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1. Introduction

The core strength of the university system is the close interconnection between research and education. At a university, unlike a school, you are taught by researchers active in their fields. Studying at a university always means to some extent participating in the research that is being performed at that university. Being on the scientific staff of a university, you realize that research and teaching are similarly essential to science: scientific progress requires a constant stream of new insights, as well as new people.; in the end only you can ensure that your science is passed on to the next generation. This description of the university system is often associated with Von Humboldt, and the Universiteit van Amsterdam, as a proud member of the League of European Research Universities, subscribes to this view of the university.

PhD education is a central component in this system of scientific research and education. Ideally, PhD students and their advisors work together in a master-apprentice relation that ensures the transfer of not just knowledge and skills, but of the scientific stance, where truth prevails over gain, an attitude that does not come natural to humans, and that is difficult to teach in any other way than this very personal one. One could say that the Humboldtian university is an ideal that in practice is not fully attained, and has become harder to attain with the growth of the universities over the last several decennia, and the emphasis on gain at the expense of truth characterizing our epoch, but certainly at API this ideal is being pursued quite vigorously.

This year API celebrated the granting of the 100th PhD degree in astronomy since it was founded in 1921 (five PhDs were granted in 2008). The celebration in the Aula of the university was attended by many of API's alumni and featured a display of all (by then 103) API theses - these are now all available online at www.dare.uva.nl. There was a big response of the alumni to API's invitation to participate, in whatever form, in this celebration and we intend to take the opportunity to maintain somewhat closer ties to this group in the future.

Another event celebrated at API this year was the 10th anniversary of the discovery, at API, of the accreting millisecond X-ray pulsars. More than ten of these long-elusive objects are known now, and surprises abound. The anniversary was marked with an international workshop on the topic which was well-attended and involved an in certain areas exceptionally fruitful clash of ideas.

Activities in the areas of research and instrumentation continued this year as documented in this report. In an amazing brief whisper from the early days of the universe, light that had traveled for more than eight billion years flared up for 40 seconds as a star visible to the naked eye on March 19th. This was accompanied by a flash of gamma rays measured from satellites orbiting the Earth, so the event was a gamma ray burst. That light from that far away can be bright enough to see without telescope illustrates the big potential that these flashes of radiation (thought to be emitted when a star collapses to form a black hole) have for cosmology and study of the early universe. A big milestone was successfully passed by the SPHERE/ZIMPOL instrument project when it passed Final Design Review in December. The project aims to detect exoplanets and to provide high-contrast images of protoplanetary disks by exploiting the polarization characteristics of these objects at the European Southern Observatory Very Large Telescope in Chile.

API scientists organized the yearly Viva Fysica event this year, which was a very successful event with over a hundred highschool teachers and pupils attending. The theme this year, "The Quantum Universe" and the Physics Fair visibly captivated the participants.

Professor Rens Waters attained membership of the Royal Academy of Arts and Sciences (KNAW). This is a rare honour; just a handful of all active astronomy professors in the Netherlands are represented in our national Academy.
2. Scientific Report


2.1. High Energy Astrophysics

2.1.1 Low-mass X-ray binaries

Altamirano, van der Klis, Wijnands and Cumming (McGill) in a study of the marginally stable nuclear-burning generated millihertz oscillations of neutron star low mass X-ray binaries discovered an up to now unknown systematic pattern of behavior in these oscillations and their relation to X-ray bursts. In a pattern repeating over and over, first a systematic frequency drift takes place in the oscillation, and then, within a few kiloseconds after the frequency drops below 9 mHz, a thermonuclear burst occurs (figure 1). This strongly suggests that the build up of nuclear fuel on the neutron star surface leads to physical changes in the pre-burst layers that are diagnosed by the millihertz oscillations. It is for the first time that such a systematic effect 'predicting' the occurrence of an X-ray burst has been found.

![Dynamical power spectrum](image)

*Figure 1: Dynamical power spectrum showing the mHz oscillations observed in the neutron star low-mass X-ray binary 4U 1636-53 during the last 12 kiloseconds before an X-ray burst occurred. The three black vertical lines correspond to the times of the occurrence of X-ray bursts. Clearly, the frequency of the mHz oscillations was decreasing before the burst occurred.*

An international team led by Cackett (U. Michigan) including Van der Klis and Wijnands using the Japanese Suzaku satellite found broad asymmetric X-ray iron lines in three neutron star low mass X-ray binaries. Applying techniques commonly used for similar lines in black holes they find values for the inner
radius of the accretion disk in agreement with expectations and supporting a similar inner disk origin and similar formation mechanisms for such spectral features in neutron stars and black holes. In addition, the Fe K lines observed in these neutron stars are narrower than those in the black holes that are thought to be close to maximally spinning, as one would expect if inferences for spin are robust. The same team also used Chandra gratings spectra obtained from one of these systems to better understand the nature of certain X-ray absorption lines in X-ray binaries. They concluded that both the ISM and local absorption remain possible for the origin of the lines.

Klein-Wolt and van der Klis published a big study about the relations between black hole and neutron star broad band variability power spectra based on a homogeneous analysis of 8.5 Megaseconds of Rossi X-Ray Timing Explorer (RXTE) data. The similarities between the neutron star and the black hole systems are found to be strong, which is in line with the expected similar accretion flow patterns around these similarly-sized compact objects, but important differences are also revealed: black holes have more power at low frequency and less at high frequency than neutron stars, and have lower maximal frequencies in their variability. These findings are in general accordance with the scenario that, in addition to similar accretion flow patterns around neutron stars and black holes producing the observed similar variability components, the characteristic frequencies of the variability scale inversely with mass (as expected for the general relativistic orbital and epicyclic frequencies) and the modulation strengths are affected by the presence or absence of a material surface to provide a one-to-one conversion between accretion flow modulation and X-ray flux modulation.

Altimirano, van der Klis, Wijnands and collaborators studied the rapid X-ray time variability in RXTE data of the low-mass X-ray binary 1E 1724-3045, including, for the first time, observations of this source in its so-called island and banana states, confirming the atoll nature of this source. They reported the discovery of kilohertz quasi-periodic oscillations (kHz QPOs). They found that Terzan 2 in its different states shows timing behavior similar to that seen in other neutron-star low-mass X-ray binaries. They also studied the flux transitions observed between 2004 February and 2005 October and concluded that they are due to changes in the accretion rate.

Maitra & Bailyn (Yale) presented simultaneous optical and near-IR observations of the major outbursts of the famous neutron star binary system Aquila X-1 from almost a decade of coverage from summer 1998 - fall 2007. Their data suggests that within the same source, fundamentally different accretion modes are present. In addition, the observed time evolution of the measured fluxes is compatible with thermal heating of the irradiated outer accretion disk. No signature of X-ray spectral state changes or any compact jet are seen, showing that the optical/near-IR color-magnitude diagram can be used as a diagnostic tool to separate thermal and non-thermal radiation from X-ray binaries.

Soleri, Belloni (INAF) and Casella presented the results of the timing analysis of five RXTE observations of the black hole candidate GRS 1915+105 between 1996 September and 1997 December to study the quasi-periodic oscillations in this source. For the first time they detected a so-called type B quasi-periodic oscillation in GRS 1915+105. Since in other systems this phenomenon has been found to appear during spectral transitions from hard to soft states and these spectral transitions have been associated to the emission and collimation of relativistic radio-jets, their presence in the prototypical Galactic jet source strengthens this association.

Tudose, van der Klis and collaborators presented observations of the neutron star X-ray binary and relativistic jet source Circinus X-1 made at 4.8 and 8.6 GHz with the Australia Telescope Compact Array during a time interval of almost 10 years. The system shows significant variations in the morphology and brightness of the radio features on all time-scales from days to years. Using the time delay between the successive brightening of the different components of the radio emission they were able to provide further evidence for the relativistic nature of the arcsec-scale outflow.

Russell and Fender, using the ESO Very Large Telescope and the UK Infrared Telescope discovered intrinsic polarization in the infrared emission from two X-ray binaries: the brightest X-ray source in the sky, the neutron star system Scorpius X-1, and, for the first time, from the black hole system GRO J1655-40. This is interpreted as optically thin synchrotron emission from the collimated relativistic jets in these systems indicating the existence of a partially ordered magnetic field present in the inner regions of the jets, providing further clues to the mechanism leading to the very high (near light speed) bulk velocities in these jets.
2.1.2 Accreting millisecond pulsars

This year marked the tenth anniversary of the discovery of the accreting millisecond pulsars. Studies of the first known accreting millisecond pulsar SAX J1808.4-3658 (Wijnands and van der Klis 1998) continued apace, with various new contributions by Anton Pannekoek Institute and other teams on this prototype system. The total number of scientific works referring to this object by the end of 2008 ran to 420. A successful international workshop, attended by the experts in the field was held at the Institute to mark this anniversary and discuss the exciting new developments in the field. Eleven accreting millisecond pulsars are now known, and the very recent discovery of the intermittent pulsations as well as the relations between accretion and nuclear-burning driven pulsations, both discussed further below, led to very lively debate indeed.

Altamirano and Casella, with Patruno, Wijnands and van der Klis obtained several exciting new results in a systematic search for intermittent X-ray periodicities and quasi-periodicities covering more than ten years of observations of X-ray binaries with RXTE. They found a number of intermittent pulsation episodes of the accreting millisecond pulsar SAX J1748.9-2021 in the globular cluster NGC 6440. This allowed for the first time to measure the orbit of this object (figure 2). A very surprising discovery was that of 550 Hz pulsations from the long-known neutron star X-ray transient Aquila X-1. These were found in the form of one single 150-second interval of pulsations lurking among 500 000 seconds of data where no pulsations could be found. The mechanism allowing this neutron star to show coherent pulsations so briefly and so sporadically is a mystery at this stage, proposals even extend to the one-off capture by the neutron star of an asteroid.

Figure 2: Dynamical power spectrum of SAX J1748.9-2021 showing intermittent pulsations (contours). In the light curve (line) three X-ray bursts are seen. The pulse frequency drifts due to orbital Doppler modulation.
Hartman and collaborators (including, Patruno, van der Klis and Wijnands) presented a 7 yr timing study of the 2.5 ms X-ray pulsar SAX J1808.4-3658 covering four transient outbursts. Analysis of the systematic pulse shape changes suggests that, as an outburst dims, the X-ray “hot spot” on the pulsar surface drifts longitudinally and a second hot spot may appear. The overall pulse shape variability limits the ability to measure spin frequency evolution within a given X-ray outburst (and calls previous spin period derivatives measurements of this source into question). However, combining data from all the outbursts shows that the pulsar is undergoing long-term spin down, with most of the spin evolution occurring during X-ray quiescence. They also measured a surprisingly large orbital period derivative which is reminiscent of what has been observed in the so-called black widow millisecond radio pulsars, which further strengthens previous speculation that SAX J1808.4-3658 may turn on as a radio pulsar during quiescence.

Watts, Patruno and van der Klis, triggered by discussions at the Amsterdam international workshop undertook a study of the phase relation between the accretion-driven and the nuclear burning-driven pulsations in the accreting millisecond pulsar XTE J1814-338. Surprisingly it turned out that the nuclear pulsations track the phase fluctuations of the accretion pulsations strictly, indicating that it is not the magnetic field of the neutron star but some action of the accretion flow itself that determines the location where on the neutron star surface the nuclear burning emission is enhanced. A scenario involving premature nuclear ignition at the accretion column impact point, due to higher local temperatures there, coupled to nuclear burning-front stalling, currently seems to provide the best explanation for this unexpected result.

Linares, Wijnands, van der Klis and co-workers reported on the analysis of the aperiodic rapid X-ray variability of the accreting millisecond pulsar Swift J1756.9-2508. They detected strong flat-topped broadband noise throughout the outburst with low characteristic frequencies (around 0.1 Hz). This makes this source similar to the rest of accreting millisecond pulsars and to other low-luminosity accreting neutron stars when they are in their hard states. They also detected a hard tail in its energy spectrum extending up to 100 keV, fully consistent with such source and state classification.

In quasi-persistent neutron star transients, long outbursts cause the neutron star crust to be heated out of thermal equilibrium with the rest of the star. During quiescence, the crust then cools back down. Such crustal cooling has been observed (as first reported in 2001 by Wijnands and collaborators) in two quasi-persistent sources: KS 1731-260 and MXB 1659-29. Cackett, Wijnands, Degenaar and collaborators presented an additional Chandra observation of MXB 1659-29 in quiescence, which extends the baseline of monitoring to 6.6 yr after the end of the outburst. This new observation strongly suggests that the crust has thermally relaxed, with the temperature remaining constant over 1000 days.

### 2.1.3 High-mass X-ray binaries

Gies, Kaper and collaborators obtained ultraviolet spectra of the massive X-ray and black hole binary system, Cyg X-1 with the Hubble Space Telescope. The spectra were obtained at both orbital conjunction phases in 2002 and 2003, when the system was in the X-ray high/soft state. The UV stellar wind lines suffer large reductions in absorption strength when the black hole is in the foreground due to the X-ray ionization of the wind ions. They constructed model UV wind line profiles assuming that X-ray ionization occurs everywhere in the wind except the zone where the supergiant blocks the X-ray flux. The good match between the observed and model profiles indicates that the wind ionization extends to near the hemisphere of the supergiant facing the X-ray source. Their results also suggested that mass transfer in Cyg X-1 is dominated by the focused wind flow that peaks along the axis joining the stars, and that the stellar wind contribution from the remainder of the hemisphere facing the X-ray source is shut down by X-ray photoionization effects (in both X-ray states).
2.1.4 Radio pulsars

The UvA/ASTRON Pulsar Group was involved in several large pulsar surveys. In a survey with the Arecibo telescope, the PALFA collaboration (including Van Leeuwen and Hessels) found PSR J1903+0327, a radio pulsar with a rotational period of 2.15 ms in a highly eccentric (e = 0.44) 95-day orbit around a solar mass companion. Infrared observations identify a possible main-sequence companion star. Conventional binary stellar evolution models predict neither large orbital eccentricities nor main-sequence companions around millisecond pulsars, and cannot explain the system that is observed. Alternative formation scenarios involve recycling a neutron star in a globular cluster and then ejecting it into the Galactic disk or membership in a hierarchical triple system. A relativistic analysis of timing observations of the pulsar finds its mass to be 1.74+/-0.04 solar masses, an unusually high value. From the same survey Hessels and collaborators presented the discovery of the young, energetic radio pulsar J1856+0245. This pulsar plausibly explains the nature of the previously unidentified TeV gamma-ray source HESS J1857+026. As such, it is likely the central engine for a rare and only recently identified type of high-energy Galactic objects, namely TeV emitting pulsar wind nebulae.

At Westerbork, the 8GR8 survey and follow-up studies continue at full pace: Janssen and collaborators determined neutron-star masses and binary inclinations, while Serylak and colleagues presented multifrequency studies of radio emitting magnetar AXP XTE J1810-197 and Karupussamy et al. used WSRT/PuMa-II to observe low magnetic field pulsars that exhibit giant pulses.

2.1.5 Magnetars

Rea and an international team of co-workers used X-ray and gamma-ray data from ESA’s XMM-Newton and Integral satellites to study the physical processes that make magnetars emit X-rays. Magnetars form a class of neutron stars with ultra-strong magnetic fields. They differ from ordinary neutron stars (whose magnetic fields are a thousand times weaker) because their magnetic field is strong enough to twist the stellar crust and produce hot plasma that fills the magnetosphere. The spectral analyses of Rea et al. of ten of these magnetars show that the X-rays are produced by inverse cyclotron scattering on this hot plasma of photons emitted by the stellar surface.

An exciting new source was discovered first in the gamma-rays with SWIFT, for which Castro-Tirado and collaborators (including Markoff and Leventis) triggered a multi-wavelength campaign expecting a typical gamma-ray burst. Instead, they detected very unusual flaring behavior, with over 40 optical flares in the following few days, as well as a faint infrared flare before the source returned to quiescence, while no radio emission was detected. While the authors determined from modeling that energetically such a scenario could be consistent with an ejection event by an X-ray binary, the favored scenario is that this source is a new magnetar that looks like a soft gamma-ray repeater, except in the optical bands rather than the gamma-rays, where only one burst was detected.

2.1.6 Gamma-ray bursts

One of the most spectacular gamma-ray bursts detected up to this date occurred on March 19, 2008: GRB080319B was at redshift 0.94 (or 8.6 billion light years away), and yet had a peak brightness of magnitude 5.3. It was thus visible to the naked eye for about 40 seconds. Fortuitously, it was only 10 degrees away in the sky from an event a few hours before, so monitoring cameras caught the radiation right from the start, without slewing delays. As a result, a completely unique data set at wavelengths from gamma rays to radio was assembled, enabling a large collaboration including the GRB group of the institute to analyse the physics of this event with unprecedented precision (figure 3, published in Nature). The extra-ordinary brightness appears to have been due to an extra component of the relativistic jet that was even more narrowly collimated than the normal outflow (opening angle only 0.2 degrees) and having an unusually large Lorentz factor of around 1000. Quite possibly, all GRBs have such a component, because such a narrow component is expected to be aimed at us only about once per decade (and we have now seen
one in 12 years of afterglow observations). Otherwise, the event was not unusual: the total energy was around the average of long GRBs. A study of the radio afterglow of GRB030329 with WSRT and GMRT by Van der Horst, Kamble, Wijers and others revealed that the afterglow became non-relativistic and uncollimated at about 80 days after the burst. Its energy was quite similar to earlier findings, and the circumburst medium turns out to be uniform at large distance, possibly indicating that the blast wave has exited the region affected by the stellar wind of the progenitor star and is now propagating into undisturbed ISM. Curran and others published a number of studies to improve the analysis of early gamma-ray burst afterglows. The results included a better method to determine the true color and photometric redshift of a burst, and a discussion of late-time flares in the X-ray light curves, which are found to be caused most likely by late re-activations of the GRB central engine. A study of a sample of ten Swift afterglows by Starling, Wijers, and others showed that afterglows occur with similar likelihoods in uniform ambient densities as in fossil stellar winds, showing that their environments are complex and rich in physics. The study also confirmed the earlier finding by the same authors (from pre-Swift bursts) that the particle acceleration mechanism in GRB blast waves varies from burst to burst. A multi-wavelength study of the very bright GRB070125 including WSRT data by Updike (Clemson), Wijers, and others found that this burst was intrinsically fairly energetic and had a well-defined achromatic jet break and a pretty steep energy spectrum of relativistic electrons.

A detailed study of absorption lines in the afterglow of GRB060206 at \( z=4.05 \) by Thoene (Copenhagen), Wijers, and others showed that the interstellar medium in the host is complex, with different components having different ionisation states and abundances. This gives rise to some caution in interpreting lower-resolution spectra to deduce the abundances of the progenitor object. It was also shown that the surprising claim by earlier authors of variability in the absorption by an intervening galaxy at \( z=1.48 \) is contradicted by their data (which have higher S/N and resolution). A detailed study of spectra and photometry of GRB040924 by Wiersema, Wijers, and others showed the object to have been a typical long GRB, despite its duration being near the long/short divide: the host galaxy shows \([\text{NeIII}]\) emission indicative of very hot stars exciting the ISM, the optical afterglow is typical in shape and energy of a long GRB, and they found a bump in the late light curve consistent with a supernova contribution.
2.1.7 Extra galactic ultra-luminous X-ray sources

Casella, Patruno and collaborators described a new method to estimate the mass of black holes in Ultraluminous X-ray Sources (ULXs). The method is based on the recently discovered `variability plane', populated by Galactic stellar-mass black-hole candidates and supermassive active galactic nuclei, in the parameter space defined by the black-hole mass, accretion rate and characteristic frequency. They applied this method to the two ULXs from which low-frequency quasi-periodic oscillations have been discovered, M82 X-1 and NGC 5408 X-1. For both sources they obtained a black-hole mass in the range 100-1300 solar masses, thus providing evidence for these two sources to host an intermediate-mass black hole.

Patruno and Zampieri (Osservatorio Astronomico di Padova) presented evolutionary tracks of binary systems with high-mass companion stars and stellar-through-intermediate mass black holes. Using Eggleton's stellar evolution code, they computed the luminosity produced by accretion from the donor during its entire evolution as well as the evolution of the optical luminosity and colors of the binary system taking the disc contribution and irradiation effects into account. The calculations presented can be used to constrain the properties of the donor stars in ultraluminous X-ray sources by comparing their position on the Hertzsprung-Russell or color-magnitude diagrams with the evolutionary tracks of massive BH binaries. This approach may actually provide interesting clues also on the properties of the binary system itself, including the BH mass. They found that, on the basis of their position in the color-magnitude diagram, some of the candidate counterparts considered can be ruled out and more stringent constraints can be applied to the donor masses.

2.1.8 Clusters of galaxies and AGN

Wise continued his studies of central galaxies in clusters, with a publication in which the jet power of the radio galaxy, as inferred by the cavity it has blown into the cluster gas, is shown to scale with its radio luminosity. He also participated in a study showing that most Spitzer IR sources in a field near the Galactic Centre are not correlated with Chandra X-ray sources.

Markoff and collaborators performed an unprecedented simultaneous broadband campaign on the weak, nearby active galactic nucleus M81*, using the Chandra High Energy Gratings, along with ground based instruments the GMRT, VLA/VLBA, PdBI, SMA and the Lick Observatory. The two highlights were the intriguing detection of strong and highly variable sub-millimeter wave, suggesting that M81* may also have a strongly polarized synchrotron "bump" originating from hot plasma very close to the central black hole. This feature has only been seen in Sgr A* so far, and was one of the motivating factors for the campaign on M81*, in order to help “place” Sgr A* in context with other weakly accreting galactic nuclei. In addition, the broadband spectrum of M81* can be well fit by exactly the same outflow-dominated model that successfully describes the low-accretion state in accreting black hole X-ray binaries, with the same physical parameters except for a larger mass. Such a result strongly supports the idea that accretion physics scales predictably with mass (figure 4), and suggests that the low-luminosity AGN class is a longer-lived analog of the transient “hard state” in X-ray binaries.
Figure 4: The best spectral fit to the broadband data from the entire multi-wavelength campaign on M81*, including non-simultaneous data from other sources which were included as upper limits in the fit (emphasizing the “sub-mm bump”). The model underpredicts these limits because the significant contribution of dust dominates in these bands.

Law published his study of the Galactic Centre region in radio and mid-IR in a series of papers. The study shows a very rich diversity of physics, with both thermal-like emission from HII regions and massive star formation activity, and non-thermal filaments from energetic processes. The mid-infrared data allow one to relate specific features in more detail to star forming activity and heavily extincted regions. Follow-up study using OH maser emission and IR spectroscopy led to the identification of a population of red supergiants in the young cluster RSGC1.

2.1.9 Computational astrophysics

The main interest of the computational astrophysics group at the University of Amsterdam is aimed at studying the ecology of dense stellar systems. This work combines the developments of numerical algorithms and theoretical tools to study the gravitational, chemical, nuclear and photonic evolution of solar systems, star clusters and galaxies. In this context the development of an advanced particle integration method plays a prominent role.

The computational astrophysics group is part of an international team of astrophysicists and computer scientists from the EU, Japan and the USA, which has started the production sequence for simulating the
formation of dark matter structure in the universe. The project called CosmoGrid aims at modeling the detailed dark fine structure in the Universe with about 10 billion dark-matter particles using two supercomputers concurrently. Half the universe is located in the Amsterdam supercomputer Huygens at the Netherlands National Supercomputer Center SARA, whereas the other half is calculated at a Cray XT4 at the Center for Computational Astrophysics in Tokyo. The two computers are interconnected using a 10 Gbit/s lightpath between Amsterdam and Tokyo via 9 intermediate stations that participate in the Global Lambda Integrated Facility. At the moment they have successfully run more than 100 time steps of the planned 50000. The entire calculation is expected to take about a year within which they plan on spending about 3 million hours of CPU time.

The same group is also strongly involved in the development of MUSE, which is a software framework for combining existing computational tools for different astrophysical domains into a single multiphysics, multiscale application. MUSE facilitates the coupling of existing codes written in different languages by providing inter-language tools and by specifying an interface between each module and the framework that represents a balance between generality and computational efficiency. This approach allows scientists to use combinations of codes to solve highly-coupled problems without the need to write new codes for other domains or significantly alter their existing codes. MUSE currently incorporates the domains of stellar dynamics, stellar evolution and stellar hydrodynamics for studying generalized stellar systems. They have now reached a “Noah's Ark” milestone, with (at least) two available numerical solvers for each domain. MUSE can treat multi-scale and multi-physics systems in which the time- and size-scales are well separated, like simulating the evolution of planetary systems, small stellar associations, dense stellar clusters, galaxies and galactic nuclei.

Belleman, Bédorf (section computational science, UvA) and Portegies Zwart performed gravitational direct N-body simulations using the Graphics Processing Unit (GPU) on a commercial NVIDIA GeForce 8800GTX. The force evaluation of the N-body problem is implemented in CUDA using the GPU to speed-up the calculations. They tested the implementation on three different N-body codes, two direct N-body integration codes, using the 4th order predictor-corrector Hermite integrator with block time-steps, and one Barnes-Hut treecode, which uses a 2nd order leapfrog integration scheme. The integration of the equations of motions for all codes is implemented in C on the host computer. They found that for \( N > 512 \) particles the GPU outperforms the GRAPE-6Af, if some softening in the force calculation is accepted. Without softening and for very small integration time steps the GRAPE still outperforms the GPU. They concluded that modern GPUs offer an attractive alternative to GRAPE-6Af special purpose hardware.

### 2.2 Low Energy Astrophysics

#### 2.2.1 Light scattering, properties of dust in space

The atmospheres of (exo)planets and moons, as well as many nebulae, contain in general independently scattering particles in random orientation. In model computations such media are often assumed to be (locally) plane-parallel. The radiation coming from a distant source, like the Sun or a star, can be scattered many times by the particles inside the medium before leaving it at the top. This is called reflected radiation and its directional distribution is usually expressed in terms of the so-called reflection function. Hovenier and Stam developed a variety of relations for the reflection function when the directions of incidence and reflection both tend to horizontal directions. These relations are quite general and may be applied, for example, for interpreting photo-polarimetric observations of regions near the intensity poles of a celestial body surrounded by an atmosphere.

Cosmic particles are all particles outside the Earth. Two types of cosmic particles can be distinguished, namely liquid and solid particles. Liquid particles may occur, for instance, in the form of clouds, hazes, fog and rain in the atmospheres of (exo)planets and satellites. These particles are (nearly) spherical so that their scattering and absorption properties can easily be computed with Mie theory. Solid particles are also called cosmic dust particles and occur in numerous astronomical objects and environments, such as comets, the interplanetary medium, circumstellar disks and the interstellar medium.
These particles are often far from spherical. Hovenier and Min reported an invited review of light scattering by cosmic particles with emphasis on modern experimental and computational methods to determine their scattering properties. Key areas for further research were also pointed out.

Dust from the surface of Mars is regularly swept up by winds and then becomes suspended in the atmosphere, sometimes covering the whole planet. These airborne dust particles scatter and absorb solar radiation and are therefore very important for the thermal structure of the thin Martian atmosphere. The material palagonite is believed to be a reasonable analog for the Martian dust particles. Results of measurements of a sample of randomly oriented palagonite particles, which was the last sample that was investigated with the Amsterdam Light Scattering Facility, were reported by Munoz, Volten, Hovenier, Laan, Roush and Stam.

In order to deduce properties of dust in astrophysical environments where dust growth through aggregation is strong, knowledge of the way aggregated particles interact with radiation is needed. For this purpose Min et al. have studied the interaction of light with inhomogeneous aggregates consisting of highly irregularly shaped constituents (figure 5). The initial step taken is to numerically compute the optical properties. In addition to this an empirical recipe to compute the optical properties of such aggregates in a fast and accurate manner is derived. Min et al. also computed the spectral structure of the emission efficiency in the 10 micron region for aggregates composed of carbonaceous and silicate materials. From this study it is found that the spectral appearance of the various components of the aggregate, is very different and depends on its abundances. Most notably, materials that have a very low abundance appear spectroscopically as if they were in very small grains, while more abundant materials appear spectroscopically to reside in larger grains. The new empirical method incorporates all these effects and is fast enough to be easily implemented in fitting procedures trying to deduce the dust characteristics from astronomical observations.

Figure 5: Model of a chemically inhomogeneous aggregate dust particle for which the optical properties have been calculated.
2.2.2 Star- and planet formation

Acke, Waters, de Koter and co-workers studied the nature of the nearby young massive B[e] star MWC 297 (figure 6). In particular, the geometrical structure of the circumstellar material that is responsible for the near- to mid-infrared flux excess was probed with the ESO interferometric spectrographs AMBER and MIDI, mounted on the VLTI in Paranal, Chili. The authors argue that the circumstellar matter in the MWC 297 system is organised in a circumstellar disk, seen under moderate inclination. The low inclination of the disk implies that the already high projected rotational velocity of the star corresponds to an actual rotational velocity that exceeds the critical velocity of the star. This result shows that stars can obtain such high rotation rates already at birth.

Figure 6: From left to right we zoom in to the center of the nearby young massive B[e] star MWC 297, which is found to be rotating at a velocity that exceeds the critical velocity of the star. Left: Spitzer IRAC image at 8 micron. Clearly visible is a complex, large-scale cloud structure. A numerical circular mask covers the saturated part of the image. Middle: VISIR image at 11.85 micron, zooming-in at the center of the Spitzer image. The image is seeing-limited, but in terms of extension is significantly larger than that of calibrator sources. Right: interferometric image at 12 micron, zooming-in at the center of the VISIR image. The greyscale in the three images is linear. (Acke et al. 2008)

The spectral energy distributions of circumstellar disks around Herbig Ae/Be stars have been classified into two major groups, group I (flaring) and group II (self-shadowed). Meijer, Dominik, de Koter, and Waters, in collaboration with Dullemond and van Boekel from Heidelberg, executed an extensive parameter study of self-consistent models of protoplanetary disks around Herbig AeBe stars. The models are computed using a 2D radiative transfer code with self-consistent vertical structure. In the parameter study, stellar and disk properties were varied in order to assess the influence on the overall appearance of the spectral energy distribution, focusing on near and mid-IR regions only, addressing the classification of Herbig AeBe stars into two groups, with a flaring (group I) or self-shadowed (group II) SED. We find that the parameter of overriding importance to the SED is the total mass in grains smaller than 25 µm. All other parameters studied have only minor influences, and will alter the SED type only in a minor way. It is found that, from a modeling point of view, there is no natural dichotomy between group I and II. The transition is a continuous function of the small dust mass.

Turbulent coagulation in proto-planetary disks is known to operate on a timescale far shorter than the lifetime of the disk. In the absence of mechanisms that replenish the small dust grain population, protoplanetary disks would rapidly lose their continuum opacity-bearing dust. This is inconsistent with infrared observations of disks around T Tauri stars and Herbig Ae/Be stars, which are usually optically thick at visual wavelengths and show signatures of small (radius ≤ 3 µm) grains. Dominik and Dullemond (Heidelberg) investigated replenishing mechanisms that might form an alternative to the earlier proposed production of small grains by collisional fragmentation or erosion of large dust aggregates. They studied the effect of residual, low-level infall of matter onto the disk surface and found that infall rates as low as
10^{11} M_\odot/yr can, in principle, replenish the small grain population to a level that keeps the disk marginally optically thick. However, such rates are difficult to reconcile with observational and theoretical limits. The authors conclude that fragmentation or erosion still appear to be the most promising processes to explain the abundant presence of small grains in old disks.

The shape of dust emission features measured from proto-planetary disks contains information about the typical size of the dust particles residing in these disks. A flattened 10 μm silicate feature is often interpreted as proof that grain growth has taken place, while a point feature is taken as evidence for the pristine nature of the dust. Dominik and Dullemond (Heidelberg) investigated what the effect of dust sedimentation is on the shape of the observed 10 μm amorphous silicate dust resonance and how this may affect the interpretation of the observations. Using a combination of modeling tools, the sedimentation of a dust grain size distribution in an axisymmetric 2-D model of a turbulent proto-planetary disk was modeled. Subsequently, a radiative transfer program was used to compute the resulting spectra. It was found that the sedimentation can turn a flat feature into a pointy one, but only to a limited degree and for a very limited set of particle size distributions. If the distribution is too strongly dominated by small grains, then the feature is pointy even before sedimentation. If the distribution is too strongly dominated by big grains, the sedimentation will not be enough to cause the feature to be pointy. Only a bimodal size distribution, i.e. a very small grain population and a bigger grain population, does transform from a flat to a pointy feature upon dust sedimentation. However, the model shows that, if sedimentation is the sole reason for the variety of silicate feature strengths observed in proto-planetary disks, disks with weak mid- to far-infrared excess are expected to have a stronger 10 μm silicate feature than disks with a strong mid- to far-infrared excess.

The formation of planetesimals requires the growth of dust particles through collisions. Micron-sized particles must grow by many orders of magnitude in mass. To understand and model the processes during this growth, both the mechanical properties and the interaction cross sections of aggregates with surrounding gas must be well understood. Paszun and Dominik used recent advances in experimental (laboratory) studies as background for pushing numerical aggregate models to a new level. The experimental results were used in order to calibrate the numerical model of aggregate dynamics. They used plastic deformation of surface asperities as the physical model to match the velocities needed for sticking with experimental results. The modified code is then used to compute both the compression strength and the velocity of sound in the aggregate at different densities. The modified code shows excellent compliance with the experimental constraints.

While the small dust particles in proto-planetary disks provide valuable information about the grain processing and early phases of planet formation, the bulk of the mass in the disk is in the form of (molecular) gas. This gas slowly dissipates as the disk evolves and planets form. The gas in the disk can be used to study the kinematics as well as the physical and chemical conditions in the disk. Van der Plas and co-workers use the [OI] line at 630 nm to study the atomic gas in the upper disk layers of several intermediate mass Herbig Ae/Be stars. The double-peaked line profiles are indicative of a rotating gaseous disk geometry and the line strength and shape are used to distinguish between flaring and self-shadowed disk geometries. Carmona, van den Ancker, Waters and others searched for emission from molecular hydrogen in a sample of Herbig Ae/Be stars and were able to set strict limits on the amount of warm H_2 gas in these disks. Boersma (Groningen), Bouwman (Heidelberg), Tielens (Leiden), Waters (Amsterdam) and others investigated the nature of polycyclic aromatic hydrocarbon (PAH) molecules in different environments. They find evidence for substantial modifications of the PAH composition in proto-planetary disks as compared to PAHs in the interstellar medium. Interestingly, these changes in PAH properties may already take place in the parent molecular cloud, i.e. before these large molecules enter the disk.

2.2.3 Massive stars in galaxies

De Koter is one of the coordinators of the VLT-FLAMES Survey of Massive Stars, a European collaboration in which the properties of early-type massive stars in the local universe are studied in order to better understand the role of mass loss, rotation and chemical composition in the evolution of these stars. An overview of the results of the first ESO Large Programme project, in which over 800 high-quality spectra were gathered and analysed, was given by Evans, de Koter, Mokiem, and co-workers. Currently, data is being taken for the second Large Program, this time concentrating on the Tarantula Nebula in the Large Magellanic Cloud.
In 2008 an important focus was on rotation in B-type stars. Together with Hunter and co-workers from several European countries, de Koter estimated chemical compositions (of C, N, O, Mg, and Si) of 135 early B-type stars in the Large Magellanic Cloud with projected rotational velocities up to about 300 km/sec (figure 7). Evolutionary models, including rotational mixing, have been generated attempting to reproduce these observations by adjusting the overshooting and rotational mixing parameters. These models produce reasonable agreement with about 60 percent of the core hydrogen burning sample. Interestingly, the authors find (excluding known binaries) a significant population of highly nitrogen-enriched intrinsic slow rotators incompatible with their models. Furthermore, while fast rotators with enrichments in agreement with the models are found, the observation of a population of evolved fast rotators that are relatively unenriched challenges the concept of rotational mixing. Because of these results a picture emerges in which invoking binarity and perhaps fossil magnetic fields is required to understand the surface properties of about 40 percent of the population of massive main-sequence stars.

Henrichs and Schnerr conducted a large survey of magnetic fields of O stars with the FORS1 in polarimetric mode at the VLT at ESO (first author: S. Hubrig). No new fields were discovered, which showed that strong fields are not very common among this type of hot stars. Henrichs and Schnerr observed five O stars with the WSRT to search for non-thermal radio emission, which is considered to be an indirect indicator for the presence of magnetic fields. In three of them such non-thermal emission was indeed detected, which supports further searches for the magnetic fields in O stars, being the progenitors of the strongly magnetized neutron stars. The results of all remaining magnetic measurements of O and B stars observed at the Pic du Midi with the Musicos polarimeter over the past 8 years have been published with upper limits for all program stars. This work puts strong constraints on the maximum value of the field strengths.

Figure 7: The surface nitrogen abundance of 135 B-type stars in the Large Magellanic Cloud is plotted against projected rotational velocity. The panel on the left shows main sequence stars; the panel on the right displays post main-sequence stars. The bulk of the core hydrogen burning objects occupy a region at low vsini and show little or modest nitrogen enrichment. The curves represent predictions of the surface nitrogen enrichment as a function of rotational velocity (assuming random orientation). Surface gravity has been used as an indicator of the evolutionary status and the objects and tracks have been split into red and blue to indicate younger and older stars, respectively. Gray shading in the left panel highlights two groups of stars which remain unexplained by the stellar evolution tracks. In the left panel gray shading highlights the apparent division of the supergiants into two distinct groups. The stars in group 3 are consistent with being in the core hydrogen phase within their uncertainties.

De Koter, Smith and Waters edited the proceedings of the conference "Mass loss from Stars and the Evolution of Stellar Clusters", which was held from May 29 to June 1st, 2006 to mark the 65th birthday of
Professor Henny Lamers. The book, published by the Astronomical Society of the Pacific in the ASP Conference Series, focuses on the physics of mass loss from individual stars as well as from young stellar clusters, and the implications of the mass loss process of these systems.

De Koter reviewed the observational constraints on mass loss of early-type massive stars, discussing the wind properties of 115 O- and early B-type stars in the Galaxy and the Magellanic Clouds. Together with Muijres and Krticka and collaborators, he continued studies of the influence of inhomogeneities on the mass-loss rate of hot star winds. On these topics several conference proceedings were published.

Together with Vink and collaborators, de Koter discussed recently reported quasi-sinusoidal modulations in the radio lightcurves of SN 2001ig and SNe 2003bg. They show that both the sinusoidal behavior and the recurrence timescale of these modulations are consistent with the predicted mass-loss behavior of Luminous Blue Variable stars, and propose that LBV stars may be direct supernova progenitors.

Yungelson, van den Heuvel, Vink, Portegies Zwart and de Koter study the evolution and fate of solar composition super-massive stars in the mass range of 60-1000 solar masses. Though at present it is unclear whether stars initially more massive than about 150-200 solar masses may actually form, the mechanism of runaway stellar collisions has been proposed to produce super-massive stars. The result of this pilot study is that super-massive stars with initial masses up to 1000 solar masses end their lives as objects less massive than 150 solar masses due to excessive mass loss in stellar winds. Such objects are expected to collapse into black holes or explode as pair-instability supernovae. This would imply that if ultraluminous X-ray sources contain black holes of order 1000 solar masses, these are unlikely to be the result of runaway stellar collisions in the cores of young clusters.

Williams, Gies, Kaper and collaborators performed an optical spectroscopic investigation of the massive binary system [L72] LH 54-425 in the LH 54 OB association in the Large Magellanic Cloud. They revise the ephemeris of [L72] LH 54-425 and find an orbital period of 2.24741 ± 0.00004 days. They find spectral types of O3 V for the primary and O5 V for the secondary. They obtain a combined solution of the radial velocities and previously published V-band photometry to determine the inclination for two system configurations, namely i=52° (+2,-3°) for the configuration of the secondary star being more tidally distorted and i=55° ± 1° for the primary as the more tidally distorted star. They argue that the latter case is more probable, and this solution yields masses and radii of M1=47±2 M☉ and R1=11.4±0.1 R☉ for the primary, and M2=28±1 M☉ and R2=8.1±0.1 R☉ for the secondary. Their analysis places LH 54-425 among the most massive stars known. Based on the position of the two stars plotted in a theoretical HR diagram, they determine the age of the system to be 1.5 Myr.

### 2.2.4 Late stages of stellar evolution

Gielen, Min, Waters and co-workers have investigated the mineralogy and dust processing in the circumbinary discs of binary post-AGB stars using high-resolution TIMMI2 and SPITZER infrared spectra. They performed a full spectral fitting to the infrared spectra allowing for the identification of the carriers of the different emission bands. It is found that in all but one star the dust is oxygen-rich: amorphous and crystalline silicate dust species prevail. The exception to this is EP Lyr, where a mixed chemistry of both oxygen- and carbon-rich species is found. A high degree of dust grain processing is found; the grains are large and highly crystalline. Temperature estimates from our fitting routine show that a significant fraction of grains must be cool, significantly cooler than the glass temperature. This, together with the high degree of crystallinity, shows that radial mixing is very efficient in these discs and/or indicates different thermal conditions at grain formation. This study clearly shows that strong grain processing is not limited to young stellar objects and that the physical processes occurring in the discs are very similar to those in protoplanetary discs.

Decin, de Koter and collaborators studied the unusual Mira variable R Hydrae. This star is well known for its declining period between 1770 and 1950, which may possibly be attributed to a recent thermal pulse. The molecular lines of the CO molecule bear evidence of a change in mass-loss rate some 220 years ago. While the mass loss before 1770 is estimated at about 2 x 10⁻⁷ M☉ per year, the present day mass-loss rate is a factor of 20 lower. This gives empirical evidence to the thermal-pulse model, which is capable of explaining both the period evolution and the mass-loss history of R Hydrae.
The star VY Canis Majoris is in the same evolutionary stage as is R Hydrae and also shows a time dependent mass-loss rate. Decin, de Koter, Waters and co-workers showed that this star underwent a phase of high mass loss some 1000 years ago, lasting some 100 years, followed by a period of relatively low mass loss taking some 800 years. The current mass loss of VY CMa is again high. This behavior is also in support of the thermal-pulse model.

2.2.5 History of astronomy

De Jong continued his studies of ancient astronomy texts. Using the observed dates of first and last visibilities of the planets and of their conjunctions with Normal stars as recorded in the Astronomical Diaries and related texts Babylonian scholars managed to identify periods (counted in years) after which a planetary first/last visibility or a conjunction with a particular Normal star recurrent on about the same date in their lunar calendar. The lengths of these periods vary from about 10 years to about 100 years. The earliest list of such periods dates from the late 7th century BC. These periods provide the basis for the Goal-year method, the simple computational scheme developed by the Babylonian scholars to predict planetary positions by using observations from one period earlier. Preserved Goal-year texts date from the last three centuries BC. The fundamental periods also forms a significant first step in the construction of much longer periods, varying from 250 to 1500 years, which play a central role in the development of the elegant arithmetic schemes to predict the positions of planets for arbitrary dates (the ACT-type mathematical texts from the last three centuries BC). Typical accuracies of the predicted positions in these ephemerides are of order 1 degree, comparable to those of the later Hellenistic planetary models of Hipparchus and Ptolemy.

De Jong studied a number of observational and theoretical texts of Mercury to try to understand the way in which the Mercury periods were derived from the observations and the way they were eventually used in the computation of the zodiacal longitude of Mercury. The case of Mercury is particularly interesting because some times the texts refer to predictions of first and last appearances as omitted. This is related to the fact that in certain times of the year Mercury’s orbit (in the ecliptic) lies so flat in the horizon that Mercury, due to its close proximity to the Sun, does not rise sufficiently high above the horizon to become observable during that particular revolution. The algorithms for predicting omitted phases in the ephemerides can be extracted from the texts. The predictions turn out to be only partially consistent with the observed omitted phases.

From a database of 100 years of synthetic observations of the planets generated by computer de Jong investigated how the Babylonian scholars might have derived the planetary periods from the recorded dates of first and last visibilities of planets and of stellar conjunctions. He could further show that the long periods used in the Babylonian planetary theories can be constructed by linear combinations of the fundamental observed ones.
3. Instrument development

3.1 X-shooter.

X-shooter is the first second-generation instrument for the ESO Very Large Telescope, and has been installed in 2008. It is the most powerful optical and near-infrared medium-resolution spectrograph in the world, with a unique spectral coverage from 300 to 2500 nm in one shot. The X-shooter consortium members are from Denmark, France, Italy, The Netherlands and ESO. The Dutch contribution to X-shooter is one of the three spectrographs: the near-infrared arm, designed, constructed and tested at ASTRON and its cryogenic enclosure at the Radboud University in Nijmegen. Funding of the Dutch work-packages is fully secured with contributions from the NOVA Phase-2 instrumentation program (1125 kEuro), a NWO-M grant (744 kEuro), a grant from the University of Amsterdam (300 kEuro), and in-kind contributions from the University of Nijmegen and ASTRON. The UvA contribution covers the construction costs of some hardware components for the near-IR spectrograph (carried out by the Section Mechanical Construction at the UvA) and a postdoc for the development of data reduction software. Kaper is the Dutch PI and member of the Project Board, Groot is co-PI and chairman of the X-shooter Science Team, and Navarro (ASTRON) is the Dutch Project Manager. First light of the UV and visual arms on the telescope was achieved in November 2008; the NIR arm will follow in March 2009.

X-shooter will have a broad and varied usage ranging from nearby intrinsically faint stars to bright sources at the edge of the Universe. The unique wavelength coverage and unprecedented efficiency opens a new observing capacity in observational astronomy. At the intermediate resolution of X-shooter 80-90% of all spectral elements are unaffected by strong sky lines, so that one can obtain sky continuum limited observations in between the sky lines within a typical exposure time. Key science cases to be addressed with X-shooter concern the study of brown dwarfs, the progenitors of supernovae Type Ia, gamma-ray bursts, quasar absorption lines, and lensed high-z galaxies, intimately linked to the Dutch science interests. The advantage of the large wavelength coverage is that e.g. the redshift of the target does not need to be known in advance (such as in the case of GRBs); also, the study of Lyman alpha in high-redshift galaxies will be possible in the redshift range $1.5 < z < 15$. 


Figure 8: The fully integrated X-shooter spectrograph in the integration lab of the European Southern Observatory Headquarters in Garching, Germany.
3.2 SPHERE

In 2008 work on the second generation VLT instrument SPHERE (Spectro Polarimetric High-contrast Exoplanet REsearch) continued. SPHERE will detect young and old exo-planets at optical and near-IR wavelengths, and will provide high-contrast images of proto-planetary disks. The Netherlands is contributing to the ZIMPOL system, which will be a very sensitive imaging polarimeter to detect the faint reflected light signal from extra-solar gas planets in wide orbits. The ZIMPOL group is led by the ETH in Zurich (H.M. Schmid), the Dutch PI for ZIMPOL is R. Waters, project manager is J. Pragt (ASTRON). NWO, NOVA, the UvA, ASTRON and Utrecht University are contributing to the project. Progress focused on the finalization of the full design of the instrument, which resulted in the successful passing of the Final Design Review in December 2008.

3.3 ELT Instrument Studies

The Astronomical Institute "Anton Pannekoek" of the University of Amsterdam is involved in phase A studies aimed at the definition and development of instrumentation for the European Extremely Large Telescope, with a 42m diameter primary mirror the largest ground-based optical/near-infrared telescope in the world. The final decision to build E-ELT is expected to be taken in 2010, with first light expected in 2018. Francois Hammer (PI, GEPI, France) and Lex Kaper (co-PI, API, Netherlands) are leading a phase A study for an optical-to-near-infrared, fibre-fed, multi-object spectrograph called OPTIMOS. The kick-off of the phase A study was in November 2008. It should be concluded in March 2010.

The OPTIMOS-EVE phase A Study Science Team studied a number of key science cases covering the three main science themes motivating the development of the E-ELT (Science Case for the E-ELT, Ed. I. Hook): (i) Planets and Stars; (ii) Stars and Galaxies; (iii) Galaxies and Cosmology.

3.4 LOFAR

The work on developing the LOFAR Transients pipeline continued at full speed. As the LOFAR hardware is beginning to be put together, the team is working towards a mid-2009 deadline to have a robust pipeline version ready for use when LOFAR becomes operational in stages during a rollout and commissioning phase that is expected to last from spring 2009 to the end of 2010. In addition to work on the pipeline, effort is put into making cross-triggering agreements with other wide-field or fast-responding instruments such as MAGIC (TeV gamma), Fermi (keV-GeV), Liverpool Telescope (optical), and others.
4. Education

4.1 Master and PhD education

The Astronomical Institute hosts the master programme "Astronomy and Astrophysics" which is part of the Master School of Sciences of the FNWI. All master students participate in research taking place at the institute, and thus become acquainted with front-line research in Astrophysics. In addition, an active role is played in the teaching of PhD students in the context of the national NOVA top research school in astronomy. The tables below list the names of students who obtained a MSc in Astronomy and Astrophysics in 2008, 13 in total and those who obtained a PhD in 2008: 5.

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<tr>
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<td>J. Withagen</td>
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<td>Evghenii Gaburov</td>
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4.2 AlumniFest in November 2008

In the autumn our Institute granted its 100th PhD, which was cause for several celebrations. Foremost of these was a reunion and party for all our alumni (among whom we count not only those who graduated from our institute, but also all who ever worked here). We made a considerable effort to trace as many alumni as possible, and regard this effort and event as the start of a habit to remain in touch with our alumni on a more regular basis. The alumnifest itself took place in the Aula of the university on Spui, and featured
a display of all (by then 103) PhD theses produced at API. These PhD theses were also made available online by the university library, so that now all theses back to 1921 can be read in electronic form in the UvA online dissertation repository (www.dare.uva.nl). About 130 alumni and many current staff attended to hear a number of lectures on hot topics in current research, after which the meeting adjourned to a nearby restaurant for a buffet dinner. Many warm and enthusiastic comments were received later by those attending, and so we regard the event as a success worth repeating.
5. Management

5.1 Finances

In 2006 the University of Amsterdam reorganized her financial system and started full cost accounting. After many start-up problems, we are happy to be able to show the overheads on personnel costs separately in 2008.

(in kEuro)

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* 2006 en 2007 Personnel incl. Overheads
5.2 Institute Staff

People working at the institute 31 December 2008 are listed below.

Theme 1 = High Energy Astrophysics
Theme 2 = Low Energy Astrophysics

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<td>Prof.dr. H.F. Henrichs (UHD)</td>
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<td>0.7</td>
</tr>
<tr>
<td>Dr. L.J. van den Horn (UHD)</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Prof.dr. L. Kaper (UHD)</td>
<td>1+2</td>
<td>1.0</td>
</tr>
<tr>
<td>Prof.dr. M. van der Klis (HL)</td>
<td>1</td>
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</tr>
<tr>
<td>Prof.dr A. de Koter (UHD)</td>
<td>2</td>
<td>1.0</td>
</tr>
<tr>
<td>Dr. S.B. Markoff (UHD)</td>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>Dr. S.F. Portegies Zwart (UD, NOVA overlap)</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Dr. A.J.J. Raassen (UD)</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>Prof.dr. L.B.F.M. Waters (HL)</td>
<td>2</td>
<td>1.0</td>
</tr>
<tr>
<td>Prof.dr. R.A.M.J. Wijers (HL)</td>
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<td>1.0</td>
</tr>
<tr>
<td>Dr. R.A.D. Wijnands (UHD)</td>
<td>1</td>
<td>1.0</td>
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</table>

**Total** (of which 1.5 fte NOVA overlap) **10.3**

<table>
<thead>
<tr>
<th>Externally funded (semi) permanent staff</th>
<th>theme</th>
<th>fte</th>
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</thead>
<tbody>
<tr>
<td>Prof.dr. R.P. Fender (Univ. of Southampton, UHD)</td>
<td>1</td>
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</tr>
<tr>
<td>Prof.dr. E.P.J. van den Heuvel (emeritus UvA)</td>
<td>1+2</td>
<td>0.2</td>
</tr>
<tr>
<td>Prof.dr. W. Hermsen (SRON, HL ad personam)</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Prof.dr. J. Hovenier (emeritus VU, emeritus UvA)</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>Dr. K.A. van der Hucht (SRON, UHD)</td>
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<td>0.2</td>
</tr>
<tr>
<td>Prof.dr. V. Icke (UL, bijz. HL)</td>
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<td>0.2</td>
</tr>
<tr>
<td>Prof.dr. T. de Jong (emeritus)</td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>Dr. A.G.J. van Leeuwen (UD, 0.2 ASTRON, 0.2 Spin.)</td>
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<tr>
<td>Dr. A.J.J. Raassen (SRON, UD)</td>
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<td>Dr. G.J. Savonije (UHD, emeritus UvA)</td>
<td>1+2</td>
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<tr>
<td>Prof dr. H.C. Spruit (MPA, AUV bijz.HL)</td>
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</tr>
<tr>
<td>Dr. B.W. Stappers (ASTRON, UD)</td>
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</tr>
<tr>
<td>Prof.dr. R. Strom (ASTRON, HL ad personam)</td>
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<tr>
<td>Dr. M.W. Wise (ASTRON, Project Manager Lofar)</td>
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</table>

**Total** **3.1**
**Temporary staff: Postdocs and PhD Students**

At the end of 2008 13 postdocs (12.2 fte) were working at the institute, 10 of them in theme 1, 2 in theme 2 and 5 in theme 1+2. Of the 12.2 fte 0.5 was UvA funded, 2.0 NOVA funded, 9.5 NWO funded and 0.2 otherwise funded. During 2008 3 postdocs left the institute for jobs elsewhere. In Appendix I information on names, dates, sponsors and subjects can be found.

At the end of 2008 23 PhD students (22.2 fte) were working at the institute, 19 in theme 1, 4 in theme 2. 1 PhD student was UvA-funded, 5 were NOVA-funded (4.4 fte), 13 were NWO funded (12.8 fte) and 4 otherwise (4 fte). During the year 5 PhD students defended their theses successfully and left for jobs elsewhere. See Appendix I for more detailed information.

**Supporting staff**

<table>
<thead>
<tr>
<th>fte</th>
<th>position</th>
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<tbody>
<tr>
<td>0.8</td>
<td>Secretary</td>
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<tr>
<td>1.0</td>
<td>Software specialist</td>
</tr>
<tr>
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<td>Librarian</td>
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<tr>
<td>1.0</td>
<td>Business manager</td>
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<tr>
<td>0.8</td>
<td>Secretary</td>
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**NOVA Information Center (NIC):**

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<tr>
<td>0.6</td>
<td>Head communication</td>
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<tr>
<td>0.4</td>
<td>Communication assistant</td>
</tr>
<tr>
<td>0.5</td>
<td>Coordinator “Astronomy in High Schools”</td>
</tr>
</tbody>
</table>

**Total** 6.8

In the table below all staff working in the institute on 31 December 2008 is summarized in terms of fte (full time equivalent):

<table>
<thead>
<tr>
<th>Position</th>
<th>Direct funding F NWI UvA</th>
<th>External funding NOVA</th>
<th>External funding NWO, ASTRON, EC, etc.</th>
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<td>9.7</td>
<td>12.2</td>
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<tr>
<td>PhD student</td>
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<td>16.8</td>
<td>22.2</td>
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<tr>
<td>Supporting staff</td>
<td>4.5</td>
<td>1.5</td>
<td>1.0</td>
<td>7.0</td>
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<tr>
<td>Total</td>
<td>13.8</td>
<td>9.4</td>
<td>30.4</td>
<td>53.4</td>
</tr>
</tbody>
</table>
6. Public Outreach Activities

6.1 Scientists in written press releases

**D. Altamirano:**

**S.B. Markoff**
http://www.astronomie.nl/nieuws/980/alle_zwarte_gaten_eten_op_dezelfde_manier.html
http://www.astronomie.nl/nieuws/1086/astronomen_ontdoken_unieke_neutronenster_in_de_melkweg.html

**N. Rea:**
Joint XMM/INTEGRAL Press Release: *XMM-Newton and Integral clues on magnetic powerhouses*

**R.A.M.J. Wijers**
Article in 'Spui' over gammaflitsen, December

6.2 Popular lectures

**C. Dominik**
Evening lecture about Astrobiology, for biology and chemistry students, January 29, Nijmegen.

**H.F. Henrichs**
*Getijdenwerking in het zonnestelsel*, Sterrenkunde Olympiade, June 3, Utrecht.
*The Dwarf Planets*, 't Mosterdzaadje, February 29, Santpoort.

**J.W.T. Hessels**

**E.P.J. van den Heuvel**
*Intelligent Life Elsewhere in the Universe: Likely or Unlikely?* Avondvoordracht, February 7th, Congres van de Nederlandse Vereniging voor Tandheelkundig Onderzoek, Lunteren,
*Gammaflitsen, Kijken naar de Verste Sterren*, Lions Club, February 12, Voorschoten.
*Einstein, Hubble en de geschiedenis van het Heelal*, UvA Betascholierendag, February 21, Artis Planetarium, Amsterdam.
*Contri-fest*, After Dinner Speech Lowell Observatory, October 14, Flagstaff, Arizona, USA
*Het Moderne Wereldebeeld*, Natuurkundig Gezelschap, November 6, Middelburg.

**G.H. Janssen**
Pulsars: *Verleden, heden en toekomst*, NVWS, Oss.
L. Kaper

M. van der Klis:
'Leven in het heelal', lezing & discussie in CREA voor AmFiBi (studievereniging filosofie).
ASTRONET Roadmap en de Strategie van de Nederlandse Sterrenkunde, during the presentation of the ASTRONET Infrastructure Roadmap to the OCW, NWO 'Parallelle Werelden', December 8, IJgebouw, Amsterdam.

A. de Koter
Andere Aardes, Mastercourse for High School Teachers, November 24, University of Amsterdam.

S.F. Portegies Zwart
Publiekslezing Artis planetarium, October 10, Amsterdam.

E.A. Rubio-Herrera
Important Steps of Astronomy after Galileo, opening lecture IYA09 inauguration in Guatemala.

A.L. Watts:
Firestorms and starquakes: the dangerous life of a neutron star Institute of Physics South-west Branch Public Lecture, September 2008, Cheltenham, UK.

R.A.D. Wijnands
Satellieten Nivon Berkhout, January 20, Hoorn.
Extreme natuurkundige verschijnselen bij neutronsterren en zwarte gaten, public lecture in Artis Planetarium, November 4, Amsterdam.

R.A.M.J. Wijers
Gammaflitsen, Academische Club, UvA, June 19, Amsterdam.
Het verre heelal, aan basisschoolleraren beta-stimuleringsplatform, January 30, Amsterdam.
LOFAR, lezing Viva Fysica, February 1, Amsterdam.

6.3 Interviews and appearances on radio/tv/film

Carsten Dominik
Meteorites interview, June 12.
Published in Trouw: Interview with Bennie Mols, about the rotation of the Earth. February 19.
Appearance on Max en Lauretta, about Asteroid 2007 TU24 coming close to the Earth, January 28.

R.A.M.J. Wijers
Interview 'Ster van Bethlehem', for an article on the webpage of UvA.
Small part in a series called: De Fascinatie, about research: website UvA and TELEAC.

L. Kaper
Documentary "Doors to the Soul", International Documentary Festival Amsterdam (IDFA), by Elizabeth Rocha Salgado, John Appel Productions.

M.B.M. van der Klis:
Interview in Skoop door Eline van der Mast
**S.B. Markoff**
Interviewed on video for an online high-school physics website
Interviewed for the Science Park Amsterdam newsletter

**R.A.D. Wijnands**
Radio interview about black holes for the radio program: *Hoe? Zo!*, November 14, Radio 5.
## Appendix I: Postdocs and PhD students and their funding source

### 1.1 Postdocs

<table>
<thead>
<tr>
<th>Name</th>
<th>Period</th>
<th>Employer</th>
<th>Sponsor</th>
<th>Subject</th>
</tr>
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<tr>
<td>D. Altamirano</td>
<td>01-06-2008</td>
<td>NWO Spinoza</td>
<td>van der Klis</td>
<td>High energy observations of neutron stars and black holes</td>
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<tr>
<td></td>
<td>01-06-2009</td>
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<td>P. Casella</td>
<td>20-01-2006</td>
<td>NWO Spinoza</td>
<td>van der Klis</td>
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<tr>
<td></td>
<td>01-04-2006</td>
<td>NWO Rubicon</td>
<td></td>
<td></td>
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<td></td>
<td>01-04-2007</td>
<td>NWO Spinoza</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>01-06-2009</td>
<td></td>
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<tr>
<td>L.K.C. Decin (0.2)</td>
<td>01-10-2004</td>
<td>Universiteit Leuven</td>
<td>Waters</td>
<td>Infrared and submillimeter astronomy</td>
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<td>01-10-2010</td>
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<td>M.A. Gürkan</td>
<td>01-07-2006</td>
<td>EC Marie Curie</td>
<td>Portegies Zwart</td>
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<td>01-07-2008</td>
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<td>01-07-2009</td>
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<td>J.W.T. Hessels</td>
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<td>van der Klis</td>
<td>Radio Pulsars</td>
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<td>2 Fellowships Canada</td>
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<td>01-01-2009</td>
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<tr>
<td>M.J. Horrobin</td>
<td>15-06-2005</td>
<td>NOVA + UvA</td>
<td>Kaper</td>
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<td>01-01-2009</td>
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<tr>
<td>A.P. Kamblé</td>
<td>01-08-2008</td>
<td>NWO Vici Wijers</td>
<td>Wijers</td>
<td>Gamma-Ray bursts, radio- and optical analysis</td>
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<td>01-01-2010</td>
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<td>M. Klein Wolt</td>
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<td>van der Klis</td>
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<td>NWO</td>
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<td>01-11-2006</td>
<td>NWO</td>
<td>Markoff</td>
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<tr>
<td>M. Min</td>
<td>01-04-2005</td>
<td>NOVA nw 2</td>
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<td>Waters</td>
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<td>D.M. Russell</td>
<td>01-10-2007</td>
<td>NWO Vidi Fender</td>
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<tr>
<td>A.L. Watts</td>
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### 1.2 PhD students

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<th>promotor/co-promotor</th>
<th>begin/einde contract</th>
<th>datum promotie</th>
<th>geldstroom</th>
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<tbody>
<tr>
<td>Diego Altamirano</td>
<td>Van der Klis</td>
<td>17-11-03/17-01-08</td>
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<td>Caroline d'Angelo</td>
<td>Spruit</td>
<td>01-10-06/10</td>
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<td>Peter A. Curran</td>
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<td>25-09-08</td>
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<td>Nathalie Degenaar</td>
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<td>01-10-06/10</td>
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<td>NWO</td>
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<tr>
<td>Samia Drappeau</td>
<td>Wijers/Markoff</td>
<td>01-09-08/12</td>
<td></td>
<td>NWO VIDI Markoff</td>
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<tr>
<td>Hendrik van Eerten</td>
<td>Wijers</td>
<td>01-10-05/09</td>
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<td>NOVA nw 3</td>
</tr>
<tr>
<td>Nicolas Faber</td>
<td>vdHeuvel/Portegies Zwart</td>
<td>24-04-06/10</td>
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<td>Beurs Luxemburg</td>
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<td>Evghenii Gaburov</td>
<td>Wijers/Sloot/Portegies Zwart</td>
<td>01-08-04/08</td>
<td>04-11-08</td>
<td>NWO</td>
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<tr>
<td>Derek Jan Groen</td>
<td>Sloot/Portegies Zwart</td>
<td>01-10-06/10</td>
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<tr>
<td>Peter den Hartog</td>
<td>Hermesen/vd Klis</td>
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<td>21-05-08</td>
<td>SRON</td>
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<td>Gemma Janssen</td>
<td>vdKlis/Stappers</td>
<td>15-11-04/08</td>
<td>25-03-09</td>
<td>NWO</td>
</tr>
<tr>
<td>Ramesh Karuppusamy</td>
<td>vd Klis/Stappers</td>
<td>01-02-03/15-07-09</td>
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<td>(0.6 fte)</td>
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<td>Dominik</td>
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<td>Kostadinos Leventis</td>
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<tr>
<td>Daan Meerburg</td>
<td>Wijers/vd Schaar</td>
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Appendix II: Memberships
Science Policy Functions, Memberships of & Offices in Learned Societies

P. Casella
Member NASA Peer Review Panel, Swift Cycle 4, January 2008.
Member Local Organizing Committee for the Workshop "A Decade of Accreting Millisecond Pulsars", Amsterdam, April 2008.

C. Dominik
Chair NOVA Inquisition.
Member NWO Rubicon committee.

H.F. Henrichs
Telescope committee
(Re)elected member IAU Working Group on Active B stars.
Member NUVA (Network for UV Astronomy).

J.W.T. Hessels
Member PALFA Pulsar Survey executive committee
Member LOC LOFAR and the Transient Radio Sky, Amsterdam, 15-17 December 2008
Full member of LOFAR Transients Key Project and Pulsar Working Group

E.PJ. van den Heuvel
Chair Spinozaclub (gezelschap van laureaten van de NWO Spinoza prijs).
Chair of the board of Stichting “Museum Sterrenwacht Sonneborgh”, Utrecht.
Chair Advies Raad, Instituut voor Interdisciplinaire Studies (IIS), UvA.
Chair Time Allocation Committee of ESA’s Gamma-ray Observatory satellite INTEGRAL.
Member INTEGRAL User Group (IUG), ESTEC, Noordwijk.
Member Space Science Advisory Committee, ESA (Parijs).
Member Begeleidingscommissie ICES-KIS Evaluatie, Ministerie van Economische Zaken, Den Haag.
Member Jury EU Descartes Prize (Brussel).
Member Jury Christiaan Huygens Prijs, KNAW.
Member Organisatie Comité Symposium “Telscopisch Perspectief”, KNAW (23 Juni 2008).
Member, Scientific Organizing Committee 7th INTEGRAL Workshop, Copenhagen 8-12 September 2008.
Member, Appointment Committee Director Max Planck Institut für Extraterrestirsche Physik, Garching (meeting 24 November 2008, Heidelberg).
Associate Editor of New Astronomy Reviews
Associate Editor of Astrophysics and Space Science
Associate Editor of Astrophysics and Space Science Library

J.W. Hovenier
Associate Editor of the Journal Quantitative Spectroscopy and Radiative Transfer.

L.Kaper
Member ESO Contact Commissie.
Chairman board Vereniging van Akademie Onderzoekers.
NL Principal Investigator VLT/X-SHOOTER consortium.
Principal Investigator E-ELT/3DESIRE consortium.
Co-Principal Investigator E-ELT/OPTIMOS-EVE consortium.
Secretaris Stichting Amsterdam's Fonds voor de Astrofysica.
Chairman Time Allocation Committee Island Observatories.
Chairman Landelijke (NOVA) Onderwijs Commissie (LOCNOC).
Vice-chairman Kamer Sterrenkunde VSNU.
Chairman FNV Opleidingscommissie Natuur- en Sterrenkunde.
Chairman "Viva Fysica 2008".
Member NOVA Instrument Steering Committee.
Member Nederlands Committee Astronomie (NCA).
Member Nederlandse Astronomen Club.
Member European Astronomical Society.
Member International Astronomical Union.
Ambassadeur Platform Beta Techniek.

M. van der Klis
Voorzitter NOVA board.
Voorzitter NCA/Kamer Sterrenkunde.
Editor Science.
Editor New Astronomy.
Lid Wetenschappelijke Adviesraad, Evaluatie IMAPP RU Nijmegen 24-25 april.
Member SOC Workshop "A Decade of Accreting Millisecond Pulsars", Amsterdam, April 2008.
Receiving Editor of the New Astronomy Reviews

A. de Koter
Member Management Team API.
Coördinator for move to new building.
Chair Minnaert Commissie, support NOVA Informatie Centrum.
Member Redactieraad Kennislink.
Ambassador, Network Platform Beta Techniek.
NOVA Key Researcher, Network II.
Member NWO Beoordelingscommissie EW Vrije Competitie.
Member, Advisory Committee NOVA Phase-III Instrumentation Program.
Member Co-I Science Team, HIFI Guaranteed Time Key Project "The Physical and Chemical Properties of Circumstellar Environments around Evolved Stars".
Member Co-I Science Team, Mid Infrared Instrument for the James Webb Space Telescope.

A.G.J. Van Leeuwen
Full member of LOFAR Transients Key Project and Pulsar Working Group
Member SOC Low-frequency pulsar science, Leiden, 23-27 June 2008

S.B. Markoff
Member SOC "The Universe Under the Microscope: Astrophysics at High Angular Resolution", Bad Honnef Physics Center, Germany, April 2008.
Member SOC "Seventh Microquasar Workshop", Foca, Turkey, September.
Member SOC "LOFAR and the Transient Radio Sky", UvA, Amsterdam, December.
Member of the Physics Working Group, Cherenkov Telescope Array, Task Leader Multiwavelength Coordination.
Member of the Dutch Astroparticle Physics Committee (CAN).
Member of ASTRON WSRT/LOFAR PC.
Member of Chandra X-ray Observatory TAC (June, Boston).
Member of Executive Board of the Women in the FNWI committee (WiF).

S.F. Portegies Zwart
Organization “CosmoGrid” workshop, held 18-19 December 2008, Universiteit van Amsterdam.
MODEST: open community for modeling dense stellar systems
MUSE: open knowledge consortium for development of a multiscale multi physics environment for computational astrophysics
ASTROSIM: ESF funding for computational astrophysics
DEISA: Inter European Supercomputer N-body community
Rhine Network: Inter European N-body community
MICA: Meta Institute for Computational Astrophysics

N. Rea:
Member Swift TAC Panel.
Member Gemini TAC Panel.
Member Fermi-LAT Collaboration Team.
Member IXO Science Team Associate.

L.B.F.M. Waters
Member Nederlandse Astronomenclub (NAC).
Member National School for Research in Astronomy (NOVA).
Member International Astronomical Union (IAU).
Member HIFI science team.
Member MIRI science team.
Member MIDI science team.
Member Fachbeirat Max Planck Institut f"ur Astronomie, Heidelberg.
Member MATISSE science team.
Member board of the "Raad voor de Technische Wetenschappen, Wiskunde, Informatica, Natuurkunde Scheikunde en Sterrenkunde (TWINS)" of the KNAW.
Member Nationaal Platform Planeetonderzoek.
Member Science Advisory Board of the Space Research Organization Netherlands.
Member executive board of SPHERE.
Chair Dutch SPHERE team.
Member board of the Amsterdams Fonds voor de Astrofysica.
Member board of the Jan van Paradijs fonds.
Chair NWO ALW beoordelingscommissie Planeetonderzoek.
Member Royal Netherlands Academy of Arts and Sciences (KNAW).
Coordinator NOVA network 2.
Chair Department of Physics, Mathematics and Astronomy, FNWI, University of Amsterdam.

A.L. Watts
Member Steering Committee, Neutron Star Dynamics Collaboration.
Member Scientific Organising Committee, NIJMEGEN09 Summer School on Astroparticle Physics.

R.A.M.J. Wijers
Editor, New Astronomy Reviews
Editor, Monthly Notices of the Royal Astronomical Society
Member bestuur SRON
Member SAC ASTRON
Chair sectie Astrofysica NNV
Member CAN (Committee on Astroparticle Physics in the Netherlands)
Member AstroNet Roadmap Panel A
Member NCA
Chair LOFAR Astronomy Research Committee
Member LOFAR Research Management Committee
Co-PI, LOFAR Transients Key Project
Member NNV, NAC, VBNGH, IAU, IAU commissie 46, AAS, HEAD, RAS
Director, MSc A&A, UvA (vanaf sept 2007)
Member adviesraad bachelor school of science, FNWI, UvA
Member UCO (Universitaire Commissie Onderwijs)
Associate Editor of the Monthly Notices of the Astronomical Society
R.A.D. Wijnands
NOVA Key researcher and deputy coordinator of network 3.
Chair of scientific and local organizing committee for the workshop "A Decade of Accreting Millisecond X-ray Pulsars" 14-18 April 2008 in Amsterdam.
Member and later chair of the inquisition committee.
Member of the NWO vrij competitie selection committee.
Member of the local organizing committee of the workshop "LOFAR and the transient Radio Sky" organized in Amsterdam, the Netherlands, Dec 15-17 2008.
Chair of the opendag committee of the institute.
Editor in chief of the conference publication "A decade of accreting millisecond X-ray pulsars".
Member of the XMM-Newton Time Allocation Committee.
Member of the scientific organizing committee of the Session E11 "Astrophysical studies of Neutron stars from multiwavelength observations" held during the 37th COSPAR scientific assembly, 13-19 July 2008, Montreal, Canada.
Appendix III: Visiting Scientists

January
Luciano Burderi, January, (8)
Ramanpreet Kaur, University of Kumaon, India (4 - July 24)
Xander Tielens, NASA Ames, USA (22)
Gregory Rudnick, University of Arizona, USA (25)
Dr. Jonathan Braithwaite, University of Toronto, Canada

February
Xander Tielens, NASA Ames, (5)
Eli Waxman, Weizmann Institute, Israël (15)
Ted Gull, Goddard Space Flight Center NASA, USA, (19)

March
Jim Hinton, University of Leeds, UK (6)
Genevieve Parmentier, University of Liege, BE (7)
Andrew King (University of Leicester, UK), (13)
Justin Kasper, Harvard Smithsonian Center for Astrophysics, USA, (14)
Henny Veerman, University of Amsterdam, (17)
Moritz Böck, University Erlangen-Nürnberg, Germany
Samia Drappeau, University of Marseille, F

April
Floris van der Tak, University of Groningen, (4)
Marina Kaufman Bernado, MPI for Radio Astronomy, Bonn, Germany, (11)
Tomoaki Ishiyama, University of Tokyo, Japan (15 – May 23)
Michael Muno, Caltech, USA (18)
Andras Zsom, University of Heidelberg, (20-25)
Alexander van der Horst, Klaas Wiersema, Rhaana Starling, Asaf Pe'er (21-25)
Moritz Böck, University of Erlangen-Nürnberg, Germany, (1-4)
Victoria Grinberg, Ludwig-Maximilians University, Germany, (7-11)

May
Kiego Nitadori, University of Tokyo, Japan, (6-11)
Martin Bell, University of Southampton, UK, (19 - 30)
Zoë Leinhardt, University of Cambridge, UK (15)
Andy Young, University of Bristol, UK (16)
Julian Krolik, John Hopkins University, USA, (19)
Caroline d’Angelo, Max Planck Institute Astronomy, Garching, Germany, (27)
Jay Farihi, University of Leicester, UK, (30)

June
P. Chris Fragile, College of Charleston, USA, (5)
Anthony Moffat, University of Montreal, CA (10)
Xander Tielens, NASA Ames, (11)
Cole Miller, University of Maryland, USA, (13)
David Meier (JPL, USA), (1-6)
Masa Nakamura (Johns Hopkins U, USA), (1-6)
P. Chris Fragile (Charleston College, USA), (1-6)
June 4, the following people attended a mini-workshop on MHD/HD, funded by NOVA: Bram Achterberg (UU), Heino Falcke (RU), Leon Golub (CfA, USA), Anders Johansen (UL), Rony Keppens (Leuven University, B), Yuri Levin (UL), Zakaria Meliani (Leuven University, B), P. Chris Fragile,

July
- 

August
Matthew van Adelsberg, University of Colorado Boulder, USA, (1)

September
Matthew van Adelsberg University of Colorado Boulder, USA, (19)
Chryssa Kouveliotou, NASA MSFC, (24)
Paul O’Brien, University of Leicester, UK (25-26)
Amit Kashi, IUCAA, Poone, India, (30)

October
Amit Kashi, Technion, Israel, (1)
Mario van den Ancker, ESO, Garching, Germany (3)
Diego F. Torres, CSIS-CE Barcelona, ES (16)
Laurens Keek, SRON/University of Utrecht, (21)
Iossif Papadakis, University of Crete, Greece, (25)
Dan Maoz, Tel Aviv University, Israel, (31)

November
Inga Kamp, University of Groningen, (14)
Marika Taylor, University of Amsterdam/ITF, (21)
Ben Stappers University of Manchester, UK, (20-21)
Tom Hassall, University of Manchester, UK, (20-21)
Stephanie Cazaux, University of Groningen, (28)

December
Gustavo Romero, Argentinian Radio institute, Buenos Aires, Argentina, (4)
Maura McLaughlin, West Virginia University, USA, (12)
Douglas Heggie, University of Edinburgh, UK, (17-18)
Steve McMillan, Drexel, USA, (17-18)
Marian Joëls, University of Amsterdam/SILS, (18)
Jun Makino, Tokyo University, Japan, (18-20)
Tomoaki Ishiyama, University of Tokyo, Japan (18 Dec ’08-13 Jan ’09)
Dr. K. Kolenberg, University of Vienna, Austria
Andreas Burkert, University of Munich, Germany
Holger Baumgardt, University of Bonn, Germany
Clovis Hopman, University of Leiden
Onno Pols, University of Utrecht
Marco Spaans, University of Groningen
Appendix IV: Colloquia

January
(14) Yan Grange, University of Amsterdam, Detection of highly inclined showers with LOFAR
(25) Gregory Rudnick, University of Arizona, The Evolution of Cluster Galaxies over the last 8 Billion Years

February
(11) Thijs Coenen, Universiteit van Amsterdam, graduation colloquium, Automatic LOFAR Transient Classification
(15) Eli Waxman Weizmann Institute, Israel, NOVA Colloquium, High energy neutrino & cosmic-ray astronomy
(19) Ted Gull, Goddard Space Flight Ctr, NASA, USA, NOVA colloquium, Eta Carinae: an Astrophysical Laboratory

March
(06) Jim Hinton, University of Leeds, UK, HESS and CTA: A new window on the extreme universe
(07) Genevieve Parmentier, University of Liege, BE Probing star formation and galaxy evolution with star clusters
(10) Edda Heinsman, Universiteit van Amsterdam, Goodbye Andromeda? - Galaxy collision simulation of the effect of the transverse velocity component on the evolution of the Milky Way Andromeda system
(14) Justin Kasper, Harvard Smithsonian Center for Astrophysics, USA, NOVA colloquium, Low Frequency Radio Exploration of the Heliosphere
(17) Henny Veerman, Universiteit van Amsterdam, Spatially resolved low resolution mid-IR spectroscopy of Herbig Ae stars
(28) Tessa Weller, Universiteit van Amsterdam, graduation colloquium, Searching for faint and very faint X-ray point sources in the Triangulum Galaxy

April
(04) Floris van der Tak, Universiteit van Groningen, Submillimeter observations of high-mass star formation
(11) Marina Kaufman Bernado, Humboldt Fellow, MPI for Radio Astronomy, Bonn, DE, Magnetic field upper limits for jet formation in X-ray binaries and AGNs
(18) Michael Muno, Caltech, USA, NOVA colloquium, The Nearest Galactic Nucleus, from Radio to X-rays

May
(09) Michiel Visser, Universiteit van Amsterdam, graduation colloquium, A Rossi X-ray Timing Explorer study of outburst decays from transient low-mass X-ray binaries
(15) Zoë Leinhardt, University of Cambridge, UK, Is there more to it than collisions? Evidence for additional mechanisms in planetesimal evolution
(16) Andy Young, University of Bristol, UK, X-raying the Environment of Black Holes
(19) Julian Krolik, Johns Hopkins University, NOVA colloquium, Dynamics of Accretion Discs Around Black Holes
(27) Caroline d'Angelo, MPA Garching, DE, Soft X-ray components in the hard state of accreting black holes
(30) Jay Farihi, University of Leicester, UK Cool Contaminated Stellar Corpses

July
(05) P. Chris Fragile, College of Charleston, USA, Black-Hole Accretion Disks: A look from the perspective of direct numerical simulation
(10) Anthony Moffat, University of Montreal, CA, Dusty Spirals
(13) Cole Miller, University of Maryland, USA, *The Astrophysical Context of Black Hole Mergers*

**August**
(01) Matthew Adelsberg, University of Colorado Boulder, USA, *Title unknown*
(19) Johan Withagen, Universiteit van Amsterdam, graduation colloquium, *On the collision between the Milky Way and the Andromeda Galaxy*
(28) Coen Peters, Universiteit van Amsterdam, graduation colloquium, *Where are the low-mass black holes? A literature study*

**September**
(04) Mihkel Kama, University of Amsterdam, graduation colloquium, *Modelling the inner rim of protoplanetary discs*
(05) Gijs Mulders, University of Amsterdam, *Dusty Disks: H3+ chemistry in protoplanetary disks*
(26) Paul O'Brien, University of Leicester, UK, *What has Swift taught us about Gamma-ray Bursts?*
(30) Kostadinos Leventis, Universiteit van Amsterdam, graduation colloquium, *Modelling the simultaneous radio/x-ray flare from Cyg X-1*

**October**
(01) Amit Kashi, Israel, *Physical Processes During the Periastron Passage of Eta Carinae*
(03) Mario van den Ancker, ESO, Garching, DE, *Infrared Observations of Planet-Forming Disks Around Young Stars*
(16) Diego F. Torres, CSIC-ICE, Barcelona, S, *Gamma-ray binaries: High energy phenomenology and models*
(21) Laurens Keek, SRON/Utrecht, High energy seminar, *Thermonuclear burning on accreting neutron stars*
(24) Iossif Papadakis, University of Crete, GR, *Long term spectral variability analysis of AGN*
(31) Dan Maoz, Tel Aviv University, Israel, NOVA colloquium, *Supernova rates: seeing cosmic metal enrichment in action*

**November**
(14) Inga Kamp, University of Groningen, *Probing protoplanetary disk evolution ... or How to make a Solar System*
(21) Marika Taylor, ITF, Universiteit van Amsterdam, *Are black holes really fuzzballs?*
(28) Stephanie Cazaux, University of Groningen, *Interstellar dust grains and the chemistry of the Universe*

**December**
(12) Maura McLaughlin, West Virginia University, USA, *New Results on Rotating Radio Transients*
(18) Professor Marian Joëls, Universiteit van Amsterdam, Neuroscience Department at SILS, Christmas colloquium: *Is stress bad?*
Appendix V: Scientific Meetings

5.1 Scientific talks at Astronomical Institutes and Conferences

D. Altamirano
Science, Techniques and Tools? (Invited talk), at the workshop X -ray timing with ASTROSAT: Science, Techniques and Tools, Pune, India October 13-15th
Testing universal frequency-frequency correlations with the black hole candidate XTE J1550-56 (Invited talk), at the Microquasar Workshop, Turkey, September 1
Millihertz oscillations and Type I X-ray bursts: and intimate relation?, (invited talk), COSPAR 2008, Solicited talk in Canada on Saturday, July 19
Intermittent accreting millisecond pulsars: light houses with broken lamps?, (Invited talk) at the workshop "A Decade of Accreting Millisecond X-ray Pulsars", Amsterdam, April 14-18

P. Casella
Discovery of two intermittent pulsar, at the 37th COSPAR Scientific Assembly, Montreal, July
Weighing the black holes in Ultraluminous X-ray Sources through timing (Contributed talk), at the 37th COSPAR Scientific Assembly, Montreal, July

C. Dominik
Cosmic Dust near and far (Invited review talk), at a meeting in Heidelberg, September 8-9
Dust Coagulation, Winterschool "Planet Formation" in Bonn, Germany, organized by the University of Tübingen, February 18-22

M.A. Gurkan
Contributed talk, Frontiers in Computational Astrophysics: The Origin of Stars, Planets and Galaxies, Ascona, Switzerland, July 13-18

H.F. Henrichs
Narval observations of Xi Persei O7.5III, Kingston, Canada, July 3

J.W.T. Hessels
Time Domain Search Techniques for Fast Radio Transients, Univ. of Amsterdam (Invited talk), Amsterdam, December 15
The Dynamic Radio Sky at High Time Resolution: Pulsars, Transients, and Bursts, NCRA-TIFR (Invited talk), Pune, December 10
Pulsars and Fast Radio Transients with LOFAR, Observatoire de Paris (Invited talk), Paris, November 26
Deep, targeted imaging of pulsar wind nebulae with LOFAR, Astrophysics with E-LOFAR (talk), Hamburg, September 16
Uncovering the population of nearby neutron stars at low radio frequencies, COSPAR Symposium E11 (talk), Montreal, July 17
Transient Neutron Stars, Low-Frequency Pulsar Science (invited talk), Leiden, June 25
European Pulsar Timing Array, WSRT Users’ Meeting (talk), Amersfoort, June 4
Eclipsing millisecond pulsars in Terzan5, A Decade of Accreting Millisecond X-ray Pulsars (Invited talk), Amsterdam, April 17

J.W. Hovenier
Light scattering by cosmic particles (Invited review talk) at the Eleventh Electromagnetic and Light Scattering Conference, Hatfield, UK, September 7-12
G.H. Janssen
Multi-telescope timing, Arecibo PTA workshop (Invited talk), Puerto Rico, August
High precision radio pulsar timing with the EPTA, NAC (talk), May 8

T. De Jong
The Babylonian prediction of the omitted phases of Mercury at the Third Regensburg Workshop on Babylonian Astronomy, Durham, UK, May 29
On Babylonian Period Relations: a Friday Afternoon Frivolity at the Third Regensburg Workshop on Babylonian Astronomy, Durham, Uk, May 31

R. Karuppusamy
PuMaII, YERAC 2008 (Invited talk), Gotenburg, June 2008

A.G.J. van Leeuwen
Radio pulsars with LOFAR: a study of extreme physics laboratories, Nederlandse Astronomen Conferentie, Dalfsen, May 8
Pulsar Surveys at Low Frequencies (Invited review talk), Low-frequency pulsar science, Leiden, June 23-27
Radio-pulsar instrumentation, CASPER digital processing work shop, Berkeley, Aug 3-10
Transient Universe with LOFAR and SKA, NL SKA workshop, Dwingeloo, November 27-28
Pulsar surveys, LOFAR and the Transient Radio Sky, Amsterdam, December 15-17

M. Linares
Timing the accretion flow around accreting millisecond pulsars, (Invited talk at the workshop "A Decade of Accreting Millisecond X-ray Pulsars", Amsterdam, April 14-18

S.B. Markoff
ISSI Team Meeting, Bern, CH, January 14-18 Dutch Astroparticle Physics Symposium, UvA, March 5
Universe Under the Microscope: Astrophysics at High Angular Resolution, Bad Honnef, D, April 21-25
MHD workshop, UvA, June 1-4
Radio Galaxies in the Chandra Era (Invited review talk), Cambridge, USA, July 8-11
Invited review talk at the Seventh Microquasar Workshop, Foca, Turkey, September 1-5, CTA Workshop, Padova, Italy, November 3-5

A. Patruno
Analysing the spin of accreting millisecond pulsars (Contributed talk) at the Neutron Star Dynamics workshop, Gregynog, Wales, UK, January 31 - February 2
Observations of low-mass X-ray binaries and accreting millisecond pulsars (Contributed talk), at the 44th arpacz Winter School in Theoretical Physics, Ladek Zdroj, Poland, February 18-29
Motion of the hot spot and spin-torque in accreting millisecond pulsars (Invited talk), at the conference: A decade of accreting millisecond X-ray pulsars, Amsterdam, April 14-18
Invited lecturer at the Bogoliubov Laboratory of Theoretical Physics at the Joint Institute for Nuclear Research for the Helmholtz International Summer School.
Dense Matter In Heavy Ion Collisions and Astrophysics, at the meeting: “Probing neutron star physics using accreting neutron stars”, Dubna, Moscow Region, Russia, July 14-26

N. Rea

D.M. Russell
Unifying disc-jet behaviour in X-ray binaries: an optical/IR approach’ (Invited talk) given at the conference 'VII Microquasar Workshop: Microquasars and Beyond', Izmir, Turkey, September 1
Spectral evidence for jets from Accreting Millisecond X-ray Pulsars (Invited talk) given at the conference ‘A Decade of Accreting Millisecond X-ray Pulsars’, Amsterdam April 16.
M. van der Klis
kHz QPOs: the Link with the Spin (Invited talk) at the workshop "A Decade of Accreting Millisecond X-ray Pulsars", Amsterdam, April 14-18
Invited review at COSPAR Montreal, Canada, July 14-19

L.B.F.M. Waters
Interstellar dust (Invited talk) at the NAC Annual meeting Utrecht, January 18
Dust around massive evolved stars (Invited talk), at the workshop "Hot and Cool: Bridging gaps in massive star evolution", Pasadena, U.S.A., November 18

A.L. Watts:
Detectability of gravitational waves from the known accreting neutron stars Neutron Star Dynamics Collaboration meeting, Gregynog, Wales, February
Detectability of gravitational waves from accreting neutron stars, 10th Astroparticle Physics Symposium, Amsterdam, March
Burst oscillations from the accreting millisecond pulsars (invited review) "A decade of accreting millisecond pulsars", Amsterdam, April
Detecting gravitational waves from the known accreting neutron stars 37th COSPAR Scientific Assembly, Montreal, Canada, July
Type I X-ray bursts and burst oscillations (invited review) 37th COSPAR Scientific Assembly, Montreal, Canada, July
Timing accreting neutron stars: torques, timing noise and anti-glitches Neutron Star Dynamics Collaboration workshop on Glitches and Timing Noise, Manchester, UK, September
Future high energy missions and their impact on studies of neutron star dynamics Neutron Star Dynamics Collaboration workshop on Glitches and Timing Noise, Manchester, UK, September

R.A.D. Wijnands
The discovery of a millisecond X-ray pulsar (Invited talk), at the workshop "A Decade of Accreting Millisecond X-ray Pulsars", Amsterdam, April 14-18
Finding fast spinning neutron stars using XMM-Newton, at the workshop "A Decade of Accreting Millisecond X-ray Pulsars", Amsterdam, April 14-18
Discovery and monitoring sub-luminous X-ray binaries using MAXI (Invited talk), at the workshop "3rd MAXI workshop", Wako-Shi, Japan, June 9-13
Accreting millisecond X-ray pulsars: recent developments (Invited Review Talk), at the second ASTRONs meeting, Istandbul, Turkey, 30 June - 4 July
Cooling of accretion-heated neutron stars (Invited talk), at the "37th COSPAR scientific assembly" in Montreal, Canada, July 13-19.
Ten years of fast-spinning accreting neutron stars (Invited talk), at the Alumni party, to celebrate the 100th PhD thesis of our institute, Amsterdam, November 22

5.2 Colloquia given

D. Altamirano:
Accretion-powered millisecond X-ray pulsars: 10 years of discoveries at MPIFR, Bonn, Germany, October 31.
Different manifestations of accretion onto compact objects: all about black holes and neutron stars in LMXBs (Invited talk), FCAGLP, Argentina, May 15
Different manifestations of accretion onto compact objects: unstable and marginally stable burning on the neutron star surface, IAR, Argentina, May 16.
Different manifestations of accretion onto compact objects: thermonuclear burning and accretion powered millisecond X-ray pulsars, seminar at SRON, the Netherlands, April 2

P. Casella:
Can an asteroid make a neutron star pulsate? (Invited talk), colloquium at the Astronomical Observatory of Milan, Italy, February 21
Weighing the black holes in Ultraluminous X-ray Sources through timing (Invited talk), colloquium at the Astronomical Observatory of Rome, Italy, May 13.
Connecting pulsating and non-pulsating X-ray sources (Invited talk), colloquium at the University of Southampton, UK, July 3.
Ultraluminous X-ray Sources: how can we weigh a black hole? (Invited talk), colloquium at the Astronomical Observatory of Milan, Italy, November 27.

H.F. Henrichs
Magnetic fields in massive stars, University of Nijmegen, January 18

J.W.T. Hessels
The Dynamic Radio Sky at High Time Resolution: Pulsars, Transients, and Bursts (Invited talk) Univ. of Alberta Colloquium, Edmonton, 17 October 2008
The Dynamic Radio Sky at High Time Resolution: Pulsars, Transients, and Bursts (Invited talk), SRON Colloquium, Utrecht, 1 October 2008

A. De Koter
Mass loss from Massive Stars: the extreme object eta Carinae (Invited talk), Queens University, Belfast, Northern Ireland, April 23
Mass loss from Massive Stars: the extreme object eta Carinae (Invited talk), Armagh Observatory, Armagh, Northern Ireland, April 24

A.G.J. van Leeuwen:
Radio pulsars with LOFAR, ASTRON colloquium, Dwingeloo, September 11

S.B. Markoff
Astrophysics Seminar and Physics Colloquium, University of Crete, Greece, June 26-27

P.D. Meerburg.
Non-Gaussianities from a modified initial state. Contributed talk at PASCOS symposium, Waterloo University, Canada, June 6
Non-Gaussian shapes: local, equilateral and squashed triangles, talk at the IUCAA, Pune, India, August 29

N. Rea:
Has given several talks at the University of Colorado Boulder (USA), IEEC CSIC Barcelona (Spain) and Purdue University (USA)

A.L. Watts:
Gravitational waves from accreting neutron stars: why ignorance is not bliss, NIKHEF Colloquium, Amsterdam, December.

5.3 Workshop/conference organization:

S.F. Portegies Zwart
MODEST-8b workshop, September 15-19
CosmoGrid workshop, December 18-19

R.A.M.J. Wijers
Appendix VI: Scientific Publications

Dissertation intern

dissertatie


Scientific Publications Refereed

Articles - papers


Galactic Center Survey point sources with Chandra X-ray point sources in the central $40 \times 40$ parsecs. *Astrophysical Journal, 685*(2), 958-970.


Proceedings


from protoplanetary disks using near- and mid-infrared high-resolution spectroscopy. In *IAU Symposium* (pp. 359-368).


international workshop held in Potsdam, Germany, 18.-22. June 2007 (pp. 143-146). Potsdam: Universitätsverlag Potsdam.


Astronomical telegrams


