtsvorträge "Reise durchs Universum" for children, HdA, 19. Dec. and 21. Dec.

Cecilia Scorza: "Resources and Delivery", EU Universe Awareness Workshop "Astronomy to Inspire and Educate Young Children" (with N. Fischer), "Cultural aspects of EU-UNAWE", "EU-UNAWE-Resources and Ages", "EU-UNAWE-Materials", Leiden, The Netherlands, 26.–30. Mar.; "Astronomy as a Motor of Education, Cultural and Social integration", Astronomy Symposium for the Opening of the German-South African Year of Science, Kapstadt, 17. Apr.; "Kompetenzen in der Astronomie", WIS-Autorentreffen, HdA, 16. June; "Education for Development Under the Skies of Chile", SpS11 auf der IAU General Assembly, Beijing, 27. Aug.; "EU-UNAWE-Evaluation", EU-UNAWE consortium meeting, Firenze, 11. Oct.; lecture on the EU-UNAWE program in the context of the Astronomy Olympiad in Bogotà, Colombia, 26. Oct.; "The IAU Strategic Plan", "EU-UNAWE" and "The IAU Strategic Plan for Latin America", astronomy meeting CoCoA, Bucaramanga, Colombia, 3., 4. und 7. Nov.

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Fischer, Olaf: Dokumentation zum Astronomiekurs "Auf der Suche nach Leben im Universum" bei der Sommerakademie Rostock der Deutschen SchülerAkademie (gemeinsam mit Kathrin Blumenstein und 16 Kursteilnehmern)

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