Astronomical Institute
Anton Pannekoek

Annual Report 2005

Faculty of Science
Universiteit van Amsterdam
Contents

1 Introductory remarks 4
  1.1 Highlights 4
  1.2 Mission, strategy and management 5

2 Research Activities 8
  2.1 The life cycle of stars and planets 8
    2.1.1 Structure, evolution, and the onset of planet formation in proto-planetary disks 9
    2.1.2 Solar system comets 10
    2.1.3 The characterization of exoplanets 11
    2.1.4 Evolved low-mass stars 12
    2.1.5 The interstellar medium 12
    2.1.6 Experimental and theoretical studies of light scattering on dust 13
  2.2 Astrophysics of Stars and Star Clusters 13
    2.2.1 The VLT-FLAMES Survey of Massive Stars 14
    2.2.2 The formation and evolution of massive stars 14
    2.2.3 Evolution of massive binary stars 15
    2.2.4 Dynamics of star clusters and stellar encounters 17
  2.3 Relativistic Astrophysics and Compact Objects 19
    2.3.1 Probing relativistic potentials with X-rays 20
      2.3.1.1 Surveys of X-ray sources 21
      2.3.1.2 Black hole candidates 21
      2.3.1.3 AGN 22
      2.3.1.4 Neutron stars and dense matter 23
    2.3.2 Pulsars and magnetars 24
    2.3.3 Jets 25
    2.3.4 Gamma-ray bursts 25
      2.3.4.1 Gamma-ray burst sources and mechanisms 27
      2.3.4.2 Gamma-ray bursts as probes of the universe and star formation 30
  2.4 History of Astronomy 30
3 Onderwijs 32
3.1 Inleiding 32
3.1.1 Sterrenkunde colleges voor de bachelor- en masteropleiding 33
3.1.2 Doctoraal examens en promoties in 2005 33
3.1.3 Onderwijs en voorlichtingsactiviteiten van de staf in 2005 33

4 Public Outreach Activities, Awards, Prizes etc. 37
4.1 Scientists in press articles 37
4.2 Popular lectures 38
4.3 Popular publications 39
4.4 Interviews and appearances on radio/tv 39

5 Management 40
5.1 Finance 40
5.2 Human Resources 41

Appendix I: Institute Staff on 31-12-2005 43
Appendix II: Promovendi en promoties 2005 44
Appendix III: Memberships 45
Appendix IV: Visiting Scientists 48
Appendix V: Colloquia 50
Appendix VI: Scientific Meetings 51
Appendix VII: Observing Sessions 59
Appendix VIII: Scientific Publications 60
Appendix IX: Contact Information 71
1. Introductory remarks

1.1 Highlights

The year 2005 was a notable one for the Astronomical Institute as the year that Ed van den Heuvel, after having led the Institute for many years, at age 65 reached mandatory retirement and resigned his post as the Institutes’ director. Ed assumed his post of professor of astrophysics at the University of Amsterdam in 1974, and since then, with a number of interruptions in the early years, was the scientific leader and inspirator of the Institute. During this time, Ed guided the Institute to an international top-position and UvA astronomy became a prominent member of the Netherlands’s astronomical scientific community. The university baseline funding for astronomy in terms of permanent scientific staff grew from 6 to 8.9 fte during this 20-year period, but thanks to external funding about 60 people now contribute to the Institute’s scientific output.

This transition was marked by a number of special events that took place in the second half of the year. An international conference entitled ‘A Life with Stars’ was held in the Rode Hoed during the week of 22-26 August; scientific debate was vigorous and Ed’s work was not spared in the clash of scientific opinions (mostly, his views prevailed). On September 1st, at the beginning of the academic year, Ed formally resigned as director of the Astronomical Institute – he was succeeded by Michiel van der Klis. Ed’s formal farewell lecture in the University Aula took place on November 3d and filled the room to overflowing. On this occasion Ed was presented with the University Medal for special merit by the chair of the University Board, Prof.dr. S. Noorda. Just for the members of the Institute on November 24th there was a final event graciously hosted by Ed and Annemike at their home in Baarn. Ed plans to stay on in the Institute in his capacity of active (and highly appreciated) emeritus.
During 2005 the Institute stayed the course outlined in its research plan 2000--2005 in the area of scientific research and in scientific education, as described in detail in Sections 2 and 3 of this report. A small selection of additional notable events and highlights is provided here.

- Dr. Ben Stappers (ASTRON & UvA) as a member of the European PULSE collaboration on December 2nd received an EU Descartes prize for their “research into the use of radio pulsars to study some of the most extreme physical conditions in the universe and test some of its most fundamental laws”, specifically, the studies of the double pulsar.

- The origin of the enigmatic short gamma ray bursts was clarified thanks to the identification with the SWIFT satellite of such a gamma ray burst with an old, elliptical galaxy. The result was published in Nature on October 6th by a large international team including Starling and Wijers.

- A state of the art radio pulsar instrument, PuMa II, was completed, and officially taken into operation at ASTRON’s Westerbork Synthesis Radio Telescope on December 16th. The design and construction of PuMa II was a project of the Nederlandse Onderzoeksschool Voor Astronomie NOVA led by van der Klis and Stappers.

- NWO VENI grants were awarded in December to Dr. Mieke C. Bouwhuis (NIKHEF & API) and Dr. Michiel Min for research into, respectively, cosmic neutrinos and planet formation.

- Dr. Lex Kaper was appointed extraordinary professor at the Vrije Universiteit. He gave his inaugural lecture on April 20th.

- A very successful workshop on Modeling Dense Stellar systems (the MODEST 5c summer school) was organized by Dr. Simon Portegies Zwart and his group from 24-29 July. About 60 students from all parts of the world were hosted by the Astronomical Institute Anton Pannekoek and the Section Computational Science.

1.2 Mission, strategy and management

The ultimate goal of astronomical research is to understand the Universe and the objects within it in terms of the laws of physics. The structure of the Universe and its development over the course of time, the nature, formation, and evolution of planets, stars, galaxies, clusters and super clusters of galaxies, and the properties of the medium in which these are embedded, are all important objects for study. Cosmological questions concerning the nature and evolution of the Universe relate directly to such questions as the geometry of space-time, the nature of dark matter which constitutes over 90% of the gravitating mass in the Universe but leaves no trace in the form of electromagnetic radiation, the formation of the elements, of planetary systems, and ultimately, the origin of the Earth and of life. Furthermore, the Universe provides a unique laboratory for investigating and testing the laws of chemistry and physics under conditions far more extreme than can be reached in laboratories on Earth: astrophysicists study phenomena involving enormous scales of length and mass (the Universe as a whole), huge densities (e.g., neutron stars, black holes), extreme vacua (interstellar and intergalactic media), immense energies (explosive phenomena such as supernovae and quasars), and intense fluxes of particles and radiation (neutrinos, gamma-ray bursts).

Since 1992, all graduate astronomy education in the Netherlands has been concentrated in NOVA, the Netherlands Graduate School for Astronomy. NOVA is a federation of the astronomy institutes at the universities of Amsterdam (UvA), Groningen (RuG), Leiden (UL), and Utrecht (UU), and also includes the new astronomy group at the Radboud Universiteit Nijmegen (RUN). The University of Amsterdam carried the responsibility for NOVA for a five-year period from 1997 through 2002 (the penvoerderschap rotates among the four large participating institutes every 5 years). In 2003 the “penvoerderschap” went to the University of Groningen.
The mission of the four university institutes that together constitute NOVA is two-fold:

- to train students and young astronomers at the highest international level;
- to carry out frontline astronomical research in the Netherlands.

In 1998 NOVA was selected by the Minister of Science as one of the six “Top Research Schools” in the country, granting it substantial extra funding for a period of ten years, starting 1-1-1999. In 1999 NOVA started its ten-year “Dieptestrategie” research programme “Astrophysics: Unravelling the History of the Universe” as a national “top researchschool”.

This NOVA programme focuses on three main research themes:

1. Formation and Evolution of galaxies: from high redshift to the present
2. Birth and Death of Stars: the life cycle of matter in the Universe

Research at the University of Amsterdam largely concentrates on the latter two themes, indicated throughout this document “Low Energy Astrophysics” and “High Energy Astrophysics”, respectively, according to the energies of the electromagnetic radiation emitted by the objects. These names are used throughout this report. Through the studies of Gamma Ray Burst sources, the research of the institute is now also branching out into Theme 1. The table on page 8 gives an overview of the present research fields in the Institute, as summarized in the Institute’s research plan for the period 2000 – 2005: “Frontiers in Astronomy and Cosmic Physics”.

Another important part of the mission of the Astronomical Institute Anton Pannekoek is the dissemination of the results of astronomical research to the general public and to schools. NOVA’s national Office of Public Outreach is located at the institute, and Prof. T. de Jong is member of the Board of the Amsterdam Zoological Garden “Artis”, responsible for the Artis-Planetarium – an important educational facility for astronomy. The foundation of this Planetarium in 1982 was the initiative of two UvA professors: E.P.J. van den Heuvel and J.W. Hovenier (at that time professor at the Vrije Universiteit).

Institute Management (per 31/12/2005)

*Scientific Director*
Prof.dr. M. van der Klis
Table 1: Areas and subjects of planned research

HIGH-ENERGY AND RELATIVISTIC ASTROPHYSICS:
Final stages of stellar evolution: physics of neutron stars and black holes

<table>
<thead>
<tr>
<th>AREA</th>
<th>SUBJECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics of Neutron Stars and Black Holes</td>
<td>Measurement of fundamental parameters of neutron stars (mass, radius rotation period, magnetic field) and black holes (mass, angular momentum).</td>
</tr>
<tr>
<td></td>
<td>Observed behavior of matter in ultra strong gravitational fields; tests of general relativity: frame dragging, last stable orbit.</td>
</tr>
<tr>
<td></td>
<td>Studies of relativistic outflows.</td>
</tr>
<tr>
<td></td>
<td>Study of (binary) radio pulsars; tests of general relativity.</td>
</tr>
<tr>
<td></td>
<td>Theoretical studies of the formation and evolution of neutron stars (NS) and black holes (BH) in binary systems; formation rate of double neutron stars and black holes.</td>
</tr>
<tr>
<td></td>
<td>Evolution of stellar populations (clusters) with a realistic binary fraction; dynamical formation of NS and BH binaries.</td>
</tr>
<tr>
<td>Gamma-Ray Burst Sources</td>
<td>Optical identifications, light curves, redshift distributions, cosmological evolution.</td>
</tr>
<tr>
<td></td>
<td>Study of population of parent galaxies as function of redshift.</td>
</tr>
<tr>
<td></td>
<td>Theoretical modeling of bursts; relativistic acceleration mechanisms.</td>
</tr>
</tbody>
</table>

LOW-ENERGY ASTROPHYSICS:
Birth and death of stars: the life cycle of matter in the Universe

<table>
<thead>
<tr>
<th>AREA</th>
<th>SUBJECT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Search for proto-planets and planets around other stars, using VLTI, ALMA, FIRST</td>
</tr>
<tr>
<td></td>
<td>Study of formation and evolution of massive stars in Local Group and “Starburst Galaxies”; relation to chemical evolution and dust formation in galaxies in the early Universe.</td>
</tr>
<tr>
<td></td>
<td>Theoretical modeling of spectra of circumstellar gas and dust.</td>
</tr>
<tr>
<td>Solar System Studies, Lab. Astrophysics</td>
<td>Spectroscopy and photometric studies of planets, comets and asteroids, in order to compare with observed properties of (proto-) planetary systems around other stars, laboratory experiments in light scattering and polarization.</td>
</tr>
<tr>
<td>Late Stages of Stellar Evolution, Mass Loss</td>
<td>Studies of dense circumstellar matter around highly evolved stars; AGB and post-AGB stars; formation of dust in envelopes of these stars.</td>
</tr>
<tr>
<td></td>
<td>Studies of winds of massive stars and mass loss from luminous blue variables (LBV’s).</td>
</tr>
</tbody>
</table>
2. Research Activities

Research at the Astronomical Institute Anton Pannekoek can be broadly divided into astrophysics of black holes and neutron stars ('high-energy astrophysics') on the one hand, and star- and planet formation ('low-energy astrophysics') on the other. However, there is considerable overlap between the two in the area of studying the nature and evolution of massive stars, so the separation is not very sharp, and an appreciable research effort in the astrophysics of stars and stellar clusters bridges the two research areas. Overall, the Institute's research touches on most aspects of the life cycle of stars, from their birth out of clouds of dust and gas, to beyond the enormous explosions in which they return much of their gas back to those clouds and become neutron stars and black holes. We report here on the main research results of the institute that appeared in print in 2005, starting with star and planet formation, followed by the astrophysics of stars and star clusters, to the final fate of stars and relativistic physics of compact objects.

2.1 The life cycle of stars and planets

Over the past 13 billion years stars have been formed out of interstellar gas and dust clouds. During their lives, they return the major part of the material from which they are composed to the interstellar medium by means of stellar outflows and supernova explosions. Part of the material that is returned has been processed by thermonuclear reactions, causing a slow but continuous enrichment of our Universe with elements more massive than Lithium. In the interstellar medium part of these ‘heavy elements’ may condense in solid-state form, called ‘dust’. During the formation of stars these dust grains may grow and aggregate to form planets, of which terrestrial planets are thought to be one of the essential ecological requirements for life.

At the Anton Pannekoek institute this great cycle of gas and dust is a key research area. The focus is on those phases in the lives of stars in which their interaction with the interstellar medium is most profound. Special emphasis is placed on the properties and life cycle of dust particles. The size, shape, structure and composition of dust particles are also investigated experimentally in our light scattering laboratory.

To facilitate this research the API is participating in a German-led study to design and build the “Planetfinder”, an optical/near-IR camera for the direct detection of extra solar giant planets for the Very Large Telescope of ESO, called
CHEOPS. In 2005, ESO selected a competing consortium (led by LAOG, P.I. J.-L. Beuzit) to take the lead in the construction of the Planetfinder, leading to a merging of both consortia into one. The Dutch participation focuses on ZIMPOL, a camera optimized for the polarimetric detection of old, Jupiter-type planets circling nearby stars. An NWO-M proposal was submitted to support the Dutch participation in the Planetfinder.

The API is also one of six international institutes participating in the design of a microgravity dust aggregation experiment to be placed on board of the International Space Station. The idea is to study the initial phases of planet formation under realistic, i.e. microgravity conditions. Part of the experiment will be to study the light scattering properties of the dust aggregates as they grow. The contribution from the API will be in calibration measurements of samples in the laboratory, and theoretical studies of dust aggregation physics, and interpretation of the science data. Due to an uncertain financial future of ESA’s microgravity programme, not much development could be reported in 2005. It is expected that early 2006 the programme will be re-activated.

Reported below are the main activities and results obtained in 2005 by the members of the low energy astrophysics group: Carsten Dominik, Huib Henrichs, Joop Hovenier, Teije de Jong, Alex de Koter, Joke Meijer, Michiel Min, Rohied Mokiem, Roald Schnerr, Daphne Stam, Arjen Verhoeff, Hester Volten, and Rens Waters.

2.1.1 Structure, evolution, and the onset of planet formation in proto-planetary disks

A further investigation of the 10 micron feature from the disks of a large sample of Herbig stars was performed by Van Boekel, Min, Waters, de Koter, Dominik and co-workers (2005). It was found that none of the sources consists of fully pristine dust comparable to that found in the interstellar medium. In addition, all sources with a high fraction of crystalline silicates are dominated by large grains. The disks around relatively massive Herbig stars have a higher fraction of crystalline silicates than those around lower mass stars, which may be a selection effect. It is concluded that the present data favor a scenario in which the crystalline silicates are produced in the innermost regions of the disk, close to the star, and transported outward to the regions where they can be detected by means of 10 micron, and that the final crystallinity of these disks is reached very soon after active accretion has stopped.

Dullemond and Dominik carried out detailed numerical simulations of dust coagulation in disks, coupled with radiative transfer calculations in order to derive observable effects of dust growth. It was found that allowing coagulation to proceed at maximum efficiency leads to extremely fast depletion of small particles in the disk, incompatible with observations. It therefore seems mandatory that dust destruction in fast collisions (occurring when grains decouple from the gas) must be treated correctly in such calculations. The small grain population in disks is likely a steady-state solution of the coagulation-fragmentation equation.

Together with de Ruyter and co-workers, Waters and Dominik studied extended Spectral Energy Distributions (SED’s) of seven classical RV Tauri stars, using newly obtained sub-millimeter continuum measurements and Geneva optical photometry supplemented with literature data. The broad-band SED’s show a large IR excess with a black-body slope at long wavelengths in six of the seven stars, R Sct being the noticeable exception. This long wavelength slope is best explained assuming the presence of a dust component of large grains in the circumstellar material. It was shown that the most likely distribution of the circumstellar dust around the six systems is that the dust resides in a Keplerian disk, truncated on the inner side by dust sublimation.
Figure 1: Processes relevant for the presence of gas-phase water in the surface layer of a protoplanetary disk. UV photons from the star or from the interstellar radiation field desorb individual water molecules from ice mantles. Once in the gas phase, further UV irradiation will dissociate some of the water molecules. Water can also be formed from a reaction between O and H3+, directly in the gas phase. Water molecules may collide with a dust grain and freeze out again. Finally, oxygen and hydrogen atoms may get attached to dust grains and react on the grain surface to form water ice.

Ceccarelli and Dominik developed a chemical model for the deuteration of H3+ in protoplanetary disks. The most important reaction is the one exchanging a proton with a deuteron (H3+ + HD to H2D+ + H). This reaction is exothermic, and the reverse reaction is forbidden at low temperatures. In the outer midplane of circumstellar disks around T Tauri stars, densities are high and temperatures are low so that CO will freeze out on dust grains. If CO freezes out, an important reaction destroying H3+ and its deuterated isotopomers becomes marginalized. This can lead to almost the entire positive charge being carried by H2D+, D2H+, and even D3+. The resulting columns of H2D+ compare well with the observed H2D+ in DM Tau.

Greaves, Dominik and co-workers re-evaluated existing observations of the ε Eridani circumstellar disk at sub-millimeter wavelength and compared these with newer observations by several other authors. The resulting images show the distribution of dusty debris generated by comet collisions. The analysis shows that clumps generated by resonant interaction with an unseen planet seem to have moved counterclockwise by about 1 degree per year. If confirmed this will allow to measure the distance of the unseen planet to the star.

Together with Ceccarelli and Lefloch from Grenoble, Caux from Toulouse and Caselli from Florence, Dominik obtained observations of the protoplanetary disk around DM Tau and found an absorption line at 464GHz, associated with deuterated water. The water vapor appears to be distributed like a blanket over the circumstellar disk, where it absorbs the continuum emitted by the dust in the disk midplane. Dominik and colleagues developed a chemical model of the disk where water molecules are desorbed from icy grain mantles by FUV photons in the upper layer of the disk. This process leads indeed to a blanket of water vapor spread out over the entire disk and may account for the observed deuterated water. Since the non-deuterated water is not observable from the ground, the ratio of HDO/H2O can only be estimated from the observations. An educated guess of the Water abundance leads to HDO/H2O = 0.01 (Figure 1).

Thi, Waters, and co-workers studied the disk surrounding the young Herbig Ae/Be star 51 Oph. The near-IR spectrum of 51 Oph is characterized by strong emission from CO first overtone vibrational bands, implying the presence of hot molecular gas. The shape of the emission bands suggests they are formed in a rotating disk which must be close to the star. Thi et al. conclude that there may be an inner dust-free gas disk in 51 Oph. This is different from what is found in some other Herbig Ae/Be stars, where no evidence for first overtone CO emission is found, and where the dust survives up to its sublimation temperature of about 1500 K.

2.1.2 Solar system comets

Comet Hale-Bopp was one of the brightest and most spectacular comets of the 20th century. Luckily, its infrared spectrum could be recorded by the Infrared Space Observatory (ISO) over a large wavelength range. This spectrum displays a large number of sharp resonances attributed to crystalline silicate particles. These crystals have to be formed at high temperature, so close to the sun, while the comet itself is a ball of mostly ice and dust, and has to be formed at very low temperatures. This apparent paradox has puzzled astronomers for quite some time. Min, Hovenier, de Koter, Waters and Dominik have conducted a detailed analysis of the infrared emission spectrum of Hale-Bopp using a statistical approach to model the dust grains in the coma of the comet. They find, for the first time, a model which is consistent with the observed emission spectrum over the entire wavelength range, with observations of the degree of linear polarization of sunlight scattered by the cometary grains at twelve different wavelengths, and with constraints of the abundances of the chemical elements in the dust.
This model shows that there is a large difference in the size of the crystalline and the amorphous dust grains, the crystals being much smaller. This results in an estimate for the crystallinity of the dust which is significantly lower than previously assumed, but consistent with the production of crystalline silicates in the inner Solar System by thermal annealing and subsequent radial mixing to the comet forming region at about 30 AU.

Figure 2: The spectrum of comet Hale-Bopp, together with a decomposition of the dust species that contribute to the observed emission (grey line). The small (large) grain component is denoted with a dotted (dashed) line in the upper panel. The black line indicates the best-fit model. The contributions of the various solid-state components are displayed in the lower panels.

2.1.3 The characterization of exoplanets

Most exoplanets found to date have been detected by the radial velocity technique, which measures the wobble of the star induced by one or more unseen planets through small changes in the star’s spectral features.

The VLT with adaptive optics may allow direct detection of the more massive exoplanets and a first physical characterization of their atmospheres. Stam, Hovenier, and Waters have developed radiative transfer models to describe the flux and state of polarization of starlight that is reflected by extrasolar planets. Numerical simulations have been done for giant, gaseous planets, such as Jupiter, and for small, terrestrial planets, such as the Earth itself. The simulations for the giant planets show that the degree of polarization of such planets can be very high (~30%) and that it depends strongly on the physical characteristics of the planetary atmosphere, such as the cloud cover and methane abundance. These simulations have been applied to the design of the polarimetric arm of Planetfinder, a second-generation instrument for the VLT. The simulations for terrestrial planets show that the flux and degree of polarization of a Venus-like extrasolar planet (i.e. covered by an unbroken cloud layer) differ strongly from those of a Mars-like extrasolar planet (i.e. with a clear or dusty sky) and/or an Earth-like extrasolar planet. The flux and degree of polarization of an Earth-like extrasolar planet are found to depend strongly on the reflection properties of the surface, i.e. vegetation or ocean, and the fraction of the planet that is covered by clouds (Figure 3). The simulations for Earth-like extrasolar planets have been used for the instrument design of EPICS, an instrument planned for ESO’s Extremely Large Telescope.

The radiative transfer algorithm has also been used to study the errors that arise in flux calculations of extrasolar planets if polarization is ignored. These errors can be up to 10 percent, and vary strongly with wavelength; the errors are larger in the continuum than in gaseous absorption bands. The wavelength dependence of the errors will introduce serious errors (up to 20%) in gaseous mixing ratios, if these are derived from flux spectra without taking polarization into account.
2.1.4 Evolved low-mass stars

Chesneau, Waters, de Koter and co-workers studied the famous OH/IR star OH 26.5+0.6 using the Mid-Infrared Interferometric Instrument MIDI (PI-Waters) at the VLTI. Emission of the dusty envelope, spectrally dispersed at a resolution of 30 from 8 to 1.35 micron, appears resolved by a single dish UT telescope. In particular the angular diameter increases strongly within the silicate absorption band. In interferometric mode the UT1-UT3 102 meter baseline was employed to detect the presence of the star. No fringes were found. This provides strong constraints on the opacities in the inner regions of the dust shell or in the close vicinity of the star.

Verhoelst, Decin and co-workers presented near-IR interferometric measurements of the K1.5 giant Arcturus, obtained at the IOTA interferometer with the FLUOR instrument in four narrow filters with central wavelengths ranging from 2.03 to 2.39 μm. These observations were expected to allow to quantify the wavelength dependence of the diameter of a typical K giant. Unexpectedly, comparison with both plane-parallel and spherical models atmospheres showed that neither can explain the observed visibilities. It is shown that these data suggest the presence of a companion, in accordance with the Hipparcos data on this star.

Matsuura, Waters and an international team of co-workers studied the morphology and mass loss history of two extreme planetary nebulae, NGC6302 and NGC6537. Both objects host a very hot central star and are likely descendants of fairly massive (3-7) solar mass main sequence stars. In the case of NGC6537 evidence was presented from HST and VLT images for the existence of both a spherical and a highly axisymmetric circumstellar envelope, with similar dynamical age. The data suggest that the axisymmetric structure was formed very late on the AGB, possibly in a run-away event at the time the star leaves the AGB.

2.1.5 The interstellar medium

Ehrenfreund, Cox and Kaper led an international consortium to study the properties of the Diffuse Interstellar Bands (DIB’s) in a large sample of galactic and extragalactic regions. DIB’s have been observed toward SN2001el in the spiral galaxy NGC1448 and are very similar to those in galactic diffuse clouds that are edge dominated, i.e., subject to a relative intense interstellar radiation field (see figure 4). In addition, a detailed study in collaboration with Kaper of the highly reddened line of sight toward a high-mass X-ray binary at a distance of 5 kpc revealed a wealth of DIB’s of unprecedented strength (Cox et al. 2005). The physical origin of the DIB’s is still unknown. The hypothesis that the DIB carriers are complex organic molecules, like fullerenes and PAH’s, is being tested through comparison with models and laboratory data. In collaboration with Spaans, diffuse cloud models were developed including a simple PAH chemistry and the resulting absorption spectrum was constructed using theoretical calculations of electronic transition in the visible spectral range (Ruiterkamp, Cox, Spaans, Kaper, et al. 2005). The model has been expanded to include different metal depletion levels, dust extinction properties and radiation field strengths. The effects of metallicity and dust extinction properties on the charge state distribution can explain the DIB’s of Galactic strength observed towards the SMC wing, as well as the observed absence of DIB’s towards the SMC bar.
Figure 4: First detection of strong narrow diffuse interstellar band profiles outside the Local Group, towards SN2001el in NGC1448. Comparison with Galactic lines of sight indicates that the local ISM conditions must resemble closely those observed for Galactic diffuse clouds exposed to an intensive UV radiation field (from Sollerman, Cox et al. 2005).

2.1.6 Experimental and theoretical studies of light scattering on dust

Volten, Munoz, Hovenier, Waters and others presented an extensive database containing tables of experimental scattering matrix elements as functions of the scattering angle at wavelengths of 441.6 and 632.8 nm for a large number of collections of micron-sized mineral particles in random orientation. This unique database is the result of experiments performed in Amsterdam over about two decades and, therefore, called The Amsterdam Light Scattering Database. It also contains tables of size distributions as well as other characteristics of the particles. The database is accessible through the World-Wide Web and is being used by an increasing number of scientists for a variety of applications, such as testing theoretical methods and interpretations of observations of scattered radiation in astrophysical environments (disks, comets, interplanetary medium, planetary atmospheres, etc.). An explanatory paper on the database was published. In order to understand and model the optical properties of complex shaped dust grains Min, Hovenier and de Koter developed a statistical approach. This approach follows logically when realizing that in nature one always observes an ensemble of dust grains with various shapes, structures and orientations. Thus, we are usually interested in the statistical properties of such an ensemble rather than in the detailed properties of single complex shaped dust grains. In the statistical approach one considers an ensemble of simple particle shapes to represent the optical properties of an ensemble of complex shaped grains in a statistical sense. Min et al. proposed to use a distribution of hollow spheres as simple particle shapes. This has the major advantage that the optical properties of hollow spherical shells are easily computed while those of irregular, complex shaped particles are simulated.

2.2 Astrophysics of Stars and Star Clusters

Most often, stars are born in groups, called clusters. Their sizes vary from a few tens of stars to hundreds of thousands. Studying stars in their cluster environment is often helpful because important properties such as their ages and distances are more easily determined from the entire cluster population. The study of the life-path of stars, from birth to death is a key research topic at the Anton Pannekoek institute, with special focus to the evolution of massive stars. These stars end their lives in a supernova explosion, and are likely candidates for the progenitors of gamma ray bursts. After such cosmic fireworks, the cinders that are left are either neutrons stars or black holes. Mass loss and rotation play a pivotal role in the lives of massive stars, and essentially controls the nature of the compact remnant and the type of supernova explosion. Therefore, the effects of rotation and the mechanisms and effectiveness of mass loss studied intensively.

The life of stars can be complicated by their cluster environment, because some clusters are dense enough that stellar collisions may occur, leading to novel pathways for making various objects (such as X-ray binaries) and to objects that
may not form in any other way (such as possibly ultra massive stars). There is already a long tradition of research at the institute of investigating globular clusters, which are very old (many billions of years) in order to explain the unusually large numbers of X-ray binaries and pulsars in them. More recently, research has focused also on young clusters. One goal here is to study a population of more or less coeval stars and try to reconstruct the natal properties of the binaries among them. Another is to investigate clusters in which the dynamical evolution time scale of the clusters is comparable to the internal evolution time of the most massive stars (a few million years) and study the complex interplay between stellar and dynamical evolution in that environment.

2.2.1 The VLT-FLAMES Survey of Massive Stars

Smartt, Evans, de Koter, Mokiem and co-workers obtained an unprecedented sample of 800 massive stars in open cluster fields in the Magellanic Clouds and Milky Way, primarily with the multi-fibre FLAMES instrument. The survey addresses the role of environment, via stellar rotation and mass-loss, on the evolution of the most massive stars, which are the dominating influence on the evolution of young, star-forming galaxies (Evans et al. 2005a, 2005b).

![Figure 5: V-band WFI image of FLAMES targets in N11 in the LMC, O-type stars are marked as open blue circles, B-type stars by yellow circles. The solid black lines are simply the gaps between CCD's in the WFI mosaic array (Evans et al. 2005a).](image)

De Koter and Puls (München) are leading the analysis of all O- and early B-type stars secured in the FLAMES project, featuring prominent stellar winds. In view of the large number of such stars observed - about 100 targets (doubling the number of such stars known) - a special technique has to be developed to allow for a homogeneous, efficient, state-of-the-art analysis. To this end, Mokiem, de Koter and co-workers (2005) developed the first automated fitting method for the quantitative spectroscopy of O- and early B-type stars with stellar winds. The method is found to be robust, fast, and accurate. Using this method of seven O-type stars in the young cluster Cygnus OB2 and five other Galactic stars were reanalyzed to assess consistency with previous studies. The fits are found to have a quality that is comparable or even better than produced by these prior classical “bye eye” methods. The derived spectroscopic masses are in agreement with those derived from stellar evolutionary models, i.e. the investigated sample does not indicate a mass discrepancy. This indicates that the improved spectral fitting resolves (part) of this long-standing problem in massive star research.

2.2.2 The formation and evolution of massive stars

Bik, Kaper, de Koter, Waters, and others continued their study of the photometric and spectroscopic properties of the youngest massive stars, deeply embedded inside their natal cloud. These star-forming regions are totally obscured in visible light; observations are required at near-infrared wavelengths, where the extinction due to the surrounding gas and dust is strongly reduced, in order to derive information on the properties of just-born massive stars. Bik, Kaper and collaborators obtained high-resolution K-band spectra with VLT/ISAAC of candidate young massive stars deeply embedded in (ultra-) compact H II regions. These objects were selected from a near-infrared survey of 44 fields centered on IRAS sources with UCHII colours. Often, the near-infrared counterpart of the IRAS source is a young embedded cluster hosting massive stars. Several of these young massive stars show normal photospheric OB-type spectra, a few of them of very early type (O3 - O4 V) consistent with the young age of the cluster. Some objects show spectra including broad Br-gamma emission, CO bandhead emission and no photospheric absorption lines, characteristic of massive young stellar objects (YSO’s). Modeling of the CO bandhead emission profiles shows that the CO emission is produced by a dense circumstellar disk.

Vink and de Koter performed a pilot study of mass loss predictions for late-type Wolf-Rayet stars as a function of metal abundance, over a range between 1/100000 and 10 times the Galactic metal abundance. The winds of nitrogen-rich Wolf-Rayet stars are dominated by iron lines, with a dependence of mass loss on
metal content similar to that of massive O and B-type stars. The winds of more evolved, carbon-rich, Wolf-Rayet stars also depend on the chemical environment of the host galaxy, but with a mass loss metallicity dependence that is less steep than for OB stars. This finding is a new one, with important consequences for black hole formation and X-ray population studies in external galaxies. For C-rich WR stars the mass loss no longer declines once the metal abundance drops below 1/1000. In combination with rapid rotation and/or proximity to the Eddington limit - likely to be relevant for massive population III stars - this effect may indicate a role for mass loss in the appearance and evolution of these objects, as well as a potential role for stellar winds in enriching the intergalactic medium of the early Universe.

The core of the nebula surrounding Eta Carinae has been observed with the VLT Adaptive Optics system NACO and with the interferometer VLTI/MIDI by Chesneau, Min, Waters, de Koter and co-workers (2005). These date constrain spatially and spectrally the warm dusty environment and the central object. In particular, narrow-band images at 3.74 and 4.05 micron reveal the butterfly shaped dusty environment close to the central star with unprecedented spatial resolution. A void whose radius corresponds to the expected sublimation radius has been discovered around the central source. A large amount of corundum (Al2O3) is discovered, peaking at 0.6-1.2 south-east from the star, whereas the dust content of the Weigelt blobs is dominated by silicates.

Savonije studied the pulsational stability of uniformly rotating main sequence stars with mass between 3 and 8 solar masses by solving the linearised non-radial non-adiabatic oscillation equations with a periodic forcing term and searching for resonant response to a complex-valued forcing frequency. To simplify the problem the so-called traditional approximation (borrowed from geophysics) was used whereby the solution becomes separable in spherical coordinates. The aim was to investigate whether a particular branch of rotational modes can be destabilized by (Eddington’s) kappa mechanism, just like gravity modes. In general Rossby-like rotational (r) waves have a strong toroidal component and very small compressibility, but there is a branch with non-negligible buoyancy effects (“quasi g-modes” or q-modes) which, for sufficiently rapid rotation of the B stars, appear indeed unstable due to the kappa-mechanism. These unstable q-modes occur in a few narrow frequency bands (defined by their azimuthal index m) and appear to fit the observed oscillation spectra in rotating B-stars much better than the standard explanation, i.e. unstable gravity modes. These q-modes may also be responsible for the non-radial oscillation seen in rapidly rotating Be stars.

Raassen and co-workers have continued their studies of the winds and coronae of stars using high-resolution X-ray spectroscopy in connection with detailed calculations of X-ray spectra of hot plasmas. This year, attention focused on the spectrum of the cool dwarf YZ-CMi with RGS aboard XMM-Newton. We have focused on the characteristics of two flares appearing during our observation. Mitra-Kraev, Raassen, and others (2005) applied models to flares observed in AT-Mic. Based on flare characteristics such as temperature, emission measure, density, rise and decay time of the flare, maximum and minimum count rates, and variability during the maximum of the flare, the loop length of the flare (L) and the magnetic field strength (M) can be determined.

2.2.3 Evolution of massive binary stars

Kouwenhoven, Brown, Kaper and Portegies Zwart carry out a research project aimed at the characterization of the primordial binary population. Although in the past studies of young stellar populations focused on single stars, it has become clear that stars form in clusters and that a large fraction is not single but part of a binary or multiple system. It may even be that all stars form as
Astronomical Institute Anton Pannekoek

From the variations of their equivalent widths and from atomographic analysis, lines, Halpha and HeII4686, display strong phase-locked profile variability. The most prominent emission of the initially more massive star. The mass transfer in all three cases must have started during the core hydrogen burning phase. Their results show that, if these systems formed through stable mass transfer, their initial periods were smaller than their current ones, which implies that mass transfer has started during the core hydrogen burning phase of the initially more massive star. The mass transfer in all three cases must have been non-conservative, with on average only ~10% of the transferred mass being retained by the mass receiving star.

Arias, Sahade, Henrichs and Kondo continued their longstanding collaboration regarding studies of the behavior of the enigmatic “discrete absorption components” in massive star. These absorption lines occur unexpectedly in nearly all mass-losing massive stars, and are indicative of the stellar winds' behavior. They are found to be highly variable, but their origin is not yet known. For the first time the behavior of these spectral lines in two bright eclipsing binaries was investigated, in the hope to discover the geometry and radial distance at which they are formed. Such a study is impossible in single stars. The result was that in mu1 Sco these absorption components could not be studied, whereas in AO Cas it was found that these lines must be formed within the binary separation, i.e. very close to the surface of the primary. Petrovic, van der Hucht and co-workers explored the progenitor evolution of three WR+O binaries with WR/O mass ratios of ~0.5 and periods of 6-10 days, to constrain the mass and angular momentum budget during the major mass transfer phase. Their results show that, if these systems formed through stable mass transfer, their initial periods were smaller than their current ones, which implies that mass transfer has started during the core hydrogen burning phase of the initially more massive star. The mass transfer in all three cases must have been non-conservative, with on average only ~10% of the transferred mass being retained by the mass receiving star.

Rauw, van der Hucht and co-workers analyzed the optical spectrum of the most massive binary system ever weighed: WR20a (WN6ha + WN6ha, P = 3.686 d, i = 75 degree, M_1 = 83 M_sun, M_2 = 82 M_sun). The most prominent emission lines, Halpha and HeII4686, display strong phase-locked profile variability. From the variations of their equivalent widths and from atomographic analysis, they find that part of the line emission probably arises in a wind interaction region between the stars. The analysis of WR20a suggesting that it actually belongs to the open cluster Westerlund 2. The location of the system at ~ 1.1 pc from the cluster core could indicate that WR 20a was gently ejected from the core via dynamical interactions. The position of the binary components in the Hertzsprung-Russell diagram suggests that they are core hydrogen burning stars in a pre-LBV stage and their current atmospheric chemical composition - nitrogen is enhanced while carbon is definitely depleted - probably results from rotational mixing that might be enhanced in a close binary compared to a single star of same age.

Gualandris, Portegies Zwart and colleagues (2005) investigated the origin of the Galactic high latitude black hole X-ray binary XTEJ1118+480, and conclude from the relatively young age of the companion (2-5 Gyr) that it is unlikely to have come from a globular cluster. They suggest that in stead it came from the Galactic disk, and that the black hole in the system received a natal kick at birth in order to explain the high system velocity that is indicated by its position far from the Galactic plane.

Van der Meer, Kaper and co-workers continued their work on the properties and evolution of high-mass X-ray binaries. In a monitoring campaign of the high-mass X-ray binary system 4U 1700-37/HD 153919, in February 2001 the system was observed at four orbital phase intervals, covering 37% of one 3.41-day orbit. The light curve includes strong flares, commonly observed in this source. The high-energy part of the continuum is modeled as a direct plus a scattered component, each represented by a power law with identical photon index, but with different absorption columns. During a low-flux interval the continuum is strongly reduced, probably due to a reduction of the accretion rate onto the compact object.

A soft excess is detected in all spectra, consistent with either another continuum component originating in the outskirts of the system or a blend of emission lines. Many fluorescence emission lines from near-neutral species and discrete recombination lines from He- and H-like species are detected during eclipse and egress (Figure 7).

The fluorescence Fe Kalpa line at 6.4 keV is very prominent; a second Kalpa line is detected at slightly higher energies (up to 6.7 keV) and a Kbeta line at 7.1 keV. In the low-flux interval the Fe Kalpa line at 6.4 keV is strongly (factor ~30) reduced in strength. The detection of recombination lines during eclipse indicates
the presence of an extended ionized region surrounding the compact object. The observed increase in strength of some emission lines corresponding to higher values of the ionization parameter further substantiates this conclusion (Van der Meer et al. 2005).

Cox, Kaper and Mokiem (2005) obtained high-resolution optical spectra of the high-mass X-ray binary 4U 1907+09 covering the wavelength range 4680-10400 Å with UVES on the ESO Very Large Telescope. The spectra indicate that the X-ray pulsar’s massive companion is an O8/O9 super giant with a dense stellar wind. The interstellar atomic lines of Na I and K I of this strongly reddened source ([E](B-V) = 3.45 mag) are used to set a lower limit to its distance: d ~ 5 kpc, excluding the possibility that the massive companion is a Be star. The system parameters are re-evaluated; the new spectral classification of 4U 1907+09’s O super giant companion is discussed in the context of its similarity in X-ray and orbital properties to Wray 15-977/GX 301-2. The Halpha line shows variability similar to what is observed in other wind-fed systems. A remarkable feature is the strong He II 4686 Å emission line, which possibly originates in the accretion flow towards the X-ray pulsar.

Figure 7: The continuum emission is modeled as three power laws, representing a direct (solid line), a scattered (dashed-dotted line) and a soft component (dotted line). The spectrum clearly shows several fluorescence emission lines and some discrete recombination lines of He- and H-like species. Note that the data in this plot are folded with the response matrix of the instrument. Therefore, some of the features (e.g. at 1.8 keV) in the plot are of instrumental origin. The lower panel shows the residuals of the model to the spectrum.
the Astronomical Institute Anton Pannekoek and the Section Computational Science.
In order to fill in some gaps in the knowledge of young researchers with regard to the MODEST activities we organized the school with as main aim to allow the students some hands-on expertise in modeling dense stellar systems. We had a total of 7 teachers, they were: Prof. Dr. Douglas Heggie (University of Edinburgh, UK), Prof. Dr. Piet Hut (Institute for Advanced Study, Princeton USA), Dr. James Lombardi (Vassar College, USA), Prof. Dr. Steve McMillan (Drexel University, USA), Dr. Bill Paxton (KITP, USA), Dr. Simon Portegies Zwart (University of Amsterdam), Dr. Peter Teuben (Maryland, USA).

Tirado-Ramos, Gualandris, and Portegies Zwart (2005) studied the performance of direct gravitational N-body codes for astrophysical simulations on parallel computers and computational grids. They developed a direct N-body code for the simulation of star clusters and compared its performance on the Dutch DAS-2 and the pan-European CrossGrid computational grids. They found that the performance on large grids improves as the size of the N-body system increases because the computation to communication ratio becomes higher and a better load balance can be achieved. Communication among nodes residing in different locations across Europe becomes more evident as the number of locations increases. Nevertheless, contrary to expectations, we found that the performance decreases only by about a factor three for a large simulation. They concluded that highly distributed computational Grid infrastructures can be used efficiently for simulating large gravitational N-body systems.

Lamers, Gieles (Utrecht) and Portegies Zwart (2005) studied the disruption time scales of star clusters in different galaxies and compared these with the observed average lifetime of star clusters in the Solar Neighbourhood, the Small Magellanic Cloud and in selected regions of M51 and M33. Empirically, the tidal disruption time scale is found to scale with cluster mass as $M_{\odot}^{0.6}$. They show that in simulations, this scaling is reproduced very well in environments, for cluster masses in the range $10^6$ - $10^9$ solar masses. The study also confirms the empirical finding that in most environments the lifetime decreases with the density of the environment approximately as $(\text{density})^{-2.5}$.

Portegies Zwart & McMillan (2005) considered the formation of the recently discovered “hot Jupiter” planet orbiting the primary component of the triple star system HD 188753. The current outer orbit of the triple is too tight for a Jupiter-like planet to have formed elsewhere and migrated to its current location, the binary may have been much wider in the past. They assume here that the planetary system formed in an open star cluster, the dynamical evolution of which subsequently led to changes in the system’s orbital parameters and binary configuration. They conclude that component A of HD 188753 with its planet was most likely formed in isolation, to be swapped into a triple star system by a dynamical encounter in an open star cluster. Within 500 pc of the Sun, there may be about 1200 planetary systems that, like HD 188753, have orbital parameters unfavorable for forming planets but still have a planet; it is thus not unlikely that the HD 188753 system was indeed formed by a dynamical encounter in an open star cluster.

Gualandris, Portegies Zwart and Sipior (2005) investigated the interplay between the super massive black hole in the center of the Milky-way Galaxy and its local stellar cluster. They simulations the interactions between the black hole and other stars to study the possibility that the hypervelocity star SDSS J090745.0+024507, found in the halo was initially ejected from this region. The star currently has a velocity exceeding 700 km/s moving away from the Galactic center. With the measured radial velocity and the estimated distance to the star, they traced its trajectory backward in time in the Galactic potential. Assuming it was ejected from the center, they found that a proper motion of about 2 mas/yr is necessary for the star to have come within a few parsecs of the SMBH. They conclude that this star is most likely ejected in a strong dynamical interaction between the super massive black hole and a tight binary, of which the currently observed star once was a component (Figure 8). Such events should occur frequently enough that the Galactic halo should be populated with more than a hundred hyper-velocity stars.
Ultra luminous X-ray sources (ULX’s) with X-ray luminosities larger than the Eddington luminosity of stellar-mass objects may be powered by so-called intermediate-mass black holes (IBH’s), with masses around 1000 solar masses. If IBH’s form in young dense stellar clusters, they can be fed by Roche lobe overflow from a tidally captured stellar companion, which itself has a mass above 10 solar masses. After the donor leaves the main sequence it forms a compact remnant, which spirals in as a result of gravitational wave (GW) emission. We show that space-based detectors such as the Laser Interferometer Space Antenna are likely to detect several of these sources. GW sources stemming from this scenario have small eccentricities, which give distinct GW signals. Detection of such a GW signal will unambiguously prove the existence of IBH’s, and support the hypothesis that some ULX’s are powered by IBH’s with captured companions (Hopman & Portegies Zwart 2005).

2.3 Relativistic Astrophysics and Compact Objects

When stars more massive than about 10 times the Sun die, they leave a very compact remnant behind, either a black hole or a neutron star, near which gravity is so strong that one must describe its effects by Einstein’s theory of general relativity. Material falling into these pits of strong gravity (‘accreting onto them’) arrives with nearly the speed of light and gets heated enough to emit X-rays. Some material is flung out again from near the center in narrow beams of material (‘jets’). By studying the light emitted from the accreting material and the jets (predominantly X-rays and radio waves) we can study the behaviour of material in strong gravity and test Einstein’s theory.

In recent years it is becoming clear that many features of this process are very
similar between black holes in binary stars, which are typically ten times the mass of the Sun, and black holes in the centers of galaxies, which can be up to a billion times the mass of the Sun. Even when comparing neutron stars and black holes, the accretion process and the jets show many similarities.

2.3.1 Probing relativistic potentials with X-rays

Beginning with the discovery by Wijnands and Van der Klis in 1998 of an accreting millisecond X-ray pulsar, SAX J1808.4-3658, we have confirmation by direct measurement that neutron stars can be spun up to very short periods in such a binary. By now, seven such systems have been found, with spin periods ranging from 1.67 to 5.41 milliseconds. Quasi-periodic oscillations (QPO’s) were also found by Wijnands, van der Klis and co-workers in SAX J1808.4-3658, in the form two peaks in the power spectrum at kilohertz frequencies, and this conclusively, as had long been suspected but not proven, that these QPO’s were physically related to the neutron star spin. This discovery also led to the rejection of the up to then dominant ‘spin-orbit beat-frequency models’ because the frequency separation between the two kHz peaks was inconsistent with the neutron star spin frequency (it was consistent with half that frequency). In 2005, Linares and Van der Klis and co-workers reported the discovery of twin kilohertz quasi-periodic oscillations in a second accreting millisecond pulsar, XTE J1807-294, where the separation between the kHz QPO’s was consistent with the pulse frequency. This confirmed for the first time from pulsation measurements the inference, that the slower millisecond accreting pulsars (with spin frequencies below 400 Hz) are fundamentally different from the faster ones in this respect. Together these results imply that the neutron star spin must be directly affecting the motions of the material in the accretion disk, presumably by a resonant interaction as was already proposed in the 2003 Wijnands paper and has since been worked out in several theoretical papers by US and Polish teams.

Van Straaten, Van der Klis and Wijnands studied the aperiodic X-ray time variability and color behavior of four of the new accreting millisecond pulsars using large data sets obtained since their discovery with the Rossi X-Ray Timing Explorer. They find that the accreting millisecond pulsars have timing properties very similar to those of non-pulsing neutron stars, and that their variability frequencies follow the same universal scheme of correlations. However, intriguingly in two of the pulsars the relations are shifted by a factor close to 1.5. This result was later also found for XTE J1807-294 in the work of Linares and Van der Klis already mentioned above. Some of the resonant interaction (spin-disk) models that were proposed include 2:3 frequency ratios as an ingredient.

There is a group of about 10 accreting neutron stars in binary systems that show quasi-periodic dips in their X-ray light curves. These are the so-called ‘dippers’. During dips, the emission from the low-energy part of the X-ray spectrum decreases, while the emission of the high-energy part decreases much less, and the spectrum then becomes harder.

The generally accepted explanation of the dips appears to be occultation’s of the central source of X rays by a denser region in the outer parts of the accretion disk; this region is thought to be the place where the stream of gas coming from the secondary impacts the disk surrounding the neutron star. This explanation is in line with the idea that these are probably high-inclination systems, given that in one cases eclipses of the central source by the secondary star have been observed.

The spectral changes during dips cannot be described by the effect of a neutral absorber on the total spectrum. Until recently, the only explanation for these changes had been that the X-ray emission is produced by a central point-like source, the neutron star itself, and an extended region around the neutron star, plus the ‘ad-hoc’ assumption that the changes during dips are due to partial and progressive covering of the extended component by an opaque neutral absorber.

In this view, the absorber would act differently upon the point-like and extended emitting regions.

Our view of these sources has changed drastically in the last few years, thanks to the large effective area and good spectral resolution of XMM-Newton and Chandra. We now know that many of these systems also show relatively narrow absorption lines from highly ionized iron and other elements. A recent study of one of such dippers, 4U 1323-62, shows lines of Fe XXV and Fe XXVI. During dipping intervals the strength of the less ionized Fe XXV line increases while the orbital phase dependence of the features suggests that the absorbing plasma is located in a thin cylindrical geometry around the compact object, probably above and below the accretion disk.

Interestingly, if these variations of the line strengths are taken a step further, and a self-consistent model of the ionized material that produces the lines is calculated, it follows that this same ionized absorber also accounts for the complex changes in the continuum during dips. The consequence of this is that the idea of extended emission and differential absorption is no longer required to explain the observations: Changes in the properties of the ionized absorber, which has a higher column density and is less ionized during dipping than during persistent
intervals, can explain simultaneously both the changes in the continuum and absorption lines.

A recurrent theme in the research into accreting neutron stars and black holes over the last years was that of comparative studies between black holes and low-magnetic field neutron stars. A neutron star is only about three times as large as its Schwarzschild radius, so if there is no strong magnetic field disrupting the accretion flow, in both types of object the accretion disk is expected to extend down all the way into the strong field gravity region. Indeed, observations confirm this, and many similarities are found in the phenomenology of the accretion process onto these two types of object. Finding either differences or similarities between neutron stars and black holes by comparative studies can strongly constrain the interpretation of the phenomena. A phenomenon that is seen in both neutron stars and black holes can not depend on any property that is unique to either neutron stars or black holes, such as the presence or absence of a solid surface or a horizon. Conversely, a phenomenon that seems to only occur in either neutron stars or black holes likely does require such a unique neutron star or black hole property. Eventually this line of research may lead to ‘definitive’ proof of the existence of black holes by the identification of a unique black hole phenomenon, in conjunction with a compelling interpretation for the phenomenon relying on a unique predicted physical black hole characteristic.

The constant-frequency QPO’s in black holes with frequencies up to 450 Hz are a candidate for such a unique black hole phenomenon, whereas the variable-frequency twin kHz QPO’s with frequencies up to 1300 Hz appears to be unique to neutron stars.

Migliari, Fender and Van der Klis compared correlations between radio luminosity and X-ray timing features in seven low magnetic field neutron stars among which two millisecond pulsars with black holes. In the neutron star systems the radio luminosity correlated with the characteristic frequency of a variability component detected in the power spectrum following a power law fit with similar index in both cases. As the variability component arises in the accretion disk and the radio flux in the jet, this is further evidence for disk-jet coupling in neutron stars that is very similar to that in black holes.

Wijnands, Van der Klis, Maccarone, J. Miller-Jones and collaborators are using a combination of XMM-Newton and Chandra observations to study the inner 1.7 square degrees of our Galaxy to find X-ray transients which have peak X-ray luminosities lower than 1e36 erg/s. Such faint transients cannot be found or studied in detail by other monitoring satellites in orbit because of sensitivity limits and confusion problems. So far, they have reported new outbursts of the neutron star transients GRS 1741.9-2853 and SAX J1747.0-2853, and one outburst of the unclassified transient XMM J174457-2850.3. The XMM-Newton/Chandra monitoring program will be very useful to find additional new transients and to put constrain on the time-averaged mass accretion rates of the known systems in the field-of-view which is urgently needed to constrain our binary evolution models for such faint transient X-ray sources. Kuulkers (ESA), Wijnands et al. are using INTEGRAL to monitor a much larger region of the Galactic Bulge. This program has so far resulted in detections of the X-ray transients GRO J1655-40, IGR J17098-3628, XTE J1818-245, XTE J1739-285 (and type-I X-ray bursts from this source demonstrating it harbors a neutron star), H1743-322, the Rapid Burster, and SAX J1747.0-2853. For most of them there are detailed hard X-ray/soft gamma-ray light curves available, which will be used to investigate the behavior of transients at high energies.

2.3.1.2 Black hole candidates

Homan (MIT), Wijnands, Van der Klis and co-workers studied the high frequency QPO’s in H1743-322 and conclude that high inclination black holes have more prominent high frequency QPO’s, which suggests interception or localized emission of flux by the disk may be related to their generation. In a major study, Belloni (Brera), Van der Klis, Mendez and co-workers studied in detail a complete, densely sampled outburst of the black hole transient GX 339-4 leading to a much better understanding of the phenomenology of black hole transient outbursts in general and providing a template to which all other black hole outbursts are now being compared (Figure 9).
2.3.1.3 AGN

As noted earlier, there are considerable overlaps in the basic physics of central black holes of galaxies and stellar-mass black holes as we study in our own Milky Way. Due to the large difference in mass, which results in a very large difference in the size of the systems and in the time scales on which events take place (everything is $10^7 - 10^8$ times slower in an AGN), what we learn from these two types of object is quite complementary.

Compact extragalactic radio sources which vary on timescales of a day or less are not well understood. Such variations imply significant emission from regions a light-day or less in size, which in turn suggests extremely high brightness temperatures, in some cases as much as $10^{20}$ K. There are reasons to believe that the brightness temperature cannot, under normal circumstances, much exceed $10^{13}$ K. If it does, then the emitting particles will be cooled by Compton scattering on the photons present - the “inverse-Compton catastrophe” - resulting in enhanced high-energy (gamma-ray) emission. One way to avoid this dilemma is if the emitting region is moving at a relativistic speed. Alternatively, interstellar scintillation could cause the source variability. In order to distinguish between these possibilities, an international campaign of coordinated, multi-wavelength observations of the highly variable blazar S5 0716+71 was mounted by Strom and co-workers. The variability appeared to imply a brightness temperature well in excess of the Compton limit, but at the same time non-detection in a long INTEGRAL observation makes it unlikely that the real temperature is that high. With ISS also excluded because the variability was seen at very high radio frequencies (up to 37 GHz), the most likely explanation is that we are seeing an outflow with a Lorentz factor of at least 8 in the blazar’s jet (Ostorero et al., 2005).

Starling and co-workers studied the X-ray emission of NGC 7213, a Seyfert-LINER galaxy, with XMM. They find its spectrum to be composed of a power-law component and a thermal plasma with a temperature of about 0.18 keV. They compared its X-ray properties, along with its accretion rate onto the galactic nucleus, with the properties of other LINER’s and Seyfert’s and conclude that they are intermediate between the two. There appears to be a continuous sequence of X-ray properties from the Galactic Centre through LINER galaxies to Seyfert’s, probably determined by the amount of material available for accretion in the central regions.

Figure 9: Plot of the track taken by the black hole GX 339-4 in the X-ray flux vs. X-ray spectral hardness plane during its X-ray outburst. Arrows indicate the time sequence, starting at bottom right. The entire track took several months to complete. Initially there is only hard X-ray emission from a corona of hot electrons (100 million Kelvin). After this coronal emission has become brighter by a factor 100, the hole suddenly begins to emit progressively softer X-rays indicating that the emission of the cooler (a few million Kelvin) accretion disk becomes stronger and that of the corona weaker. During this hard-soft transition a major reconfiguration is thought to take place in the geometry of the emission regions surrounding the hole. Radio observations indicate the ejection of a large amount of plasma at relativistic speeds, and different types of high-frequency variability (referred to by different symbols in the plot) show that complex in homogeneities in the flow occur down to very close to the event horizon. After this the disk emission fades by more than an order of magnitude. Then there is another sudden transition, back to the hard, coronadominated state and after that the holes fades from view – until the next outburst in a few years. This big sequence of coordinated X-ray spectral and variability observations has provided the best view of what a black hole does during a transient outburst to date (Belloni et al. 2005). The ‘squareness’ of the track, indicating very sudden changes in the character of the hole’s evolution was an unexpected discovery and is shaping current thinking on the nature of black hole states as described above.
2.3.1.4 Neutron stars and dense matter

New and exciting results are continuously being published about the growing group of accreting millisecond X-ray pulsars, of which the first one was discovered nearly 8 years ago by Wijnands & Van der Klis. These systems are important for our understanding of binary evolution, especially the link between accreting neutron stars and the millisecond radio pulsars.

Wijnands and co-workers used Chandra to observe the X-ray transients and accretion-driven millisecond X-ray pulsars XTE J0929-314 and XTE J1751-305 in their quiescent states. XTE J0929-314 could be detected at an X-ray luminosity of 7E31 erg/s for an assumed distance of 10 kpc. The X-ray spectrum was dominated (by more than 70%) by a non-thermal component, which is similar to the quiescent spectrum of other neutron star X-ray binaries in their quiescent state when they have similar X-ray luminosities. XTE J1751-305 could not be detected with an upper limit of around 1E32 erg/s. Using simple accretion disk physics, upper limits on the magnetic field strength were obtained of 3E9 Gauss for XTE J0929-314 and 7E8 Gauss for XTE J1751-305.

Wijnands and collaborators used Chandra to study the quiescent counterpart of the neutron-star X-ray transient which is located in the globular cluster Terzan 5. They found that the quiescent neutron star X-ray transient had an X-ray luminosity of around 2E33 erg/s, which is typical for quiescent neutron star systems. However, the X-ray spectrum of the source was fully dominated by a hard non-thermal component with no clear evidence for the soft thermal component, which usually dominates the quiescent spectrum of neutron-star X-ray transients when they are at X-ray luminosities of about 1E33 erg/s. The reason for this unusual behavior is currently unclear, mainly due to our lack of understanding of the hard non-thermal component. Cackett (University of St Andrews), Wijnands et al. (2005) studied two Chandra observations of the quiescent counterpart of the neutron-star transient in NGC 6440. During the first observation a thermal and a non-thermal component could be found in the quiescent X-ray spectrum of the source, but during the second observation only the thermal component was present. This change in spectral properties caused the X-ray luminosity to decrease by a factor of two between observations. Possible explanations for this variation in quiescent properties are variable residual accretion onto the neutron star magnetosphere or some variation in the interaction of the pulsar wind with the matter still out flowing from the companion star.

Evidence for a red shifted X-ray line in a transient low-mass X-ray binary was presented by Tiengo, Mendez, Van der Klis and co-workers and a broadened iron line in the neutron star binary 4U 1705-44 found by di Salvo, Mendez, Van der Klis and co-workers indicates relativistic effects similar to those found in iron lines seen in black holes. Continuum spectroscopy of three other neutron star low-mass X-ray binaries led to the detection of a time variable hard tail in GX 17+1 (indicative of the formation of a hot corona at lower mass accretion rates), a soft excess in Cir X-1 (leading to a revised distance estimate of this source), and a similarly revised distance for GX 9+1.

Van den Horn worked on the theory of bulk viscosity in relativistic matter, in the physical contexts of the cosmological fluid of the early universe, and stellar gravitational collapse with extensions to gamma-ray bursts. The radiation component of the fluids is not restricted to photon radiation, but may include other relativistic species, notably neutrinos. Such radiative fluids may be highly dissipative, and non equilibrium processes may then play a major dynamical role. In the cosmological fluid, the only non equilibrium effect compatible with homogeneous and isotropic expansion is the phenomenon of relativistic bulk viscosity. However, the classic expression for radiative bulk viscosity in this context, due to Weinberg, does not appreciably affect the dynamics for a radiation dominated equation of state. On the other hand, particle production...
processes giving rise to an effective bulk viscosity are a topic of current interest in cosmology. I have extended earlier attempts to clarify the dissipation mechanism of radiative bulk viscosity in cosmological and astrophysical fluids to include neutrino radiation. The fermionic nature of this radiation is particularly relevant in stellar gravitational collapse. At the same time, it allows to explore the ‘chemical’ connection of relativistic bulk viscosity and particle production. Moreover, other non equilibrium processes occurring in the neutrino-matter fluid give rise to hydrodynamic instabilities which merit further investigation.

2.3.2 Pulsars and magnetars

The 8gr8 pulsar survey is a survey for new pulsars in the Cygnus region of the Galaxy. It uses a unique aspect of the Westerbork Synthesis Radio Telescope (WSRT) to allow us to use a multi-beaming mode to survey a very large piece of sky simultaneously. This technique makes the WSRT one of the best instruments in the world for undertaking pulsar surveys. This work is being undertaken by Stappers and AIO’s Janssen and Rubio. The large size of the survey requires large cluster computing and almost 2 years of processing time. 2005 is our first year of processing and in that period we have discovered three new pulsars. These represent the first pulsars ever discovered from the Netherlands and are a great achievement for the group and the WSRT. The aim of the survey was to find young pulsars in this region of the sky where recent star formation has taken place. So far one of the new pulsars that we have discovered appears to be associated with a supernova remnant. This would be one of the few cases where the remnant of the explosion which formed the pulsar is still identifiable. We are now undertaking follow-up timing of all three pulsars to confirm their nature. With the majority of the survey still process there is a good chance that this number will be increase significantly in 2006.

ESA’s INTEGRAL mission detected during an observation of the Cassiopeia region serendipitously the outburst of a new source, IGR J00291+5934, which in total lasted about 16 days. Rapid multi wave lengths follow-up observations.

COMPLETION OF PUMA-II

The NOVA funded instrumental project PuMa II was completed in 2005. The development of this state-of-the-art pulsar machine was led by principal investigator Michiel van der Klis, project manager Ben Stappers and technical AIO Ramesh Karrupusamy. PuMa II is located at the Westerbork Synthesis Radio Telescope and is a combination of off-the-shelf hardware and purpose built data acquisition cards. It also consists of 8 data acquisition computers each with 4 TBytes of disk space and 32 processing nodes and acquires data at a rate of 640 MBytes/s.

The new instrument results in an increased sensitivity of at least a factor of two due to its digital design and the increased bandwidth it can sample. Moreover the use of sophisticated processing techniques mean that it can completely correct for the deleterious effects imparted on the radio pulses as they traverse the interstellar medium. This results in pulse profiles which are in some cases an order of magnitude sharper than was possible with the old instrumentation and makes it one of the best pulsar machines in the world. These sharper profiles impact directly on all the pulsar research undertaken at the University of Amsterdam. For example, our high precision pulsar timing program will become one of the best in the world with the combined sensitivity and sharpness improvements. This will bring our goal of using pulsar timing to detect the nano-Hz gravitational waves from the inspiraling and merging of black holes early in the universe.
Revealed that this object is a new accreting millisecond pulsar, with a period of 1.67 ms it appeared to be the fastest of the total sample of six accreting millisecond pulsars known to date, the first being discovered by Wijnands and Van der Klis. Hermsen and Kuiper (SRON) in collaboration with Falanga (CEA Saclay) and Poutanen (Oulu, Finland), studied in detail INTEGRAL and RXTE follow-up observations during this long outburst. For the first time the spin-up of an accreting millisecond during its outburst was detected, supporting the recycling scenario, linking millisecond radio pulsars and Low Mass X-ray Binaries. In this scenario, first proposed by Bhattacharya and Van den Heuvel, an old, slowly spinning neutron star is accelerated by the accretion of matter and angular momentum from an accretion disk down to a spin period in the millisecond range. Surprisingly, the imager IBIS aboard INTEGRAL detected for the first time total emission as well as the 1.67-ms periodic emission up to energies of about 150 keV. Interestingly, the pulsed emission becomes harder with increasing energy and the pulsed fraction increases with energy. These observations appear compatible with thermal Comptonisation and Doppler boosting of emission from a rapidly rotating polar hot spot.

Hermsen, Den Hartog and Stappers in collaboration with Kuiper (SRON) continued their study of non-thermal emission from one of the two flavours of magnetars, namely Anomalous X-ray Pulsars (AXP’s), slowly rotating isolated neutron stars with magnetic field strengths of order $10^{14} - 10^{15}$ Gauss. The surprising first detection was announced in 2004 (for AXP 1E 1841-045). This year they could announce for three more AXP’s the discovery in the INTEGRAL hard X-ray data, supported by archival RXTE monitoring data, of very hard spectral tails with luminosities between 10 and 100 keV two to three orders of magnitude higher than available from spin-down energy loss. This dictates that firstly the energy source of this emission is in the extreme magnetic field, and secondly that the production of the energetic non-thermal emission must take place higher in the magnetosphere of the neutron star involving particle acceleration. In 2005 a multi wave lenghts campaign was carried out on one of the AXP’s, 4U 0142+61, including a deep radio observation with Westerbork’s PUMA in an attempt to reveal for the first time an AXP radio signal. This campaign, as well as very deep INTEGRAL observations (millions of seconds) of the small sample of enigmatic AXP’s is in progress.

2.3.3 Jets

Fender continued to pursue research into the formation of jets in black hole and neutron star X-ray binaries, their contribution to the overall accretion budget, their impact on their environment and quantitative scalings with mass for comparison with active galactic nuclei. A highlight was the discovery of a jet-blown bubble around the classical black hole binary Cygnus X-1 (Figure 11), acting as a ‘calorimeter’ for the jet power over the past million years or so, and demonstrating that a large fraction (around half) of the available accretion power goes into the jet (Gallo, Fender et al., 2005). Other highlights include an estimate of the integrated kinetic power of all the galaxy’s jets, revealing that they might be a major contributor to cosmic ray production (Fender, Maccarone and Van Kesteren, 2005), and the discovery of the correlations between X-ray timing features and jet power, tying together two aspects of the accretion process that were previously studied independently (Migliari, Fender and Van der Klis, 2005).

![Figure 11: Westerbork SRT radio map of the region around the accreting black-hole source Cygnus X-1. The cross marks the location of Cygnus X-1, and the ring-shaped structure above and to the right of it is the edge of the bubble that, according to Gallo, Fender and colleagues in a Nature publication, has been pushed into the surrounding gas by the jets produced by the accreting black hole.](image)

Migliari, Fender, Mendez, Van der Klis and co-worker discovered rapid (days to hours) variability in high resolution X-ray images of the jets in the well known relativistic jet source SS 433, which they interpret as evidence of a propagating shock wave related to a jet flow moving much faster than the well known velocity of 26% of the speed of light characterizing the jets in this object. (REF)

2.3.4 Gamma-ray bursts

The study of these cosmic explosions via their long wavelength afterglows was given a strong new impulse by the successful launch of Swift and its start of full
operations in early 2005. The Amsterdam-led European GRB network held two meetings in 2005, in Reykjavik (April) and Santorini (September), in which many new results of the Swift satellite and the GRACE collaboration were discussed.

Figure 12: The Swift satellite, which can detect GRB’s and slew X-ray and UV/optical telescopes towards their location autonomously, within minutes. Its first year of operations has brought many new discoveries in GRB science, including a breakthrough on the nature of short gamma-ray bursts.

SHORT GAMMA-RAY BURSTS REVEALED

Gamma-ray bursts come in at least two varieties: long bursts, which last more than 2 seconds and have been known for a few years to originate from the explosions of massive stars, and short bursts (duration less than 2 sec), which have remained enigmatic up to now.

On May 9, 2005, the Swift satellite localized a short gamma-ray burst and quickly alerted ground-based telescopes. The satellite slewed onto the location and found a very weak X-ray afterglow. Neither Swift nor ground-based telescopes discovered an optical afterglow. With our collaborators from GRACE, we slewed the VLT to the location of the afterglow. The burst turned out to be located in a giant, old, elliptical galaxy within a cluster at redshift 0.225 (i.e., a distance of 3 billion light years). This is in stark contrast with long gamma-ray bursts, which are always found in galaxies with ongoing star formation. This indicates that short gamma-ray bursts are not the result of exploding massive stars, since there are no such stars in elliptical galaxies (Gehrels, Starling, Wijers, et al. 2005). Further confirmation of this comes from analysis of the VLT mages at later times, which show that no supernova was associated with the burst (Hjorth et al. 2005). These observations are consistent with the notion that short bursts are caused by the merger/collision of binary neutron stars or a black hole and a neutron star.

Further observations of locations of short gamma-ray bursts have shown that they can occur both in old and young stellar populations, and that they are associated with very weak afterglows, which are sometimes detected in the optical and sometimes not. Their distances are on average quite a bit smaller than those of long bursts, and consequently their explosion energy is less by an order of magnitude than that of long bursts. However, due to the faint afterglows detailed studies of the physics of short bursts have been difficult, and their properties are only known approximately (Barthelmy, Wijers, et al. 2005).
2.3.4.1 Gamma-ray burst sources and mechanisms

The GRB group added a new member, PhD student H. van Eerten, who will work on theoretical studies of relativistic blast waves. Dr. M. Bouwhuis was awarded the PhD for her work at NIKHEF to develop methods of detecting outbursts of high-energy neutrinos with the ANTARES instrument, an undersea Cerenkov detector. She then joined the GRB group to work on refinement of these methods and to study potential astrophysical sources of high-energy neutrinos.

Members of the X-ray, gamma-ray and pulsar groups together constitute the LOFAR transient centre, to exploit the science coming from the Low Frequency ARray in the area of transient and variable sources. Many of these are expected to be relativistic compact sources and their jets, which are the traditional fare of these groups, but the radio surveys carried out by this wide-field telescope are expected to also find many other types of transient radio source, such as flare stars, exoplanets, and novel types of object such as the recently discovered ‘RRATS’ and ‘burpers’ (both probably related to Galactic neutron stars). The LOFAR transient team is developing the modes and detailed observing plan for LOFAR’s operation as a transient finder and explorer, working towards a gradual commissioning of the LOFAR core in 2006-7 and the full array in 2009, especially focusing on the analysis software that can keep up with searching and exploiting the very large data volume. The team was expanded with PhD student B. Scheers and had its first exploratory discussion with the external review board in November.

The year started with observations of a spectacular event discovered by the Swift satellite on 27 December 2004: the most intense gamma-ray flash ever recorded by instruments in the 40-year history of space science. Briefly, this flash was as bright in gamma rays as the full moon in visible light. The source of this outburst was a known magnetar, SGR1806--20, which is an extremely highly magnetized neutron star in our Galaxy. Only 4 such objects are known, and this event was only the third recorded ‘super outburst’ of a magnetar, which was like the previous two super outbursts in respects except one: it was even 100 times more luminous than the previous two. These super outbursts are thought to be caused by rapid dissipation of some of the large amount of magnetic energy in the neutron star; for this event, as much as 10% of the total magnetic energy may have been lost (Palmer, Wijers, and co-workers 2005). Various lines of argument show that such energetic outbursts must be quite rare, perhaps occurring as infrequently as once per millennium in our Galaxy, and hence we have been

Figure 13: Image of the sky near the location of the first short GRB with a detected afterglow, GRB050509B. The red circle shows the initial location of the gamma-ray event with the Burst Alert Telescope on board Swift. The smaller blue circle shows the refined location of the afterglow from Swift’s X-Ray Telescope. Within this refined location lies a giant elliptical galaxy. Such galaxies contain only old, low-mass stars, proving conclusively that short GRB’s are not caused by the same mechanism as long GRB’s, namely the explosion of a very massive star at the end of its life.

Figure 14: Artist’s impression of the merger of two neutron stars: the neutron stars approach each other because they emit gravitational radiation (these events are also the prime targets for gravity-wave observatories like Virgo and LIGO). When they collide, a black hole is formed, surrounded by a disk of leftover material. This system ejects a power fast jet, which makes the short gamma-ray burst.
unusually lucky in seeing one within the first 40 years of observing gamma rays from space.

Koers and Wijers examined the possible role of neutrino emission in the very early stages of a fireball. They find that for conditions usually assumed for the initial fireball, neutrino emissivity is very large and thus the fireball is very neutrino-rich. However, this does not usually lead to catastrophic energy loss and quenching of the explosion, because at the same time the neutrino opacity of the fireball is large and therefore the neutrinos are trapped. As the fireball expands, a few tens percents of the fireball energy is emitted in a burst at the time when the neutrinos cease to be trapped. The characteristic energy of these neutrinos is about 60 MeV, a few times higher than with ordinary supernovae. Given that neutrinos of that energy are very difficult to detect, the chances of discovering such an initial GRB neutrino burst are small.

Yoon and co-workers examined a novel scenario for the evolution of massive stars into GRB’s. The difficulty with such scenarios is that massive stars lose large amounts of mass and angular momentum via their winds, which makes it difficult to retain a rapidly rotating core until the end. Such a rapidly rotating core is a necessary ingredient of currently favoured GRB models (so-called ‘collapsars’). Their novel scenario involves having the star rotate rapidly enough from the beginning to cause meridional flows in the star. These exist in all rotating stars, but for rapid rotation the flows are strong enough to mix material between core and envelope so efficiently that star evolves in a chemically homogeneous way, and burns all its hydrogen to helium. This avoids the star ever becoming a red giant, which is the evolutionary stage in which the core would otherwise lose most of its angular momentum.

Even in this scenario, however, the mass loss of the star has to be reduced significantly from commonly accepted values to avoid it losing too much angular momentum. Making the star metal-poor (metallicity less than 0.1 times solar could do this, according to observations and theory of stellar winds; this ties in nicely with the fact that GRB’s are most often found in fairly low-metallicity environments.

Pe’er, with Waxman, studied the emission of gamma rays in the early stages of a GRB due to internal shell collisions, accounting for the significant optical depth of the flow to the photons and for the electron distribution due to the
energy exchange with the photons and pair creation. They find that the GeV emission of gamma-ray burst is predicted to be well-detectable with GLAST from significant redshifts \((z \sim 1)\) for a wide range of burst parameters. The TeV emission is more sensitive to the ambient medium and the strength of the magnetic field, but should still be detectible by advanced TeV telescopes such as HESS. Using the same formalism, Pe’er, Meszaros and Rees found that for significant scattering optical depths, as applies in GRB prompt emission, the Compton balance between electrons and photons naturally results in a peak in the comoving photon spectrum around 1--10 keV. For bulk Lorentz factors of 100, this naturally gives the observed clustering of peak energies in the range 0.1-1 MeV seen in the BATSE sample. The efficiency of converting electron energy into photons is fairly high (about 30\%) in these models.

Barthelmy (NASA/GSFC), Wijers, and co-workers examined some early afterglows of GRB’s with the Swift X-ray telescope and found that the early afterglow connects smoothly with the prompt emission via a phase of very steep decay that lasts about 100 s, after which the decay becomes much flatter. It seems that the steep decay is the tail end of the prompt emission, and the very flat part thereafter represents the onset of the afterglow.

Van der Horst, Wijers, and co-workers triggered their WSRT programme for follow-up of GRB’s and found a radio source associated with the outburst. In large world-wide campaign involving also VLA, GMRT, and ATCA, the evolution of the radio flux was followed and even resolved spatially: it consisted of an expanding blob of radio-emitting material powered by the energy and matter ejected by the super outburst. This is very much like a mini-version of a GRB afterglow, and the ability to actually observe the expansion rate provides unique constraints on the models (Gaensler, Wijers, Van der Horst et al. 2005, Gelfand, Wijers, et al. 2005, Taylor, Wijers et al. 2005). They found that the expansion of the source was not constant in time, i.e., was being slowed down by ambient material within months of the outburst. A re-brightening of the nebula after two months supports this, and constrains the amount of material originally ejected by the magnetar.

The radio afterglow of the nearby GRB of 29 March 2003 continued to be observable, and illustrates well how important aspects of a GRB such as its total energy can be determined by following the afterglow at late times. Van der Horst, Wijers, Strom, Kaper, and co-workers (2005) reported on the centimeter wavelength afterglow of the burst, finding that at very late times the behaviour changes. This probes the effect of the slowest material ejected in the original outburst. It may mean that there was relatively mildly relativistic material that was ejected at large angles from the axis of the collimated explosion. Alternatively, it could mean that the whole blast wave has slowed down to sub relativistic speeds. We will be able to tell which is the case from longer-wavelength observations that will take place in 2005 and 2006.

Starling, Wijers and co-workers studied the afterglow of GRB021004, a burst at redshift 2.33. Several lines in its spectrum, notably Lyman-alpha, Si IV and C IV, show very rich velocity structure, up to 3000 km/s blueshifted relative to the rest frame of the host galaxy. It is likely that this reflects velocities in the fossil wind of the progenitor star of the GRB. For an exploding Wolf-Rayet star, that structure can be quite rich, because in its evolution from ZAMS to supernova such a star goes through a large number of evolutionary stages, each time with a different characteristic wind velocity and mass loss rate. A riddle is the fact that atoms such as neutral H and triply ionized Si and C still exist in this wind after it has been hit by the large ionizing flux of the GRB. One possible explanation for this is that the jet was structured, with only a narrow core producing the initial burst, ionizing only a narrow column of the wind directly above the jet axis. The later afterglow, of which the spectra were taken, comes from a much broader region and therefore shines largely through parts of the wind that were not ionized by the burst. This same burst was also studied with HST. Fynbo, Wijers, and co-workers followed the afterglow for a long time, and conclude that the density into which the blast wave is ploughing two weeks after the burst must be radius-independent. They find that the host galaxy is very blue and star forming, with the dominant stellar population having an age of 30-100 million years and a current star formation rate of 10 solar masses per year. The GRB occurred very close to the centre of the host.

The HST telescope was used to study a number of other GRB’s, from which some remarkable results were derived. In HST images of GRB020410, taken 28 and 65 days after the burst, an optical transient was discovered that had gone unnoticed in ground-based images. In hindsight, a faint OT was found in an optical image at the HST-indicated location 6 hours after the burst. This indicates that the OT re-brightened. Given its light curve and colours, the HST detections are best explained by a type Ib/c supernova at a redshift of about 0.5 associated with the GRB (Levan, Wijers and co-workers). Two locations of very soft GRB’s (often called XRF’s: X-Ray Flashes) were examined by HST with late-time imaging: XRF 011030 and XRF 020427. For both these sources, radio and/or X-ray afterglows were found and used to accurately localize the bursts, but no optical counterparts were found.
In both cases, faint hosts were found not unlike those of regular GRB’s, but no excess emission brighter than V=28.5 could be associated with the GRB location around 40 days after the event. This implies either that no supernova was associated with these events, or they were hidden by severe extinction (consistent with the non-detection of optical afterglows).

In order to study the extinction towards GRB’s systematically, and to discover whether the lack of optical afterglow in many GRB’s can always be explained by extinction, or alternatively may be an intrinsic property of some types of burst, Rol, Wijers, Kaper, and co-workers examined a large sample of GRB’s for which X-ray emission was found but no optical emission. They used the X-ray afterglow, plus a range of afterglow models consistent with the X-ray afterglow, to examine in each individual case what the optical flux should have been for any allowed afterglow model and compared this with the actual upper limits (or detections) achieved by afterglow observations. They conclude that in only three out of over 30 cases can one state conclusively that the non-detections require either extinction or completely different types of afterglow; in all other cases, the upper limits are consistent with a normal, unextincted afterglow. Only these three are therefore truly dark. Curiously, there is some marginal evidence that these are among the brighter GRB’s in gamma rays, but the number is too small to make much of that.

2.3.4.2 Gamma-ray bursts as probes of the universe and star formation

The power of gamma-ray bursts to probe the conditions of star formation at high redshift and the nature of galaxies in which they occur has been demonstrated again clearly with a number of studies. The host galaxies of gamma-ray bursts are under luminous on average relative to other samples of galaxies at the same redshift. At present, the cause for this is not known. It may be that star formation is dominated by faint small galaxies, which are underrepresented in magnitude-limited optical surveys. A gamma-ray burst can be detected even when the host is not visible, however, and absorption lines in its spectrum provide information about the host, so such a sample has no bias on galaxy luminosity.

The redshifts of gamma-ray bursts detected by Swift are clearly higher than those found before: the average redshift of pre-Swift GRB’s was about 1, whereas Swift bursts have a mean redshift above 2. Obviously, this average is affected by selection effects, and the change mostly reflects a greater sensitivity of the gamma-ray instrument on Swift as well as the much faster follow-up that Swift enables. In a study of the expected redshift distribution, Natarajan, Wijers, and co-workers calculated what fraction of gamma-ray bursts would come from high redshift. They find that if the GRB rate follows the star formation rate, less than 25% of bursts should have redshifts above 4. If, however, GRB’s favour a low-metallicity environment, as is implied by the observed metallicities of GRB hosts, and also by the collapsar model, then more than 40% of bursts could come from redshifts above 4.

An extreme case of a metal-poor host galaxy was found by Starling, Wiersema, Wijers and co-workers in the afterglow of GRB 050730 at redshift 3.968. Spectra of this afterglow taken 3–4 hours after the burst with the ISIS spectrograph on the William Hershell Telescope (La Palma) shows that the GRB location is surrounded by a large column of dense gas, but that there is almost no optical extinction. This implies there can be very little dust in the gas, and indeed analysis of the metal abundances indicates that the GRB environment has a metallicity of only 0.01 times solar. The X-ray afterglow in the first 1000 seconds is bright enough that we can also derive the column of absorbing gas from it. For the first time, we see the gas column in the afterglow decrease with time, and we speculate that this is due to the fact that the radiation from a strong re-flare of the burst after 500 seconds ionizes away some of the gas so that it no longer absorbs X-rays. The inferred gas column towards the end of the 1000-s period is consistent with the value derived from the hydrogen absorption lines in the optical spectra a few hours later.

Smith, Wijers and co-workers continued their SCUBA submillimetre observations of gamma-ray burst afterglows and their host galaxies. These observations are important to test the afterglow models, despite the difficulty in observing with sufficient sensitivity in this wavelength regime, because GRB afterglows have their peak brightness here in the days after trigger. The submillimetre light curve of GRB030329 does indeed show this very nicely (Smith et al. 2005). The results of ToO follow-ups of 5 further GRB’s, unfortunately all non-detections, were published separately (Smith et al. 2005).

2.4 History of Astronomy

De Jong and Inklaar continued improving their model to compute dates of first and last visibility of stars and planets. In this model the visibility of stars and planets depends on the physical properties of the atmosphere (sky brightness at twilight, extinction and refraction) and on the sensitivity of the human eye. To be able to analyze Babylonian observations dating from the times of the old-Babylonian king Ammisaduqa (17th century BC) the model was adapted to
include the daily variation in the atmospheric extinction. A description of the model and a few applications to the dating of Babylonian observations of stars and planets are being prepared for publication.

At present the main arithmetical methods used by Babylonian scholars to compute lunar and planetary positions are reasonably well understood. What remains puzzling is how these methods were developed based on observations as they are preserved - albeit fragmentarily - in the so-called “astronomical diaries” and other “non-mathematical astronomical texts”. This was the topic of the “2nd Regensburg Workshop on Babylonian Astronomy: From Observation to Theory” organized by de Jong in Amsterdam in May 2004. This meeting brought together a dozen scientists from all over the world to discuss this problem. De Jong presented a paper at the Workshop where he argued that the Babylonians were able to model the variation in planetary angular velocity by analyzing observed series of first and last visibilities over about a hundred years of continuous observations as documented in the astronomical diaries.

Lunar theory is the most refined and sophisticated Babylonian theory. One of the fundamental and least understood functions that play a crucial role in the build-up of lunar ephemerides is the so-called function $\Phi$. This is a linear zigzag function with a period of 505 years so that the known lunar ephemerides (all from the last three centuries BC) can be uniquely dated based on the listed value of $\Phi$. The earliest known texts in which (lists of) values of $\Phi$ occur date from the 6th and the 5th century BC. De Jong began a study of these texts to try to understand the way in which Babylonian lunar theory evolved during the roughly two centuries preceding the appearance of the first fully developed lunar ephemerides.

A chapter on the "Heliacal rising of Sirius", reviewing the astronomical aspects and the methods of its computation was written by de Jong and will be published in the Handbook of "Ancient Egyptian Chronology" in 2006.
3. Onderwijs

3.1 Inleiding

Met ingang van het studiejaar 2003-2004 is de doctoraal opleiding Sterrenkunde gesplitst in een bacheloropleiding Natuur- en Sterrenkunde gedurende de eerste drie jaar van de studie en een masteropleiding Astronomy and Astrophysics voor de daarop volgende twee jaar van de opleiding. In het begin van het eerste jaar wordt een college Inleiding exacte wetenschappen gegeven door vier docenten uit de faculteit FNWI (waaronder een sterrenkundige: R. Wijers) dat beoogt de beginnende studenten enthousiast te maken voor een studie in een van de beta-richtingen.

De bacheloropleiding Natuur- en Sterrenkunde bestaat voor het grootste deel uit natuurkunde- en wiskundevakken waarbij er naar wordt gestreefd om in elk semester een sterrenkundevak te verzorgen dat studenten met interesse voor sterrenkunde in hun pakket kunnen opnemen. Twee van die colleges zijn verplicht voor alle studenten: Sterrenkunde I (M. van der Klis) en Astrofysica (L. Kaper) welke in het eerste en tweede jaar worden gegeven. Daarnaast worden enkele algemene oriënterende colleges verzorgd (T. Raassen) zoals ‘Highlights’, waarin de verschillende onderzoeksgebieden in de natuur- en sterrenkunde aan bod komen, het Studentenseminarium dat een voorbereiding is voor de 2e- en 3e jaarprojecten en als laatste Keuzevoorlichting dat de studenten inzicht geeft in de verschillende specialisaties in en na het 3e studiejaar.

Een groot deel van de onderwijsinspanningen van het instituut is in feite gelegen in het verzorgen van de verplichte - en keuzevakken sterrenkunde voor de bacheloropleiding. Ook de projecten aan het eind van het tweede, en derde jaar (bachelor scriptie: 12 EC) worden gedeeltelijk door sterrenkunde verzorgd en vergen een aanzienlijke onderwijsinspanning.

De masteropleiding kent zoals gebruikelijk drie varianten, te weten de onderzoeksopleiding (O-variant), de communicatieve/educatieve CE-variant en de maatschappelijke M-variant. Bij de twee laatste varianten wordt een belangrijk deel (60 EC) buiten de sterrenkunde ingevuld. De O-variant richt zich op het verwerven van ‘in-depth’ kennis over een breed terrein van de sterrenkunde, waarbij al in het tweede semester van het eerste jaar met het eigen onderzoeksproject wordt gestart dat in totaal 60 EC, dus de helft van de studie, beslaat. Er worden vier sterrenkundige basiscolleges gegeven (Cosmology, Interstellar and circumstellar matter, Stellar atmospheres and radiation transfer, Stellar structure and evolution). Voor de O-variant zijn deze basiscolleges
verplicht (voor de twee andere varianten slechts twee) terwijl daarnaast nog vier specialisatievakken worden verzorgd waaruit studenten een keuze kunnen maken. *(High energy astrophysics, Formation of star and planets, Radiative processes, Radio astronomy).* Naast de opleiding voor het masterdiploma is de primaire onderwijsactiviteit van het instituut de opleiding tot zelfstandig onderzoeker welke plaats vindt in het kader van de Toponderzoekschool NOVA. In dit kader worden elk jaar landelijke AIO-colleges verzorgd. Het Sterrenkundig Instituut en het Centrum voor Hoge Energie Astrofysica zijn in feite in hoge mate een “graduate school”, met thans een twintigtal promovendi.

In het jaar 2005 behaalden drie promovendi de doctorsgraad (§3.1.2).

### 3.1.1 Sterrenkunde colleges voor de bachelor- en masteropleiding

**Bacheloropleiding Natuur- en Sterrenkunde:**
1e jaar: Structuur en patroonvorming in de natuur (1/4 deel), Sterrenkunde 1 inclusief (waarneem)practicum en Zonnestelsel. 2e jaar: Astrofysica, Melkwegstelsels, Project sterrenkunde. 3e jaar: Waarnempracticum, Astrofysica van compacte sterren, Kosmologie, Workshop sterrenkunde en Bachelorproject sterrenkunde III.

**Masteropleiding Astronomy & Astrophysics:**
High energy astrophysics, Radiative processes in astrophysics, Cosmology, Stellar structure and evolution, Observation project La Palma, Formation of stars and planets, Stellar atmospheres and radiation transfer, Radio astronomy, Inter/ circumstellar matter and Hydrodynamics (samen met TF). **De overige helft van het sterrenkunde curriculum bestaat uit het afstudeerproject dat wordt afgesloten met een scriptie en een voordracht.** Naast deze locale colleges wordt er ieder jaar minstens een landelijk, zogenaamd Interacademiaal, college voor masterstudenten gegeven door wisselende docenten. Het onderwerp hiervan wordt mede door de studenten bepaald. In het academisch jaar 2005 was dit Computational Astrophysics: Dynamics of Stars and Gas (Vincent Icke & Simon Portegies Zwart).

### 3.1.2 Doctoraal examens en promoties in 2005

*Doctoraal Examens (Masters degrees awarded)*
In 2005 deed 1 student met goed gevolg het doctoraal examen:

J. van den Berk 19 december

*Promoties (Ph.D. degrees awarded)*

- M. Min 12 mei Optical Properties of Circumstellar and Cometary Grains (Cum Laude)
- S. Migliari 21 sept. Disc-Jet Coupling in Neutron Star and Black Hole Binaries
- E. Gallo 23 sept. Relativistic Jets from Stellar Black Holes

### 3.1.3 Onderwijs en voorlichtingsactiviteiten van de staf in 2005

**Rooster 2e semester 2004-2005 en 1e semester 2005-2006**

- **2e semester van studiejaar 2004-2005**
  - Bachelor vakken (aantal EC):
    - T. Raassen Highlights (1)
    - T. Raassen Oriëntatie op de Master Nat/Stk (2)
    - T. Raassen Studentenseminarium (1)
    - H. Henrichs Waarnempracticum (6)
    - C. Dominik & Zonnestelsel (6)
    - E. van den Heuvel Astrofysica Compacte Sterren (6)
    - L. van der Horn Elektrodynamica & relativiteitstheorie 2 (3)
  - Mastervakken (3 uur/week)
    - L. Kaper Sterrenkunde colloquium (3)
    - R. Wijers Radiative Processes (6)
    - L. van der Horn Hydrodynamics of fluids and plasmas
    - M. van der Klis & High Energy Astrophysics (6)
    - L. van der Horn

- **1e semester 2005-2006**
  - Technieken van ruimte onderzoek en sterrenkunde

**Postdoctoraal onderwijs:**
In het kader van de landelijke onderzoekschool NOVA wordt er wisselend een college gegeven waarvan een gedeelte door docenten van het API:
- Massaverlies van sterren, Late evolutiestadia van sterrenstelsels
- Infrarood astronomie
- Geavanceerde dynamica van sterrenstelsels
1e semester van studiejaar 2005-2006
Bachelorvakken (aantal EC):
R. Wijers Symmetrie en Patroonvorming in de Natuur (SPIN) 
(1/4 deel ) (6)
M. van der Klis Sterrenkunde I (6)
R. Wijers (coord.) Sterrenkunde practicum I (6)
T. de Jong Melkwegstelsels (6)
L. Kaper Astrofysica (6)
G.J. Savonije Kosmologie (6)
L. van der Horn Electrodynamica & relativiteitstheorie I (6)
C. Dominik & R. Wijers Workshop Sterrenkunde (3)

Mastervakken (3 uur/week):
L. Kaper Sterrenkunde colloquium (3)
V. Icke Cosmology (6)
G.J. Savonije Structure & Evolution of stars (6)
R. Waters Observation Project (La Palma) (6)

Projecten Sterrenkunde voor 2e-jaars studenten
‘De fysica van tsunami’s’ (Jeannette Nguyen, Fenneke Overes, Justin Rasink, 
Merel Witteveen) L. van den Horn
‘Superzware ster formatie in de Lagoon en Trifid Nebula’ (Chao Kang Tai, Koen 
Maaskant, Sjors Broersen) L. Kaper
‘Het vinden van structuur in stervormingsgebied NGC6334’ (Frank Tramper, 
Wouter Staa) L. Kaper
‘Radiation from relativistic blast waves in gamma-ray bursts’ (Bouwe Andela, 
Javier Freire Sanchez) A. van der Horst, R. Wijers
‘Simulating GRB optical spectra at high redshift’ (Bas v.d. Berg, Joppe van Driel) 
K. Wiersema, R. Wijers, A. van der Horst

Begeleiding Bachelorprojecten
‘De eerste sterren’ (Lucinda Rasmijn) A. de Koter

Begeleiding Masterprojecten
‘Neutrino Detection with Antares & LOFAR’ (Y. Grange) R. Wijers & E. de Wolf

‘The redshift distribution of gamma-ray bursts detected by Swift and BATSE’ 
(G. van der Plas) R. Wijers

‘Low frequency radio studies of X-ray binaries’ (A. Kapinska) R. Wijers 
& J. Miller-Jones

‘Radio observations of candidate magnetic O stars’ (K. Rygl) R. Schnerr 
& H. Henrichs

‘Properties of Be stars with anomalous wind variability’ (B. Plaggenborg) 
R. Schnerr & H. Henrichs

‘Detecting chaotic orbits in N-body simulations’ (J. Gemmeke) S. Portegies Zwart

‘The formation of multiple stars in an open star cluster environment with 
primordial triples’ (J. van den Berk) S. Portegies Zwart

‘Low mass X-ray binaries in globular clusters’ (M. Smits) T. Maccarone

‘Cooling curves of accretion heated neutron stars’ (N. Degenaar) R. Wijnands

‘Quarksterren: Theoretische aspecten en observationele gevolgen’ (S. Hardeman) 
R. Wijnands, D. Boer (VU)

‘Massaverlies van de eerste generatie sterren’ (B. Anthonisse) A. de Koter

‘Giant eruptions of η Carinae’ (C. Kruip) A. de Koter

‘String models of the early universe’ (D. Meerburg) R. Wijers & J.P. van de Schaar

‘Timing properties of the Rapid Burster with RXTE’ (S. Ennaji) M. van der Klis 
& R. Wijnands

‘Using Polarimetry to Characterize Saturn-like Extrasolar Planets and their 
Rings’ (R. Nederlof) D. Stam

‘Properties of the dust particles in the disk of Beta Pictoris derived from 
scattering observations’ (J. Perez) R. Waters
Promotors en co-promotors en overige commissieleden
M.Min: J. Hovenier (promotor), L. Waters (promotor), A. de Koter (co-promotor), T. de Jong, C. Dominik
S. Migliari: M. van der Klis (promotor), R. Fender (supervisor), E. van den Heuvel, L. van den Horn, M. Méndez, R. Wijers
E. Gallo: M. van der Klis (promotor), R. Fender, E. van der Heuvel, L. van den Horn, R. Wijers

Lidmaatschappen andere promotiecommissies
Morten Anderson, Universiteit Potsdam, Duitsland, 4 maart
Lid commissie: S. Portegies Zwart
Indi Pelepussi, Universiteit Leiden, 16 maart
Lid commissie: S. Portegies Zwart
Mieke Bouwhuis, Nikhef, Amsterdam, 7 juli
Lid commissie: Ralph Wijers

La Palma waarneemproject
Het masterprogramma Astronomy & Astrophysics van het astronominisch instituut kent sinds 2003 een waarneemproject op het Roque de Los Muchachos Observatory te La Palma, Spanje, waar de Isaac Newton Group of Telescopes (INT) is gelegen. De INT wordt mede gefinancierd door de Nederlandse Organisatie voor Wetenschappelijk Onderzoek (NWO).
Het idee achter het La Palma waarneemproject is om studenten uit de eerste hand alle aspecten van het definiëren en uitvoeren van een waarneemprogramma te leren, inclusief het werk op de telescopenlocatie. Studenten worden daartoe gevraagd om een waarneemprogramma te definiëren voor de 1.2 meter Mercator telescoop, die door België (Leuven) geëxploiteerd wordt in een samenwerkingsproject met het Observatoire de Genève. De studenten schrijven een waarneemvoorstel waarin ze de algemene wetenschappelijke achtergrond uiteenzetten, het directe doel van de waarnemingen beschrijven, de uitvoerbaarheid, alsook de analyse en interpretatiestrategie.
Ze reizen naar de Canarische Eilanden in een groep van ongeveer 8 à10 studenten en twee begeleiders om de waarnemingen uit te voeren. Gedurende een week nemen ze - als de weersomstandigheden het toestaan - elk hun bronnen waar, daarbij geassisteerd door de andere studenten. Bij terugkomst analyseren ze de data en schrijven ze een verslag. Het type projecten die de studenten kiezen varieert van objecten in het zonnestelsel tot massieve Röntgen dubbelsterren, stervorming en interstellaire materie.

Hoewel het project, geïnitieerd en geleid door Waters, pas kort bestaat beschouwen de studenten het La Palma project als een van de hoogtepunten uit het masterprogramma.

Andere onderwijs activiteiten
N. Cox
- IMC Weekendschool, Amsterdam, 6, 13, 20 maart & 3 april

C. Dominik
- College ‘Chemie van Aarde en Hemel’, Amsterdam, sept

E. Gaburov
- Master class ‘Distributed Stochastic Simulations’, Universiteit van Amsterdam, Fall term

H. Henrichs
- College ‘Geschiedenis in het Groot’, Amsterdam, 17 feb
- College ‘Geschiedenis in het Groot’, Eindhoven, 6 april
- Mars, HOVO, Utrecht, 7 maart
- Exoplaneten, HOVO, Utrecht, 14 maart
- Inleiding Sterrenkunde 1e jaars, VU, Amsterdam, april-juni

E. van den Heuvel
- College ‘Chemie van Aarde en Hemel’, 2e en 3e jaars Chemie Studenten, (sept, 5 x, totaal 9 uur)
- College ‘Geschiedenis in het groot’, UvA, 15+18 feb
- College ‘Geschiedenis in het groot’, TU Eindhoven, 30 maart

L. Kaper
- Melkwegstelsels 3de jaars college, VU, Amsterdam, 2004-2005
- Profielwerkstuk ‘De levensloop van de ster’ van Max Thone & Tiedo van Kuijk, Vossius Gymnasium, Amsterdam

M. van der Klis
- College ‘Keerpunten BetaGamma’, UvA, Amsterdam, Spring term
- College ‘Keerpunten UvA breed’, UvA, Amsterdam, Fall term

A. de Koter
- UvA voorlichtingdag op locatie: Proefcollege “Het leven van de zwaarste sterren”, 10 juni
- Coördinatie Presentatiecursus voor promovendi en Postdocs, 4, 11, 18 juli

R. Mokiem
- Gastdocent IMC Weekendschool, Amsterdam, maart-april

S. Portegies Zwart
- ‘HOVO Galaxies and Cosmologie’, Radbout Universiteit Nijmegen, Spring 2005
- Caput college, Universiteit van Amsterdam, 7 april
- ‘IAC Computational Astrophysics: Dynamics of Stars and Gas’, Utrecht, (feb-aug)
- Master class ‘Distributed Stochastic Simulations’, Universiteit van Amsterdam, Fall term

L. Waters
- College ‘Chemie van Aarde en Hemel’, Amsterdam, sept.
- Interstellaire materie, Leuven, België, feb-mei

K. Wiersema
- Begeleiden van de volgende profielwerkstukken:
  ‘Slinger van Foucault’
  ‘Lichtsnelheid meten met de manen van Jupiter’
  ‘Zonspectrum’

R. Wijers
- College Ethiek in de natuurwetenschap, 11 maart

- Colleges Leicester Physics of GRB Afterglows, 11-13 april
- Proefcollege UvA voorlichtingsdag Sterrenkunde, 6 juli
4. Public Outreach Activities, Awards, Prizes etc.

4.1 Scientists in press articles

Elena Gallo

Ed van den Heuvel
*De ontdekking van…Ed van den Heuvel*, Scoop, Dec.
*Een leven met de sterren*, Spui, No. 3 2005
*‘Het is een spectaculair vak’*, Folia, Nov 18.
*Een gedrevene uit sterrenstof*, De Volkskrant, Nov 5.
*Exact knipperen volgens Einstein*, De Volkskrant, Sept 10.

Simon Portegies Zwart
*Exoplanete*, De Gelderlander, Nov 19.
*There may be 1000 “Hot Jupiter’s” in our Galactic Neighbourhood!*, Hindustan Times, Nov 18.
*Hunderte Planeten sollen drei Sonnen haben*, der Spiegel, Nov 17.
*Planeet drievoudige ster is weggekaapt van andere ster*, NRC, Nov 19.
*Interview met Simon Portegies Zwart*, Betabulletin, Jan.

Daphne Stam
*Europese ruimtesonde is op weg naar Venus*, De Volkskrant, Nov 10.
*Zoeken naar een tweede Aarde*, Kijk, Nov.

Rhaana Starling

Rens Waters
*Pleiaden voor de hele klas*, De Volkskrant, March 5.

Ralph Wijers
4.2 Popular lectures

Huib Henrichs
*De actieve Zon*, Artis Planetarium, Feb 1

Ed van den Heuvel
*Kijken Naar De Verste Sterren*, Dies-Lecture Universiteit van Amsterdam, Amsterdam, Jan 10
*Gammaflitseren, de krachtigste explosies in het Universum*, Hoftorenlezing Ministerie van Onderwijs, Cultuur en Wetenschappen, Den Haag, Feb 24
*Einstein’s Grootste Blunder*, Artis Planetarium, Amsterdam, June 7
*De Cassini-Huygens Missie naar de Saturnusmaan Titan*, Universiteitsdag Universiteit van Amsterdam, June 11
*Kijken naar de Verste Sterren*, Rotary Club Doorn-Maarn, June 14
*Einstein en de zwaartekracht: van Oerknal tot Uitdijend Heelal*, Open dag WCW en Universiteit van Amsterdam, Amsterdam, Oct 22
*De Eenheid van het Heelal*, Afscheidscollege, Amsterdam, Nov 3
*Zwaartekracht, Motor van de Evolutie van Zon en Sterren*, van Witte Dwergen tot Zwarte Gaten, Natuurkundig Gezelschap Middelburg, Nov 26

Alexander van der Horst
*Bursts & Giant flares*, API, Amsterdam, March 21
*Gammaflitseren: laboratoria voor extreme fysica*, KNVWS afdeling ’t Gooi, Hilversum, Oct 14

Karel van der Hucht
*De Boscha Sterrenwacht in Lembang Indonesie*, Stichting ITFAvdHcs, Leiden, April 24
*Kosmische Rampen*, Sterrenwacht Sonnenborgh, Utrecht, Oct 9 & Oct 11
*Kosmische Rampen*, Gezelschap ’Christiaan Huijgens’, PHRM, Utrecht, Nov 16
*Kosmische Rampen*, SRON, Utrecht, Dec 21

Teije de Jong
*Babylon: de Bakermat van de Sterrenkunde*, NVWS Het Gooi, Hilversum, Feb 13
*Sterrenkunde in Babylon*, Publiekssterrenwacht Phoenix, Lochem, Nov 12

Lex Kaper
*X-shooter: een nieuw instrument voor de ESO Very Large Telescope*, De Jonge Onderzoekers, Hilversum, Feb 11
*Cursus sterevolutie voor beginners*, NVWS afdeling Hoorn, March 1
*Sterevolutie*, NVWS, Amersfoort, March 9

Michiel van der Klis
*Einstein en het zwarte gat*, Artis Planetarium avondlezing, Amsterdam, April 5
*Astronomy from below*, Amsterdam, Feb 4

Thijs Kouwenhoven
*Missies naar Mars*, Gezelschap Physica, Tiel, Jan 12
*De Europese reis naar de planeet Mars*, KNVWS, Arnhem, Jan 19
*Sterren en Planeten*, IMC Weekendschool, Amsterdam, March 13
*De Melkweg-een eiland van sterren*, St. J.C. van der Meulen Hoorn, April 5

Michiel Min
*Optische eigenschappen van vaste deeltjes in circumstellaire schijven en kometen*, Amsterdam, May 12

Simon Portegies Zwart
*Immigranten in het Galactisch Centrum*, NWO Bessensap, Amsterdam, May 24
*Kunst en Wetenschap*, Farewell talk for Ed van den Heuvel, Amsterdam, Nov 3
*Viva Fysica lezing*, Amsterdam, Jan 14

Ton Raassen
*Ruim, Ruimte, Ruimst*, Huiskamerbijeenkomst, Blaricum, Feb 18

Roald Schnerr
*Magnetism in astronomy*, Metius (KNVWS afdeling Alkmaar), April 29

Leo van den Horn
*Ken je krachten: zwaartekracht en elektromagnetisme*, Vesta, Oostzaan, Oct 23

Rens Waters
*Sillicates in Space*, Chemistry student symposium Leiden, March 3
*Introductory talk*, Mars symposium organized by the Mars society, July 2
*Proto-planetaire schijven*, NSA symposium, Oct 27
4.3 Popular publications

Huib Henrichs
10 Jaar Exoplaneten, Vakidoot, Studievereniging A-eskwadraat Univ. Utrecht, p. 4-9, April 8

4.4 Interviews and appearances on radio/tv

Ed van den Heuvel
Grote onopgeloste problemen van de hedendaagse sterrenkunde, Teleac Radio, June 30.

Michiel van der Klis
Interview, Radio Amsterdam FM, April 7.

Thijs Kouwenhoven
De Hubble Space Telescope, interview Stads FM Radio Amsterdam, Feb 17.

Daphne Stam

Rens Waters
Interview on Titan, Noorderlicht, VPRO Radio, Jan 25.

Ralph Wijers
Intensievere jacht op gammaflitsers, Noorderlicht Nieuws, Jan 12.
Gammaflitsen, Interview Radio Ping-Pong, Dec 22.
5. Management

5.1 Finance

The table below gives the expenditure of the Astronomical Institute in 2005. The institute still has a relatively small ‘hard income’: the FNWI lump sum of €990. This income is used almost completely to finance the salaries of the non-supernumerary permanent staff members. Since 2/3 of the total funding is ‘soft money’ the continuation of income provided by NOVA and NWO is of extreme importance for running the institute.

<table>
<thead>
<tr>
<th>Direct funding (k€)</th>
<th>External funding (k€)</th>
<th>Total (k€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st geldstroom</td>
<td>2nd and 3rd geldstroom</td>
<td></td>
</tr>
<tr>
<td>FNWI lump sum</td>
<td>NWO</td>
<td>817</td>
</tr>
<tr>
<td>NOVA</td>
<td>EU</td>
<td>92</td>
</tr>
<tr>
<td>CvB UvA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KNAW</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2077</td>
<td>Total 869</td>
</tr>
<tr>
<td>Personnel</td>
<td>Personnel 724</td>
<td>2384</td>
</tr>
<tr>
<td>NOVA committed</td>
<td>307</td>
<td>307</td>
</tr>
<tr>
<td>Other costs</td>
<td>Other costs 145</td>
<td>255</td>
</tr>
<tr>
<td>Total</td>
<td>2077</td>
<td>Total 869</td>
</tr>
</tbody>
</table>

*) UvA matching funds for Vernieuwingsimpuls projects (k€ 91 in total) have been transferred to the corresponding 2nd geldstroom budgets from which the funds are spent.
5.2 Human Resources

People working at the institute 31 December 2005 are listed below.

theme 1 = High Energy Astrophysics;

theme 2 = Low Energy Astrophysics

<table>
<thead>
<tr>
<th>Permanent scientific staff</th>
<th>theme</th>
<th>fte</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof.dr. M. v.d. Klis (HL)</td>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>Prof.dr. T. de Jong (HL)</td>
<td>2</td>
<td>0.2</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>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>Dr. G.J. Savonije (UHD)</td>
<td>1+2</td>
<td>1.0</td>
</tr>
<tr>
<td>Prof.dr. H.F. Henrichs (UHD)</td>
<td>1+2</td>
<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>Dr. A. de Koter (UHD)</td>
<td>2</td>
<td>1.0</td>
</tr>
<tr>
<td>Dr. G.C.M.J. Hammerschlag-Hensberge (UD)</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Dr. A.J.J. Raassen (UD)</td>
<td>1</td>
<td>0.4</td>
</tr>
<tr>
<td>Prof.dr. L. Kaper (UD)</td>
<td>1+2</td>
<td>1.0</td>
</tr>
<tr>
<td>Dr. R.A.D. Wijnaads (UD, NOVA overlap)</td>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>vacature (1fte, UD)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Dr. C. Dominik (UD, NOVA overlap)</td>
<td>2</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Total (of which 2 fte NOVA overlap) 10.0

PM: Dr. Th. Nieuwenhuizen (UHD ITFA) 0.2**

** Our budget has been decreased in 2002 to pay for this position although it is not part of our official formation (due to WINS-reorganization)

<table>
<thead>
<tr>
<th>Externally funded (semi) permanent staff</th>
<th>theme</th>
<th>fte</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof.dr. V. Icke (UL, bijz. HL)</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Prof.dr. R. Sezom (ASTRON; HL)</td>
<td>1+2</td>
<td>0.2</td>
</tr>
<tr>
<td>Prof.dr. W. Hermsen (SRON)</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>H.C. Spruit (AUV CHEAF bijz.HL)</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Prof.dr. J. Hovenier (emeritus UvA)</td>
<td>2</td>
<td>0.5</td>
</tr>
<tr>
<td>Prof.dr. E.J. van den Heuvel (emeritus UvA)</td>
<td>1+2</td>
<td>0.5</td>
</tr>
<tr>
<td>Prof.dr. K.A. van der Hucht (SRON, UHD)</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Prof.dr. R.P. Fender (Univ. of Southampton, UHD)</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Dr. R.M. Mendez (SRON, UHD)</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Dr. B.W. Stappers (ASTRON, UD)</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Dr. A.J.J. Raassen (SRON, UD)</td>
<td>1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Total 2.7

Postdocs Michael Sipior and Tom Maccarone left the institute during 2005.

Ph.D. Students

During 2005, 3 PhD students obtained their PhD’s. By the end of 2005, 24.5 PhD students are working at the institute, of which 1 is university funded, 11.5 are funded by NOVA, 11 by NWO and 1 by SRON. Six new students started a PhD in 2005. Names can be found in Appendix II.

<table>
<thead>
<tr>
<th>Temporary staff: Postdocs and Fellows</th>
<th>theme</th>
<th>fte</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. S.F. Portegies Zwart (KN AW) (+0.5 at IrV1)</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Dr. L.K.C. Decin (Universiteit Leuven)</td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>Dr. J.C.A. Miller-Jones (NWO)</td>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>Dr. A. Pe’er (NWO)</td>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>Dr. D.M. Stam (NWO VENI)</td>
<td>2</td>
<td>1.0</td>
</tr>
<tr>
<td>Dr. R.L.C. Starling (EC-RTN)</td>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>Dr. H. Volten (Institute for Informatics)</td>
<td>2</td>
<td>1.0</td>
</tr>
<tr>
<td>Dr. S.-C. Yoon (NWO-VENI)</td>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>Dr. M. Bouwman (NWO-VICI + Nikhels)</td>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>Dr. M. Min (NOVA)</td>
<td>2</td>
<td>1.0</td>
</tr>
<tr>
<td>Dr. M. Klein Wolt (NWO Spinoza)</td>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>Dr. M. Horrobin (NOVA)</td>
<td>1+2</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Total 10.7

Jacques Visser left on 1 September. He worked as a communication manager at the NOVA Information Center since the start of the Center in 2000. Marieke Baan joined on 1 April and is now leading the Information Center. Fieke Kroon left on 15 September. She worked at the institute’s secretariat for 4.5 years.
Formation

In the table below all staff working in the institute on 31 December 2005 is summarized in terms of fte (full time equivalent):

<table>
<thead>
<tr>
<th>Position</th>
<th>Direct funding FNWI UvA</th>
<th>Direct funding NOVA, CvB, KNAW</th>
<th>External funding NWO, ASTRON, EC, etc.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full professor</td>
<td>3.2</td>
<td>1.8</td>
<td></td>
<td>5.0</td>
</tr>
<tr>
<td>Associate professor</td>
<td>3.2</td>
<td>0.6</td>
<td></td>
<td>3.8</td>
</tr>
<tr>
<td>Assistant professor</td>
<td>1.6</td>
<td>2.0</td>
<td>0.3</td>
<td>3.9</td>
</tr>
<tr>
<td>KNAW fellow</td>
<td>0.5</td>
<td></td>
<td></td>
<td>0.5</td>
</tr>
<tr>
<td>Postdoc</td>
<td>2.0</td>
<td>8.2</td>
<td></td>
<td>10.2</td>
</tr>
<tr>
<td>Ph.D. students</td>
<td>1.0</td>
<td>11.5</td>
<td>12.0</td>
<td>24.5</td>
</tr>
<tr>
<td>Supporting staff</td>
<td>3.65</td>
<td>0.6</td>
<td></td>
<td>4.25</td>
</tr>
<tr>
<td>Total</td>
<td><strong>13.65</strong></td>
<td><strong>16.6</strong></td>
<td><strong>22.9</strong></td>
<td><strong>52.15</strong></td>
</tr>
</tbody>
</table>
Appendices

Appendix I: Institute Staff on 31-12-2005

Gewoon Hoogleraren
Prof.dr. T. de Jong (0.2 fte), Prof.dr. M.B.M. van der Klis, Prof.dr. L.B.F.M. Waters (tevens deeltijd hoogleraar K.U. Leuven), Prof.dr. R.A.M.J. Wijers

Bijzonder Hoogleraren
Prof.dr. W. Hermsen (0.2 fte SRON), Prof.dr. V. Icke (bijz. hoogleraar, Stichting Beta-Plus), Prof.dr. R. Strom (0.2 fte, affiliated prof.; NWO Foundation ASTRON, Dwingeloo), Prof.dr. H. Spruit (0.2 fte, MPIA, Garching; bijz. hoogleraar AUV)

Emeriti
Prof.dr. E.P.J. van den Heuvel, Prof.dr. J.W. Hovenier

Universitair Hoofddocenten
Prof.dr. R.P. Fender (0.2 fte, Univ. of Southampton), Prof.dr. H. F. Henrichs (0.7 fte; tevens 0.3 fte hoogleraar Sterrenkunde VU), Dr. L. J. van den Horn (0.5 fte), Dr. K.A. van der Hucht (0.2 fte, SRON), Dr. A. de Koter, Dr. R.M. Méndez (0.2 fte SRON), Dr. G.J. Savonije

Universitair Docenten
Dr. C. Dominik (NOVA overlap), Dr. G. Hammerschlag-Hensberge (0.2 fte), Prof.dr. L. Kaper (tevens 0.3 fte bijz. hoogleraar onderwijs in de Sterrenkunde VU), Dr. A.J.J. Raassen (0.37 fte + 0.13 SRON), Dr. B.W. Stappers (0.2 fte ASTRON), Dr. R.A.D. Wijnands (NOVA overlap)

KNAW-Fellow
Dr. S.F. Portegies Zwart (0.5 fte Astron. Inst.; 0.5 fte Informatics Inst.)

Postdocs (met financieringsbron)
Dr. M.C. Bouwhuis (NWO-VICI), Dr. L.K.E. Decin (0.2 fte KU Leuven), Dr. M. Horrobin (NOVA), Dr. M. Klein Wolt (NWO-Spinoza), Dr. J. Miller Jones (NWO-VIDI), Dr. M. Min (NOVA), Dr. A. Pe’er (NWO-VICI), Mw. Dr. D.M. Stam (NWO-VENI), Mw. Drs. R.L.C. Starling (EC/RTN), Mw. Dr. H. Volten (NOVA), Dr. S.C. Yoon (NWO-VENI)

Ph.D. students (met financieringsbron)
Drs. D. Altamirano (NOVA), Drs. N.L.J. Cox (NOVA), Drs. P.A. Curran
(NWO-VICI), Drs. H. van Eerten (NOVA), Drs. E. Gaburov (NWO), Mw. Drs. A. Gualandris (NWO) (0.5 fte API, 0.5 fte IvI), Drs. P.R. den Hartog (SRON), Drs. A.J. van der Horst (UvA), Mw. Drs. G.H. Janssen (NWO), Drs. Ramesh Karuppusamy (NOVA), Drs. M.B.N. Kouwenhoven (NWO), Drs. M. Linares (NWO), Drs. A. van der Meer (NOVA), Drs. J. Meijer (NOVA), Drs. R. Mokiem (NWO), Drs. D. Paszun (NWO), Drs. A. Patruno (NOVA/Spinoza), Drs. E. Rubio Herrera (NOVA), Drs. B. Scheers (NOVA/LOFAR), Drs. R.S. Schnerr (NOVA), Drs. J.N. Spreeuw (NWO-VICI), Drs. V.M. Tudose (NWO-VIDI), Drs. A. Verhoeff (NWO), Drs. P. Weltevrede (NOVA), Drs. K. Wiersema (NOVA)

Business manager
L. Stolte

Scientific software engineer
Dr. M.H.M. Heemskerk

Management-assistants
M.C. van Beurden (0.5 fte UvA + 0.4 fte ASTRON), Drs. A. Lenssen (0.55 fte)

Librarian
E.S. van Iterson (0.3 fte, bibliotheekformatie FNWI)

Nova Information Centre
Drs. H.M. Baan (0.6 fte NOVA)

Appendix II: Promovendi en promoties 2005

<table>
<thead>
<tr>
<th>AIO’s/OIO’s</th>
<th>promotoren/begeleiders</th>
<th>einde contract</th>
<th>promotie</th>
<th>gs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michiel Min</td>
<td>Waters/de Koter/Hovenier</td>
<td>01-04-05</td>
<td>12-05-05</td>
<td>UvA</td>
</tr>
<tr>
<td>Arjen van de Meer</td>
<td>van den Heuvel</td>
<td>01-08-05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simone Migliari</td>
<td>van der Klis/Fender</td>
<td>16-09-05</td>
<td>21-09-05</td>
<td>NWO</td>
</tr>
<tr>
<td>Elena Gallo</td>
<td>van der Klis/Fender</td>
<td>16-09-05</td>
<td>23-09-05</td>
<td>NOVA</td>
</tr>
<tr>
<td>Rohied Mokiem</td>
<td>v.d. Heuvel/de Koter</td>
<td>01-03-06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nick Cox</td>
<td>Ehrenfreund/Kaper</td>
<td>01-05-06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thijs Kouwenhoven</td>
<td>Kaper</td>
<td>01-09-06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allesia Gualandris</td>
<td>van den Heuvel/ Sloot/</td>
<td>01-09-06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.5 fte API, 0.5 fte IvI) Portegies Zwart</td>
<td>Peter den Hartog</td>
<td>van der Klis/Hermensen</td>
<td>01-11-06</td>
<td>SRON</td>
</tr>
<tr>
<td>Patrick Weltevrede</td>
<td>van der Klis/Stappers</td>
<td>01-12-06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roald Schnerr</td>
<td>Henrichs</td>
<td>01-12-06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joke Meijer</td>
<td>Waters/de Koter</td>
<td>01-01-07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alexander van der Horst</td>
<td>Wijers</td>
<td>01-09-07</td>
<td></td>
<td>UvA</td>
</tr>
<tr>
<td>Klaas Wiersema</td>
<td>Wijers</td>
<td>01-10-07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diego Altimirano</td>
<td>Van der Klis</td>
<td>17-11-07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ramesh Karuppusamy</td>
<td>Van der Klis/Slump</td>
<td>01-02-08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evghenii Gaburov</td>
<td>Portegies Zwart</td>
<td>01-08-08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dominik Paszun</td>
<td>Waters/Dominik</td>
<td>15-08-08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peter Curran</td>
<td>Wijers</td>
<td>01-10-08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hanno Spreeuw</td>
<td>Wijers</td>
<td>01-11-08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gemma Janssen</td>
<td>van der Klis/Stappers</td>
<td>15-11-08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valeriu Tudose</td>
<td>van der Klis/Fender</td>
<td>01-12-08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allesandro Patruno</td>
<td>van der Klis/Wijnaards</td>
<td>01-04-09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arjan Verhoeuff</td>
<td>Waters</td>
<td>01-05-09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manuel Linares</td>
<td>van der Klis</td>
<td>01-07-09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eduardo Rubio Herrera</td>
<td>Stappers/vdKlis/Wijers</td>
<td>01-10-09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hendrik van Eerten</td>
<td>Wijers</td>
<td>01-10-09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bart Scheers</td>
<td>Wijers</td>
<td>01-11-09</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix III: Memberships

Committee memberships of the University of Amsterdam

C. Dominik
Member Organization Open Dag
Member NOVA Inquisition

H. Henrichs
Member Commissie World Year of Physics 2005
Member Bibliotheekcommissie Faculty FNWI for the Astron. Institute
Member Huisvestingscommissie Faculty NWI
Member Studentenklachtencommissie for Astronomy students FNWI
Member Beheergroep Sterrenkoepel, Telescopen en instrumentatie

E.P.J. van den Heuvel
Chairman Stuurgroep “Instituut voor Interdisciplinaire Studie (IIS)”, UvA
Member European Mobility Scheme for Physics Students
Member Examcommissie Faculty NWI
Daily Management Examcommissie N&S
Member Accreditatievoorbereidingscommissie Natuur- en Sterrenkunde
Coördinator of Education ITF

L. Kaper
Member Delegation Board UvA visiting South America
Chairman Colloquiumcommissie
Coordinator third semester Bachelor Physics and Astronomy

M.B.M. van der Klis
Member UD benoemingscommissie

A. de Koter
Member Klankbordgroep Beowulf Cluster
Member UD benoemingscommissie
API co-coordinator for move to new building

A. Raassen
Member Ondernemingsraad (OR) of the Faculty NWI
Chairman Commission of Finance OR-Faculty NWI

G.J. Savonije
Coordinator Education Astronomy UvA
Member Landelijke Onderwijs/NOVA Onderwijs Commissie

L.B.F.M. Waters
Member Senate of University of Amsterdam

K. Wiersema
Member Landelijke en NOVA Onderwijscommissies (LOCNOC)

R.A.M.J. Wijers
Member UD benoemingscommissie
Member Opleidingscommissie Natuur- en Sterrenkunde
Coördinator College Symmetrie en Patroonvorming in de Natuur
Chairman Promotiebegeleidingscommissie Astronomical Institute
Coordinator Master Program Astronomy and Astrophysics
Member LOC Viva Fysica
Member WTCW e-Science Fysica
Member Accreditatievoorbereidingscommissie Natuur- en Sterrenkunde

Science Policy Functions

R. Fender
Member of LOFAR Nederland Stuurgroep (NL-SG)
Member of ASTRON Telescopes Time Allocation Committee
Member ESO Telescope Time Allocation Committee

H. Henrichs
Member WIC (World Space Observatory Implementation Committee)

W. Hermsen
Vice-president, Committee on Space Research (COSPAR) of the
International Council of Scientific Unions (ICSU) and Chairman of the
Publications Committee
Chair, COSPAR Sub-commission E1 on Galactic and Extragalactic
Astrophysics
Vice-Chair, COSPAR Scientific Commission E on Research in
Astrophysics form Space
Secretary, IAA Academy Commission I on Space Physical Sciences
Vice-Chair INTEGRAL Science Working Team (ESA mission scientist)
Member, NASA GLAST (Gamma-ray Large Area Telescope) Users Committee
Member, Advisory Board NOVA PUMA at Westerbork Synthesis Radio Telescope
Member, ESA INTEGRAL Users Group

E.P.J. van den Heuvel
Member, Ethics Committee of the Royal Netherlands Academy of Sciences (KNAW)
Secretary, Section for Physics & Astronomy, Royal Netherlands Academy of Sciences (KNAW)
Chairman “Spinozaclub”, Association of Spinozaprise laureates, NWO, (meetings 29 March and 14 December in Rijnsburg)
Chairman National Contact Council, NWO-ASTRON, Dwingeloo
Member Board Pulsar Machine PuMa, ASTRON, Dwingeloo
Chairman Management Museum “Sterrenwacht Sonnenborgh”, Utrecht
Member Jury Scholierenwedstrijd Fysica “Land van Ooit” (June 10)
Member Jury EU Descartes Prize, Brussels
Member KNW Evaluation Committee Dutch Space Research
Advisory Board “Kennislink” Foundation, Amsterdam
Visitation Committee Education in Physics and Astronomy at the Flemish Universities, Flemish Interuniversity Council, Brussels
European Science Foundation Evaluation Committee of the European Centre for Very Long Basement Interferometry “JIVE”, Dwingeloo
Board of National Research School for Astronomy NOVA

A.J. van der Horst
Member LOC “A Life with Stars”, Amsterdam, August 2005

J. Hovenier
Member Science Advisory Committee of Journal of Quantitative Spectroscopy and Radiative Transfer

K.A. van der Hucht
Board of Directors Leids Kerkhoven-Bosscha Fonds, Leiden, co-director
Board of Directors Leids Sterrenwacht Fonds, Leiden, co-director
Board of Directors Jan Hendrik Oort Fonds, Leiden, co-director

Board of Directors Stichting de Koepel, Utrecht, chairman
Steering Committee Indonesian-Netherlands Astrophysics (INA), secretary
Assistant General Secretary International Astronomical Union

T. de Jong
Member Scientific Committee NLR/NIVR
Member Board Artis Natura Magistra
Member Commission of CHAMA of IUHPS
International Society for Archaeoastronomy and Astronomy in Culture
Jury “Dr. Ir. Spee prize”
Organizing Committee Working Group 2 on Astronomical Chronology of IAU
Commission 41 on History of Astronomy
Chairman Organizing Committee 2nd Regensburg Workshop on Babylonian Astronomy: “From Observation to Theory”

L. Kaper
Chairman board Vereniging van Akademie Onderzoekers
Chairman ESO User Committee
Member ESO Contact Committee
NL Principal Investigator X-Shooter Consortium
Secretary Stichting Amsterdams Fonds voor de Astrofysica

M. van der Klis
Principal Investigator NOVA PuMa-2 radio pulsar instrument
Member of Association of NWO’s Spinoza Prize laureates
Member NOVA Instrument Steering Committee
Member Science Advisory Board SRON
Member NWO-Gebiedsbestuur Exacte Wetenschappen
Member Commissie Nieuwe Leden Sectie Natuur- en Sterrenkunde KNAW
Board of Leids Kerkhoven-Bosscha Fonds
Editor New Astronomy
Editor Science

A. de Koter
Chairman Minnaert Commissie, NOVA Information Centre
Member benoemingscommissie Persvoorlichter NOVA Information Centre
Member NWO Vernieuwingsimpulsp VIDI beoordelingscommissie
Member Advisory Commission NOVA Phase 2 Instrument proposals
Member Redactieraad Kennislink
Chair LOC, member SOC Conference “Mass loss from stars and the evolution
of stellar clusters”
Member FLAMES program on massive stars consortium, O-star programme co-coordinator
Dutch Representative ESO/OPC

M. Méndez
Member ESA XEUS Astrophysics Working Group
Member NASA Chandra Science Working Group
Member Editorial Board of Space Research Today
Member SOC Aspen workshop Revealing Black Holes
Member SOC The Multicoloured Landscape of Compact Objects and their Explosive Origins: Theory vs. Observations, Cefalu, Italy

S. Portegies Zwart
Member Scientific Advisory Committee VPRO Noorderlicht Radio
Member Board NWO Interdisciplinaire Onderzoeksdag, May 24
Member SOC Conference on Massive Stars in Interacting Binaries, Canada, August 15 – 20

R.G. Strom
Secretary of the European VLBI Network Program Committee, TAC
Member, Board, Stichting voor Euraziatische Hemelkunde
Co-chair, Scientific Organizing Committee and proceedings co-editor, 5th ICOA (Oct. 2004)
Chairman XMM-Newton panel, AO-3 proposal review
Member, Scientific Organizing Committee, “The New Astronomy: Opening the Electromagnetic Window and Expanding our View of Earth” (June 2004)
Member, KARST Support Group, National Astronomical Observatories – Chinese Academy of Sciences
Member of Working Committee, International Conference on Oriental Astronomy (ICOA)
IAU representative to the International Geosphere-Biosphere Programme

L.B.F.M. Waters
Member National School for Research in Astronomy (NOVA)
Member ESO-ESA GENIE Science Team
Member ESO VLTI Steering committee
Member ESO VLTI Science Demonstration Team
Chairman, Dutch Science Team for VISIR

Co-principal investigator for Mid-infrared Instrument for VLTI MIDI
Co-chair, NOVA VLTI team
Member NWO Committee “Advies Commissie Astronomie”
Member, advisory board Lorentz Center
Member, HIFI science team
Member, MIRI science team
Member NEVEC management team
Member science advisory board MPIA Heidelberg
Co-I CHEOPS Phase-A Study
Member “Nationale Platform Planeetonderzoek”
Member MATISSE science team
Member SOC Workshop “From Dust to Planetsimals”, Ringberg Castle
Chair Conference “Mass Loss from stars and stellar clusters”, Lunteren
Member Board of the “Raad voor Natuur- en Sterrenkunde” of the KNAW
Member ASTRON Board
Member Astronomy Working Group of the European Space Agency
Member Science Advisory Board of the Space Research Organization Netherlands

R.A.M.J. Wijers
Coordinator EU RTN “Gamma-Ray Bursts: An enigma and a tool”
Editor New Astronomy Reviews
Member Board Stichting Amsterdams Fonds voor de Astrofysica
Member Beoordelingscommissie Astronomie (NWO grant jury)
Member ASTRON nationale contactraad
Member council SRON Netherlands Organisation for Space Research
Member LOFAR Astronomy Research Committee
Member advisory board Lorentz Center
Member Committee for Astroparticle Physics in the Netherlands
Member ASTRON Program Committee (TAC for WSRT and ING)
Co-PI LOFAR Transient Key Project
Member SOC and LOC “A life with Stars”, Amsterdam, August 2005
Member Jury Scholierenwedstrijd Fysica “Land van Ooit” (June 10)
Member SOC RTN Meeting on GRBs, Santorini, September 2005
Member SOC Maryland Meeting on Gamma-Ray Bursts, Washington, November 2005
Memberships of & Offices in Learned Societies

W. Hermsen
Member International Academy of Astronautics (IAA)

G. Hammerschlag-Hensberge
Treasurer Dutch Astronomers Club (NAC)

E.P.J. van den Heuvel
Royal Netherlands Academy of Sciences, KNAW, Amsterdam
Royal Netherlands Society for Sciences, Haarlem
Honorary Member Indian Academy of Sciences, Bangalore, India
Academia Europaea (European Academy of Sciences)
New York Academy of Sciences
Foreign Associate, Royal Astronomical Society, London

K. A. van der Hucht
Assistant General Secretary International Astronomical Union
Chairman IAU Editorial Board

M.B.M. van der Klis
Royal Netherlands Academy of Sciences, KNAW, Amsterdam
Royal Netherlands Society for Sciences, Haarlem

R.G. Strom
Member Dutch URSI Committee

L.B.F.M. Waters
International Astronomical Union (IAU)
Nederlandse Astronomen Club (NAC)

R.A.M.J. Wijers
Chair section Astrophysics of Dutch Physical Society

Appendix IV: Visiting Scientists

January
Dr. B. J. Braams, Emory University Atlanta, GA, USA (3-7)
Dr. O. Muñoz, Instituto de Astrofísica de Andalucía, Granada, Spain
(22-Feb. 4)
Prof. Dr. J. Rankin, University of Vermont, Burlington, VT, USA
(22-June 27)
Dr. M. Audard, Columbia University, New York, NY, USA (23-25)
Dr. B. McKernan, University of Maryland, College Park, MD, USA
(23-25)
Dr. R. Braun, ASTRON, Dwingeloo, The Netherlands (26)
Drs. A. Patruno Università degli Studi di Milano Bicocca, Milan, Italy (27-30)
Dr. S. Markoff, MIT, Cambridge, MA, USA (30-Feb. 2)

February
Dr. A. Papitto, Osservatorio Astronomico di Roma Monteporzio Catone, Rome, Italy (6-10)
Dr. F. Kemper, University of Virginia, Charlottesville, VA, USA (8-11)
Prof. Dr. M. Davies, Lund Observatory, Lund, Sweden (14-18)
Dr. S. Smartt, Queens University, Belfast, UK (16-18)
Dr. G. Muñoz Caro, Centro de Astrobiologia, Madrid, Spain (21)

March
Dr. F. Najarro, Inst. de Estructura de la Materia, Madrid, Spain (6-10)
Prof. Dr. R. Blandford, Stanford University, Stanford, CA, USA (11)
Dr. H. Baumgardt, Sternwarte der Universität Bonn, Germany (15-18)
Drs. E. Mamikonyan, Drexel University, Philadelphia, PA, USA (16-24)
Prof. Dr. H. Bal, Vrije Universiteit Amsterdam, The Netherlands (17)
Prof. Dr. A. King, University of Leicester, Leicester, UK (21-April 22)
Dr. G. Wright, University of Sussex, Brighton, UK (21-July 31)

April
Dr. J. Lee, Harvard-Smithsonian Center for Astrophysics
Cambridge, MA, USA (4+5)
Dr. H. Baumgardt, Sternwarte der Universität Bonn, Bonn, Germany (5)
Dr. M. Horrobin, Max Planck Institut für extraterrestrische Physik, Garching, Germany (21-25)
Drs. C. Hopman, Weizman Institute of Science, Rehovot, Israel (25-29)
May
Dr. J.E. Dale, University of Leicester, Leicester, UK (2-11)
Prof. Dr. D.C. Heggie, University of Edinburgh, Edinburgh, UK (10-12)
Dr. G. Videen, US Army Research Laboratory, Raleigh, NC, USA (10-13)
Dr. M.I. Mischenko, NASA Goddard Institute for Space Studies, New York, NY, USA (11-15)
Dr. R. Klessen, Astrophysikalisches Institut Potsdam, Potsdam, Germany (7-9 +26)
Dr. D. Psaltis, University of Arizona, Tucson, AZ, USA (28-June 26)
Dr. F. Ozel, University of Arizona, Tucson, AZ, USA (28-June 26)

June
Dr. P. Wood, Research School of Astronomy & Astrophysics, Weston Creek, Australia (2-3)
Dr. R. Klessen, Astrophysikalisches Institut Potsdam, Germany (6-9)
Dr. C. Ceccarelli, LAOG, Grenoble, France (6-10)
Prof. Dr. A. Kembhavi, Inter Univ. Centre for Astronomy & Astrophysics, Pune, India (16-20)
Prof. Dr. A. Alpar, Sabanci University, Istanbul, Turkey (17-26)
Drs. M. Pessah, University of Arizona, Tucson, AZ, USA (19-26)
Dr. M. Muno, University of California, Los Angeles, CA, USA (22-25)
Dr. G. Videen, US Army Research Laboratory, Raleigh, NC, USA (24-June 30, 2006)

July
Dr. C. P. Dullemond, MPI für Astronomie, Heidelberg, Germany (6)
Dr. S. Clark, University College London, London, UK (6+7 / 16-19)
Dr. S. Owocki, University of Delaware, Newark, DE, USA (15-20)
Prof. Dr. S. McMillan, Drexel University, Philadelphia, PA, USA (17-30)
Prof. Dr. P. Hut, Institute for Advanced Study, Princeton, NJ, USA (23-August 3)

August
Drs. C. Hopman, Weizman Institute of Science, Rehovot, Israel, (1-5)
Dr. R. Misra, Inter Univ. Centre for Astronomy & Astroph., Pune, India (3-15)
Drs. N. Faber, Université Louis Pasteur, Strasbourg, France (4-7)
Dr. L. Yungelson, Institute of Astronomy of the Russian Academy of Sciences, Moscow, Russia (20-Nov 10)
Prof. Dr. V. Radhakrishnan, Raman Research Institute, Bangalore, India (18-29)
Prof. Dr. R. Srinivasan, Raman Research Institute, Bangalore, India (20-29)

Dr. W. Sutantyo, Institut Teknologi Bandung, Bandung, Indonesia (21-30)
Michiel van Leeuwen, GRAY Nederland, (30)

September
Dr. S. Harfst, Rochester Institute of Technology, Rochester, NY, USA (11-15)
Drs. L. Resmi, Raman Research Institute, Bangalore, India (19-23)
Dr. Q.Z. Liu, Purple Mountain Observatory, Nanjing, China (20-Dec.19)
Dr. A. Celotti, International School for Advanced Studies, Trieste, Italy (22+23)
Dr. C. Kaiser, University of Southampton, Southampton, UK (23)

October
Prof. Dr. D. Merritt, Rochester Institute of Technology, Rochester, NY, USA (6-8)
Drs. E. Cackett, University of St. Andrews, Fife, UK (9-16)
Dr. B.R. Brandl, Leiden University, Leiden, The Netherlands (11)
Prof. Dr. P. Meszaros, Pennsylvania State Univ., University Park, PA, USA (13)
Prof. Dr. F. Halzen, University of Wisconsin, Madison, WI, USA (25)

November
Dr. Y. Levin, Leiden University, Leiden, The Netherlands (1)
Dr. A. Riggio, Università degli Studi di Palermo, Palermo, Italy (14)
Drs. F. Soleri, Università degli Studi di Milano, Milan, Italy (16)
Dr. O. Muñoz, Instituto de Astrofísica de Andalucía, Granada, Spain (14-26)
Drs. C. Gielen, Katholieke Universiteit Leuven, Leuven, Belgium (21)

December none
Appendix V: Colloquia

January
(24) Marc Audard, Columbia University
*High-Energy Processes in Star Formation*
(24) Barry McKernan, University of Maryland
*The Search for the Hot Missing Matter*
(27) Robert Braun, ASTRON
*Radio Cosmology: Some Recent Results and Future Directions*
(27) Peter Jonker, Harvard CfA
*Soft X-ray transients & binary millisecond pulsars: constraining the neutron star equation of state*
(31) Gijs Nelemans, Radboud Universiteit, Nijmegen
*Ultra-compact binaries as sources of gravitational waves*
(31) Sera Markoff, MIT Cambridge, USA
*Understanding the Ins -- and Especially the Outs -- of Accretion*

February
(4) Pedro Lacerda, Sterrewacht Leiden
*Shapes and Spins of Kuiper Belt Objects*
(11) Ignas Snellen, Sterrewacht Leiden
*Transiting extra-solar planets*
(18) Stephen Smartt, Queen’s University Belfast, NOVA colloquium
*Detecting the progenitors of core-collapse supernova*
(25) Hans van Winckel, KU Leuven
*Evolved low mass binaries*

March
(4) Marco Spaans, Kapteyn Instituut, Groningen
*Molecules in Extreme Environments*
(7) Paco Najarro, Inst. de Estructura de la Materia, Madrid
*Massive stars in the Galactic Center*
(11) Roger Blandford, KIPAC Stanford, NOVA colloquium
*Accretion and its Consequences*

April
(1) Bernhard Brandl, Leiden Observatory
*Spitzer Studies of Massive HII Regions*
(15) Wim Hermsen, SRON/UvA
*INTEGRAL High Lights*
(22) Michiel Hogerheijde, Sterrewacht Leiden
*Planet-forming disks: Recent results from (sub)millimeter interferometers and the Spitzer Space Telescope*
(29) Andreas Brunthaler, JIVE
*The Geometric Distance and Proper Motion of M33*

June
(3) Peter Wood, Australian National University
*The Pulsation of Red Giant Stars*
(10) Jim Dale, University of Leicester
*Collisions and close encounters involving massive main-sequence stars*
(17) Prof.dr. Ajit Kembhavi, Inter-University Centre for Astronomy & Astrophysics, Pune, India
*Fundamental Correlations in Galaxies*

July
(29) Stefan Schröder, MPI für Sonnensystemforschung, Lindau
*A close-up view of Titan: First results of the Descent Imager/Spectral Radiometer aboard Huygens*

September
(9) Elena Gallo, Sterrenkundig Instituut, Universiteit van Amsterdam
*Relativistic jets from Stellar Black Holes*
(16) Stefan Harfst, Rochester Institute of Technology, New York
*Modelling galaxies with a multi-phase interstellar medium*
(30) Lev Yungelson, Institute. of Astronomy of the Russian Academy of Sciences, Moscow
*Low-mass helium stars and their progeny*

October
(7) David Merritt, Rochester Institute of Technology
*Dynamics of Galactic Nuclei: Beyond the Million-Body Problem*
(21) Joop Schaye, Leiden Observatory
*The Chemical Enrichment of the Intergalactic Medium*
(25) Francis Halzen, Dept. of Physics, Univ. of Wisconsin, NOVA colloquium
*Neutrino Astronomy at the South Pole: From AMANDA to IceCube*

November
(4) Jort Gemmeke, Universiteit van Amsterdam, Graduation colloquium
*Detecting chaotic orbits in N-body simulations*
(11) Michiel Min, Sterrenkundig Instituut, Universiteit van Amsterdam
Optical properties of circumstellar and cometary grains

(18) Henny Lamers, Sterrenkundig Instituut, Universiteit Utrecht
Formation and Destruction of Star Clusters in Galaxies

(22) Jelle van den Berk, Universiteit van Amsterdam, Graduation colloquium
Introducing primordial triples in N-body simulations

(25) Mieke Bouwhuis, Sterrenkundig Instituut, Universiteit van Amsterdam, NIKHEF
Detection of neutrinos from gamma-ray bursts

December

(2) Gorden Videen, Space Science Institute and US Army Research Laboratory
Some studies of the negative polarization branch of irregular particles

(9) Tomasz Plewa, Computational Physics & Validation Group, Univ. of Chicago
Modeling Type Ia supernovae

(16) Paul Murdin, Institute of Astronomy, Cambridge, Christmas colloquium
The Paris Meridian in fiction, art, adventure and science

Appendix VI: Scientific Meetings

Participation in Scientific Meetings

MIDI Science Group Meeting, Zurich, Switzerland, Jan 6
Alex de Koter

NWO meeting, Leiden, The Netherlands, Jan 12-13
Alessia Gualandris

NAC meeting, Leiden, The Netherlands, Jan 14
Rens Waters

COSPAR colloquium ‘Spectra and Timing of Compact X-ray Binaries’, Mumbai, India, Jan 15-21
Rudy Wijnands, Michiel van der Klis, Ed van den Heuvel

X-shooter DRS meeting, Paris, France, Jan 18
Lex Kaper

INTEGRAL Internal Science Workshop, Noordwijk, The Netherlands, Jan 18-21
Wim Hermsen

GAIA meeting, Leiden, The Netherlands, Jan 28
Simon Portegies Zwart

NL participation Extremely Large Telescope, Leiden, The Netherlands, Feb 3
Lex Kaper

Meeting of the Scientific and Technical Subcommittee of the UN Committee on the Peaceful Use of Outer Space, Vienna, Austria, Feb 21
Karel van der Hucht

First Mars Express Science Conf., ESTEC, Noordwijk, Netherlands, Feb 21-25
Daphne Stam (poster)

X-shooter Project Board meeting ESO, Amsterdam, The Netherlands, Feb 22-23
Lex Kaper
Constellation-X-XEUS science meeting, Boston, MA, USA, Feb 23-25  
*Mariano Mendez*

NORDITA QPO workshop, Copenhagen, Denmark, Feb 24 - March 1  
*Michiel van der Klis, Mariano Mendez*

NOVA Instrument Steering Committee meeting, Leiden, The Netherlands, March 4  
*Lex Kaper*

Einstein-Tagung of the German Physical Community, Berlin, Germany, March 4-9  
*Stratos Boutloukos*

From Disks to Planets: New Observations, Models and Theories, Pasadena, CA, USA, March 7-10  
*Joke Meijer, Carsten Dominik*

X-shooter meeting ASTRON, Dwingeloo, The Netherlands, March 14  
*Lex Kaper*

Dutch Astrophysics Days, Dwingeloo, The Netherlands, March 17-18  
*Alexander van der Horst*

Triggering Relativistic Jets, Cozumel, Mexico, March 28 – April 1  
*James Miller-Jones (poster), Michiel van der Klis*

Planetary Fourier Spectrometer meeting, Espinho, Portugal, March 29-31  
*Daphne Stam*

Time and astronomy in past cultures, Torun, Poland, March 30-April 2  
*Teije de Jong*

Nucleosynthesis in binary stars, Leiden, The Netherlands, April 4-8.  
*Sung-Chul Yoon*

GRB RTN training meeting, Leicester, UK, April 10-14  
*Klaas Wiersema, Peter Curran, Rhaana Starling, Ralph Wijers*

ESO User Committee meeting, Garching, Germany, April 11-12  
*Lex Kaper*

X-shooter Preliminary Design Review DRS, Garching, Germany, April 13  
*Lex Kaper*

MIDI Science Group Meeting, Nice, France, April 13-16  
*Alex de Koter*

Workshop ‘Stellar end products’, Granada, Spain, April 13-15  
*Alexander van der Horst, Elena Gallo*

The Central Parsec of The Galaxy, Santa Barbara, CA, USA, April 13-17  
*Simon Portegies Zwart, Ed van den Heuvel*

GRB RTN meeting, Reykjavik, Iceland, April 17-26  
*Klaas Wiersema, Peter Curran, Rhaana Starling*

N-Body Problems in Astrophysics, Los Angeles, CA, USA, April 18-23  
*Simon Portegies Zwart*

*Mariano Mendez*

4th Astro Particle Physics Symposium, Groningen, The Netherlands, April 22  
*Alexander van der Horst*

Korean Astronomical Society Meeting, Yong Pyeong, South Korea, April 21-23  
*Sung-Chul Yoon*

X-shooter meeting ASTRON, Dwingeloo, The Netherlands, May 4  
*Lex Kaper*

Intel Science and Engineering Fair, Phoenix, AZ, USA, May 7-13  
*Thijs Kouwenhoven (special judge earth and space)*

8th Conference on Electromagnetic and Light Scattering by Nonspherical Particles, Salobrena, Spain, May 16-20  
*Hester Volten, Michiel Min*

IAU Symposium 227, Massive star birth: a crossroad of Astrophysics, Acireale,
Italy, May 16-20
*Thijs Kouwenhoven (poster)*

Sigrav Graduate School, A century from Einstein and relativity: Probing Gravity in Binary Systems, Como, Italy, May 16-21
Gemma Janssen, Diego Altamirano, Manu Linares, Ed van den Heuvel, Alessandro Patruno

Nederlandse Astronomen Conferentie, Blankenberge, Belgium, May 18-20
Klaas Wiersema, Alexander van der Horst (poster), Godelieve Hammerschlag-Hensberge, Peter Curran, Rhaana Starling, Roald Schnerr, James Miller-Jones (poster), Patrick Weltevrede, Rohied Mokiem, Joke Meijer, Hanno Spreeuw (poster), Michiel van der Klis, Stratos Boutloukos (poster), Arjan Verhoeff

Ralph Wijers

Frascati Workshop 2005: Multifrequency Behaviour of High Energy Cosmic Sources, Vulcano, Italy, May 23-28
Wim Hermsen

XEUS – A high-energy mission for ESA's Cosmic Vision 2015-2025 program Consortium Meeting, Garching, Germany, May 30-31
Mariano Mendez

X-shooter meeting ASTRON, Dwingeloo, The Netherlands, June 8
Lex Kaper

SRON Wetenschapsdagen, Dalfsen, The Netherlands, June 13-14
Ralph Wijers

International Molecular Spectroscopy Meeting “Large Astronomical Molecules”, Columbus, OH, USA, June 20-24
Nick Cox

Astrophysical Sources of High Energy Particles and Radiation, Torun, Poland, June 20-24
Wim Hermsen

X-shooter DRS meeting, Amsterdam, The Netherlands, June 22
Lex Kaper

FLAMES Large Program consortium workshop, Belfast, UK, June 27-28
Rohied Mokiem, Alex de Koter

High Energy in the Highlands, Fort William, UK, June 26-July 2
Rudy Wijnands, Michiel van der Klis

Massive Stars and High-Energy Emission in OB Associations, Liege, Belgium, July 4-7
Ton Raassen

Oort Workshop: Protoplanetary Disk Evolution, Leiden, Netherlands, July 7-8
Joke Meijer, Michiel Min, Carsten Dominik

7th Biennial History of Astronomy Workshop at Notre Dame, South Bend, IN, USA, July 7-10
Teije de Jong

Workshop “Stars with the B[e] phenomenon”, Vlieland, Netherlands, July 10-16
Rens Waters

Aspen Summer Workshop ‘Black Holes’, Evanston, IL, USA, July 10-31
Michiel van der Klis

Ultra Relativistic Jets in Astrophysics, Banff, Alberta, Canada, July 11-15
Valeria Tudose (poster)

ESO Workshop on Multiple Stars across the H-R diagram, Garching, Germany, July 12-15
Thijs Kouwenhoven, Simon Portegies Zwart

X-shooter meeting ASTRON, Dwingeloo, The Netherlands, July 13
Lex Kaper

Pulsar Timing Array Workshop: A Nanohertz Gravitational Wave Telescope, State College, PA, USA, July 21-23
Gemma Janssen, Ben stappers

Masterclass on the art of computational N-body dynamics, Amsterdam, The Netherlands, July 24-30
Thijs Kouwenhoven
MODEST-5c Summer School, Amsterdam, The Netherlands, July 24-30
Alessia Gualandris, Simon Portegies Zwart (Organiser)

Lake Hanas International Pulsar Symposium, Urumqi, China, August 1-7
Patrick Weltevrede, Ben Stappers

Dublin, Ireland, August 15-19
Rudy Wijnands, Ed van den Heuvel

Stellar evolution at low metallicity: evolution, explosion, cosmology, Tartu,
Estonia, August 15-19
Sung-Chul Yoon, Alex de Koter

A Life with Stars, Amsterdam, The Netherlands, August 22-26
Sung-Chul Yoon, Alessia Gualandris, Klaas Wiersema, Godelieve Hammerslag-Henberge, Peter Curran, Valeriu Tudose (poster), Rhaana Starling, Roald Schnerr, James Miller-Jones, Ton Raassen (poster), Rudy Wijnands, Gemma Janssen, Diego Altamirano, Elena Gallo, Hanno Spreeuw (poster), Michiel van der Klis, Lex Kaper (chairman LOC), Stratos Boutloukos (poster), Simon Portegies Zwart, Ed van den Heuvel, Alessandro Patruno, Wim Hermsen, Asaf Pe’er, Ralph Wijers, Ben Stappers

IAU 231: Astrochemistry, Asilomar, CA, USA, August 26-Sept 1
Nick Cox

Workshop ‘Active OB stars: Laboratories for stellar and circumstellar Physics’,
Sapporo, Japan, August 27 – Sept 11
Huib Henrichs, Roald Schnerr

RTN Meeting: The First Three Hours, Santorini, Greece, August 29 - Sep 2
Sung-Chul Yoon, Klaas Wiersema, Peter Curran, Rhaana Starling, Asaf Pe’er, Ralph Wijers

X-shooter meeting ASTRON, Dwingeloo, The Netherlands, Aug 31
Lex Kaper
SKA key science meeting for Pulsars, Sydney, Australia, August 15-17
Ben Stappers

Summerschool d’Oleron 2005, Interaction in composite systems: Stars, Discs and Planets, Oleron, France, Sept 4-10
Gertjan Savonije

European Radio Interferometry School, Manchester, UK, Sept 5-9
Valeriu Tudose

X-shooter DRS meeting, Paris, France, Sept 18-19
Lex Kaper

Workshop, Grenoble, France, Sept 19-21
Michiel Min

48th Annual Meeting of the Argentinian Astronomical Society, La Plata, Argentina, Sept 20-23
Mariano Mendez

NOVA Instrument Steering Committee meeting, Leiden, Netherlands, Sept 22
Lex Kaper

Dwingeloo Neighbourhood Symposium, Bonn, Germany, Sept 22
Valeriu Tudose

Summerschool “Molecular Astrophysics”, Les Houches, France, Sept 26-30
Nick Cox

The X-ray Universe 2005, Madrid, Spain, Sept 26-30
Ton Raassen (poster), Manu Linares, Alessandro Patruno, Wim Hermsen

LOFAR Survey Team Meeting, Leiden, The Netherlands, Sept 27
Hanno Spreeuw

X-shooter meeting ASTRON, Dwingeloo, The Netherlands, Sept 28
Lex Kaper

IAU Colloquium 200, Nice, France, Oct 3-7
Daphne Stam

NOVA Fall School, Astron, Dwingeloo, The Netherlands, Oct 3-7
Klaas Wiersema, Alexander van der Horst, Valeriu Tudose
LOFAR Source Extraction Meeting, Leiden, The Netherlands, Oct 6  
*Hanno Spreeuw*

X-shooter Project Board meeting, Palermo, Italy, Oct 10-11  
*Lex Kaper*

Workshop: Measuring the Diffuse Intergalactic Medium, Yokohama, Japan, Oct 10-13  
*Wim Hermsen*

Young Radio Astronomers Conference, Cagliari, Italy, Oct 12-16  
*Valeriu Tudose*

Astroparticle Physics Symposium, Utrecht, The Netherlands, Oct 14  
*Ralph Wijers*

X-shooter OFDR meeting ASTRON, Dwingeloo, The Netherlands, Oct 24  
*Lex Kaper*

Protostars and Planets V, Waikoloa, HI, USA, Oct 24-28  
*Dominik Paszun, Joke Meijer, Michiel Min, Carsten Dominik, Christiaan Boersma, Arjan Verhoef*

X-shooter meeting ASTRON, Dwingeloo, The Netherlands, Oct 26  
*Lex Kaper*

NSA-Symposium ‘History of the Universe’, Amsterdam, The Netherlands, Oct 27  
*Ed van den Heuvel*

LOFAR young scientists meeting, Dwingeloo, The Netherlands, Nov 3  
*Bart Scheers, Hanno Spreeuw, Ben Stappers*

Very Large Volume neutrino Telescope workshop, Catania, Italy, Nov 8-11  
*Mieke Bouwhuis*

LOFAR system CDR meeting, Spier, The Netherlands, Nov 16-17  
*Ralph Wijers*

---

ESO/OPC Meeting, Munchen, Germany, Nov 21-25  
*Alex de Koter*

LOFAR software PDR meeting, Dwingeloo, The Netherlands, Nov 23  
*Ralph Wijers*

CNOC IV National Congress on Compact Objects, Padova, Italy, Nov 23-25  
*Alessandro Patruno*

Rhine Stellar Dynamics Network meeting, Bonn, Germany, Nov 25-28  
*Simon Portegies Zwart*

Symposium ‘Zwaartekracht’ in honour of 225th anniversary of Natuurkundig Gezelschap Middelburg, Middelburg, The Netherlands, Nov 26  
*Ed van den Heuvel*

Lorentz center workshop: “Spitzer’s view on mass-losing AGB stars”, Leiden, The Netherlands, Nov 28-Dec 2  
*Rens Waters*

Gamma-Ray bursts in the swift era, Washington DC, USA, Nov 29-Dec 2  
*Asaf Pe’er (poster)*

Seminar ‘X-rays from neutron stars and black holes: murmurs from strong field gravity’, Shell, Rijswijk, The Netherlands, Dec 1  
*Micke van der Klis*

MPIA Heidelberg: “Frontiers in Astrophysics”, Heidelberg, Germany, Dec 1  
*Rens Waters*

Descartes prize giving ceremony, London, UK, Dec 2-3  
*Ben Stappers*

Modest-6A, Lund, Sweden, Dec 11-15  
*Alessia Gualandris Evgeni Gaburov Simon Portegies Zwart*

New Techniques and Results in Low Frequency Radio Astronomy, Hobart, Australia, Dec 6-10  
*James Miller-Jones*
<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lex Kaper</td>
<td>X-shooter meeting ASTRON, Dwingeloo, The Netherlands, Dec 7</td>
</tr>
<tr>
<td></td>
<td>Pacificchem 2005, Astrochemistry symposium, HI, USA, Dec 15-20</td>
</tr>
<tr>
<td>Nick Cox</td>
<td>Computational and Technological Challenges of LOFAR, Jülich, Germany, Dec 15-16</td>
</tr>
<tr>
<td></td>
<td>Scientific talks at Astronomical Institutes and Conferences</td>
</tr>
<tr>
<td>Mieke Bouwhuis</td>
<td>Data taking, filtering and online triggers in ANTARES, Catania, Italy, Nov 8</td>
</tr>
<tr>
<td></td>
<td>Stratos Boutloukos</td>
</tr>
<tr>
<td></td>
<td>Eigenmodes of axisymmetric neutron stars in linear perturbation theory, Berlin, Germany, March 4</td>
</tr>
<tr>
<td>Nick Cox</td>
<td>PAH charge state distribution and DIB carriers: implications from the translucent line of sight toward HD147889, Columbus, OH, USA, June 22</td>
</tr>
<tr>
<td></td>
<td>PAH chemistry and diffuse interstellar bands in the Galaxy and beyond, Honolulu, HI, USA, Dec 21</td>
</tr>
<tr>
<td>Peter Curran</td>
<td>Photometric Redshifts of GRB’s using the Lyman Forest, Leicester, UK, April 11</td>
</tr>
<tr>
<td></td>
<td>Modeling of high redshift Gamma-Ray bursts, Dwingeloo, The Netherlands, Oct 3</td>
</tr>
<tr>
<td>Carsten Dominik</td>
<td>Dust coagulation, Mountain View, CA, USA, July 21</td>
</tr>
<tr>
<td></td>
<td>Dust settling, stirring and coagulation in disks, Pasadena, CA, USA, March 8</td>
</tr>
<tr>
<td></td>
<td>Dust settling stirring and coagulation in disks, Leiden, The Netherlands, July 7</td>
</tr>
<tr>
<td></td>
<td>Dust aggregation at the first step toward planet formation, Waikoloa, HI, USA, Oct 28</td>
</tr>
<tr>
<td></td>
<td>Protoplanetary disks, Grenoble, France, April 14</td>
</tr>
<tr>
<td></td>
<td>Intermediate mass protostars for the HiFi Spectral Survey Key Program, Bonn, Germany, June 9</td>
</tr>
<tr>
<td>Elena Gallo</td>
<td>Accretion modes and jet production in black hole X-ray binaries, Granada, Spain, April 13</td>
</tr>
<tr>
<td></td>
<td>Relativistic jets from stellar black holes, Dwingeloo, The Netherlands, Sept 8</td>
</tr>
<tr>
<td></td>
<td>Relativistic jets from stellar black holes, Milan, Italy, Oct 19</td>
</tr>
<tr>
<td>Alessia Gualandris</td>
<td>The dynamical ejection of high velocity stars from dense stellar systems, Nijmegen, The Netherlands, Oct 19</td>
</tr>
<tr>
<td></td>
<td>The ejection of hypervelocity stars from the Galactic Centre, Lund, Sweden, Dec 15</td>
</tr>
<tr>
<td>Wim Hermsen</td>
<td>INTEGRAL Science High Lights, Vulcano, Italy, May 24</td>
</tr>
<tr>
<td></td>
<td>Anomalous X-Ray Pulsars in the RXTE, Newton, Chandra and INTEGRAL era, Vulcano, Italy, May 25</td>
</tr>
<tr>
<td></td>
<td>INTEGRAL Science High Lights, Stanford, CA, USA, June 8</td>
</tr>
<tr>
<td></td>
<td>INTEGRAL Observations of the Vela Pulsar and Pulsar Wind Nebula, Torun, Poland, June 23</td>
</tr>
<tr>
<td></td>
<td>Census of High Energy Emitting Rotating Neutron Stars, Amsterdam, August 23</td>
</tr>
<tr>
<td>Ed van den Heuvel</td>
<td>Formation and Evolution of Neutron Star Binaries, Mumbai, India, Jan 19</td>
</tr>
<tr>
<td></td>
<td>Conference Summary, Mumbai, India, Jan 21</td>
</tr>
<tr>
<td></td>
<td>Double Neutron Stars: Evidence for Two Different Neutron Star Formation Mechanisms, Pune, India, Jan 22</td>
</tr>
<tr>
<td></td>
<td>Formation and Evolution of Relativistic Binaries, Como, Italy, May 17 &amp; 19</td>
</tr>
<tr>
<td></td>
<td>Gamma-Ray bursts as Rare Stages of Stellar Evolution, Dublin, Ireland, Aug 17</td>
</tr>
<tr>
<td></td>
<td>Double Neutron Stars: Evidence for Two Different Neutron Star Formation Mechanisms?, Amsterdam, The Netherlands, August 24</td>
</tr>
<tr>
<td></td>
<td>Wij zijn van Sterrenstof Gemaakt, Amsterdam, The Netherlands, Oct 27</td>
</tr>
<tr>
<td>Alexander van der Horst</td>
<td>Radio afterglows of gamma-ray bursts, Granada, Spain, April 13</td>
</tr>
<tr>
<td></td>
<td>The recent super-giant flare from the magnetar SGR1806-20, Groningen, The Netherlands, April 22</td>
</tr>
</tbody>
</table>
Karel van der Hucht
*Statement of the International Astronomical Union*, Vienna, Austria, Feb 21

Teije de Jong
*Astronomical dating of the Venus observation of Ammisaduqa*, Torun, Poland, March 30
*Time and astronomy in past cultures*, Torun, Poland, March 30
*A new attempt to date the observations of rising stars in MULAPIN*, South Bend, IN, USA, July 7
*Babylonian observations of first appearances and disappearances of Venus*, South Bend, IN, USA, July 9

Lex Kaper
*The Infancy of massive stars*, Bonn, Germany, June 3
*The neutron star mass distribution*, Meudon, France, Sept 19

Michiel van der Klis
*Murmurs from the strong field region*, Amsterdam, The Netherlands, March 8

Alex de Koter
*The death-struggle of eta Carinae, the most massive star in the Galaxy*, Nijmegen, The Netherlands, March 16
*The observed relation between mass-loss and metallicity in O-type stars*, Belfast, UK, June 27
*The observed mass loss vs. metallicity relation for O-type stars*, Tartu, Estonia, August 16

Thijs Kouwenhoven
*The Primordial Binary Population in OB associations*, Garching, Germany, July 12

Mariano Méndez
*Equation of State Studies*, Boston, MA, USA, Feb 23
*On the distribution of the kHz QPO frequency and its relation to resonance models*, Copenhagen, Denmark, Feb 24
*Equation of State Studies*, Garching, Germany, May 30
*Black holes, space, and time*, La Plata, Argentina, Nov 1
*X-Ray Astronomy*, La Plata, Argentina, Nov 25

James Miller-Jones
*Radio Observations of Cygnus X-3*, Dwingeloo, The Netherlands, Jan 21
*Radio Observations of relativistic ejections in X-ray binary systems*, Southampton, UK, June 22
*Low-frequency observations of transient sources*, Hobart, Tasmania, Dec 10

Michiel Min
*Modeling optical properties of dust grains using the statistical approach*, Salobrena, Spain, May 16
*Cosmic dust: The building blocks of planetary systems*, Nijmegen, The Netherlands, June 8
*MIDI observations of silicate emission*, Leiden, The Netherlands, July 7
*The shape and composition of interstellar silicates*, Leiden, Netherlands, Sept 13
*Modeling optical properties of dust grains using the statistical approach*, Grenoble, France, Sept 19
*Ironsulfide as the carrier of the 90 micron feature*, Grenoble, France, Sept 20

Rohied Mokiem
*Automated fitting of spectra of massive stars*, Blankenberge, Belgium, May 18
*Automated fitting & SMC analysis*, Belfast, N. Ireland, UK, June

Dominik Paszun
*Different effects influencing dust aggregation*, Braunschweig, Germany, July 14
*Aggregation Physics: elongation of aggregates and sticking efficiency*, Grenoble, France, Sept 20

Alessandro Patruno
*Evolution of IMBH binaries and possible connection with ULXs*, Padova, Italy, Nov 23

Asaf Pe’er
*High energy photon emission in the early afterglow of GRB’s*, Garching, Germany, Jan
*The physics of GRB Prompt emission*, Santorini, Greece, Sept
*Peak energy Clustering and efficiency in compact objects*, University Park, PA, USA, Oct
*The observable effects of a photospheric component on GRB’s and XRF’s prompt emission spectrum*, Washington DC, USA, Nov
*The signature of a wind reverse shock in GRB afterglows*, University Park, PA, USA, Dec
Simon Portegies Zwart  
*Talk at GAIA meeting, Leiden, The Netherlands, Jan 28*

Ton Raassen  
*X-Ray spectroscopy of hot and cool stars with CHANDRA and XMM-Newton, Dalfsen, The Netherlands, June 13*

Gertjan Savonije  
*Three lectures on Dynamical tides and resonance locking, Oleron, France, Sept 4-10  
Unstable quasi g-modes in rotating B-stars, Cambridge, UK, Oct 24*

Daphne Stam  
*Characterizing Terrestrial Extrasolar Planets using Polarimetry, Nice, France, Oct 3*

Ben Stappers  
**Pulsars at the WSRT**, Dwingeloo, The Netherlands, June 6  
**Pulsars**, Dwingeloo, The Netherlands, June 14  
**The European Pulsar Timing Array**, Urumqi, China, August 1  
**8gr8: A Pulsar survey of the Cygnus region**, Amsterdam, Netherlands, August 24  
**Pulsars with LOFAR**, Dwingeloo, The Netherlands, Nov 3  
**PUMA II**, Westerbork, The Netherlands, Dec 16

Rhaana Starling  
**AGN in the X-ray regime**, Alkmaar, The Netherlands, Feb 9  
**Cosmic Powerhouses**, Leicester, UK, Feb 28  
**Optical observations of GRB 021004**, Surrey, UK, March 1  
**Absorption in DLA GRB’s**, Santorini, Greece, Sept 2

Valeriu Tudose  
**Jets at different scales: the cases of PKS 0820+225 and CIR X-1**, Southampton, UK, June 20  
**Radio observations of the 2004 december 27 flare of SGR 1806-22**, Bonn, Germany, Sept 22  
**Jets at different scales**, Dwingeloo, The Netherlands, Oct 3  
**Jets at different scales**, Cagliari, Italy, Oct 12

Hester Volten  
**The Amsterdam Light Scattering Facility**, Orleans, France, Feb 17

*Experimental evidence for extremely high polarization of fluffy Mg-Silicate aggregates, Granada, Spain, May 16  
Size effects on the scattering behavior of cometary analogues, Granada, Spain, May 17*

Rens Waters  
**Scientific Results of the MIDI instrument**, Leiden, The Netherlands, Jan 14  
**Herbig Ae/Be stars**, Vlieland, The Netherlands, July 12  
**Mineralogy of Protoplanetary Disks**, Grenoble, France, Sept 21  
**Building planets: dust as a tracer of planet formation**, Heidelberg, Germany, Dec 1

Patrick Weltevrede  
**Statistics of the Drifting subpulse phenomenon**, Urumqi, China, August 1  
**De pulsen van Pulsars**, Westerbork, The Netherlands, Dec 19

Klaas Wiersema  
**Short talk on GRB40924**, Reykjavik, Iceland, April 17  
**GRB afterglow spectroscopy**, Dwingeloo, The Netherlands, Oct 3

Ralph Wijers  
**Theory of prompt and afterglow emission of GRB’s**, Leicester, UK, April 11  
**New(s) Flashes on GRB’s with Swift**, Blankenberge, Belgium, May 18  
**Theory of GRB blast waves**, Santorini, Greece, August 31

Rudy Wijnands  
**Kilohertz Quasi-Periodic Oscillations in the accreting millisecond X-ray pulsar SAX J1808.4-3638**, Bombay, India, Jan 17  
**Very faint X-ray transients in the Galactic Center region**, Fort William, UK, June 28  
**Very faint X-ray transients in our Galaxy**, Dublin, Ireland, August 18

Sung-Chul Yoon  
**Progenitor models of Type Ia supernovae**, Leiden, The Netherlands, April 5  
**On the Progenitors of Gamma-Ray Bursts**, Yong Pyeong, South Korea, April 23  
**On the evolution of rapidly rotating white dwarfs towards supernovae or collapses**, Tokyo, Japan, April 26  
**On the evolution of massive single and binary stars towards gamma-ray bursts**, Tartu, Estonia, August 15  
**On the evolution of massive stars towards gamma-ray bursts**, Santorini, Greece, August 29
Working Visits

Evghenii Gaburov  
Vassar College, Poughkeepsie, NY, USA, May 23-June 14  
Lund Observatory, Lund, Sweden, Nov 28-Dec16

Elena Gallo  
University of Southampton, Southampton, UK, Feb & July

Alessia Gualandris  
Rochester , NY, USA, May 8-20

Alex de Koter  
MPI Heidelberg, Heidelberg, Germany, Feb 1-2

Simon Portegies Zwart  
Potsdam, Germany, March 3-5  
Bonn, Germany, July 3-6  
International Space Science Institute, Bern, Switzerland, Nov 7-11  
Max Planck Institute for Astrophysics, Garching, Germany, Nov 23-25

Valeriu Tudose  
University College, Cork, Ireland, June 1-13  
University of Southampton, Southampton, UK, June 13-24  
University of Southampton, Southampton, UK, Nov 19-26

Appendix VII: Observing Sessions

Diego Altamirano  
IAC, La Palma, Spain, Sept -Dec

Christiaan Boersma  
JCMT, Mauna Kea, HI, USA, Oct 11-16

Nick Cox  
CFHT/Espadons, Mauna Kea, HI, USA, May 18-20

Carsten Dominik  
JCMT, Mauna Kea, HI, USA, Feb 4-12

Huib Henrichs  
Catania, Italy, May 30-June 8  
La Palma, Spain, Dec 9-14

Roald Schnerr  
TNG, La Palma, Spain, Dec

Rhaana Starling  
IAC, La Palma, Spain, Oct 30-Nov 5

Arjan Verhoeff  
VISIR, Paranal, Chili, June 28 + July 1
Appendix VIII: Scientific Publications

Dissertations


Migliari, S. (21-09-2005). Disc-Jet Coupling in Neutron Star and Black Hole Binaries. UvA Universiteit van Amsterdam (191 pag.) Prom./coprom.: Klis, Prof. dr. M. van der, & Fender, dr R.P.


Publications in international refereed journals


Astronomical Institute Anton Pannekoek


Publications in non-refereed journals


Gillessen, S., Davies, R., Kissler-Patig, M., Lehnert, M., Werf, P. van der, Nowak, N., Eisenhauer, F., Abuter, R., Horrobin, M.J., Gilbert, A., Genzel, R., Bender,
First science with SINFONI. The Messenger, 120, 26-32.

Circulars and Abstracts


## Appendix IX: Contact Information

<table>
<thead>
<tr>
<th>Last Name</th>
<th>Initials</th>
<th>E-mail</th>
<th>Phone</th>
<th>Last Name</th>
<th>Initials</th>
<th>E-mail</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altamirano</td>
<td>D.M.</td>
<td><a href="mailto:diego@science.uva.nl">diego@science.uva.nl</a></td>
<td>525 7472</td>
<td>Laan</td>
<td>E.C.</td>
<td><a href="mailto:elaan@science.uva.nl">elaan@science.uva.nl</a></td>
<td>592 5097</td>
</tr>
<tr>
<td>Baan</td>
<td>H.M.</td>
<td><a href="mailto:mbaan@science.uva.nl">mbaan@science.uva.nl</a></td>
<td>525 7480</td>
<td>Lenssen</td>
<td>A.</td>
<td><a href="mailto:alessen@science.uva.nl">alessen@science.uva.nl</a></td>
<td>525 7491</td>
</tr>
<tr>
<td>Beurden van</td>
<td>M.C.</td>
<td><a href="mailto:mvbeurde@science.uva.nl">mvbeurde@science.uva.nl</a></td>
<td>525 7491</td>
<td>Meer van der</td>
<td>A.</td>
<td><a href="mailto:ameer@science.uva.nl">ameer@science.uva.nl</a></td>
<td>592 5097</td>
</tr>
<tr>
<td>Boersma</td>
<td>C.</td>
<td><a href="mailto:boersma@astro.rug.nl">boersma@astro.rug.nl</a></td>
<td>525 7495</td>
<td>Meijer</td>
<td>J.</td>
<td><a href="mailto:jmeijer@science.uva.nl">jmeijer@science.uva.nl</a></td>
<td>525 7482</td>
</tr>
<tr>
<td>Bouwhuis</td>
<td>M.C.</td>
<td><a href="mailto:mieke.bouwhuis@nikhef.nl">mieke.bouwhuis@nikhef.nl</a></td>
<td>592 2073</td>
<td>Mendez</td>
<td>R.M.</td>
<td><a href="mailto:M.Mendez@sron.nl">M.Mendez@sron.nl</a></td>
<td>525 7495</td>
</tr>
<tr>
<td>Cox</td>
<td>N.L.J.</td>
<td><a href="mailto:ncox@science.uva.nl">ncox@science.uva.nl</a></td>
<td>525 7473</td>
<td>Miller-Jones</td>
<td>J.</td>
<td><a href="mailto:jmiller@science.uva.nl">jmiller@science.uva.nl</a></td>
<td>525 7499</td>
</tr>
<tr>
<td>Curran</td>
<td>P.A.</td>
<td><a href="mailto:pcurran@science.uva.nl">pcurran@science.uva.nl</a></td>
<td>525 7471</td>
<td>Min</td>
<td>M.</td>
<td><a href="mailto:mmin@science.uva.nl">mmin@science.uva.nl</a></td>
<td>525 7476</td>
</tr>
<tr>
<td>Dominik</td>
<td>C.</td>
<td><a href="mailto:dominik@science.uva.nl">dominik@science.uva.nl</a></td>
<td>525 7477</td>
<td>Mokiem</td>
<td>M.R.</td>
<td><a href="mailto:mokiem@science.uva.nl">mokiem@science.uva.nl</a></td>
<td>525 7475</td>
</tr>
<tr>
<td>Eerten van</td>
<td>H.J.</td>
<td><a href="mailto:hveerten@science.uva.nl">hveerten@science.uva.nl</a></td>
<td>525 7482</td>
<td>Paszun</td>
<td>D.</td>
<td><a href="mailto:dpaszun@science.uva.nl">dpaszun@science.uva.nl</a></td>
<td>525 7494</td>
</tr>
<tr>
<td>Fender</td>
<td>R.P.</td>
<td><a href="mailto:rpf@phys.soton.ac.uk">rpf@phys.soton.ac.uk</a></td>
<td>525 7472</td>
<td>Patruno</td>
<td>A.</td>
<td><a href="mailto:apatruno@science.uva.nl">apatruno@science.uva.nl</a></td>
<td>525 7472</td>
</tr>
<tr>
<td>Gaburov</td>
<td>E.</td>
<td><a href="mailto:egaburov@science.uva.nl">egaburov@science.uva.nl</a></td>
<td>525 7582</td>
<td>Pe’er</td>
<td>A.</td>
<td><a href="mailto:apeer@science.uva.nl">apeer@science.uva.nl</a></td>
<td>525 7499</td>
</tr>
<tr>
<td>Gualandris</td>
<td>A.</td>
<td><a href="mailto:alessiag@science.uva.nl">alessiag@science.uva.nl</a></td>
<td>525 7582</td>
<td>Portegies Zwart</td>
<td>S.F.</td>
<td><a href="mailto:spz@science.uva.nl">spz@science.uva.nl</a></td>
<td>525 7510</td>
</tr>
<tr>
<td>Hammerschlag</td>
<td>G.C.M.J.</td>
<td><a href="mailto:godeleive@science.uva.nl">godeleive@science.uva.nl</a></td>
<td>525 7474</td>
<td>Raassen</td>
<td>A.J.</td>
<td><a href="mailto:raassen@science.uva.nl">raassen@science.uva.nl</a></td>
<td>525 7473</td>
</tr>
<tr>
<td>Heemskerk</td>
<td>M.H.M.</td>
<td><a href="mailto:martin@science.uva.nl">martin@science.uva.nl</a></td>
<td>525 7475</td>
<td>Rubio-Herrera</td>
<td>E.</td>
<td><a href="mailto:erubio@science.uva.nl">erubio@science.uva.nl</a></td>
<td>525 7482</td>
</tr>
<tr>
<td>Henrichs</td>
<td>H.F.</td>
<td><a href="mailto:huib@science.uva.nl">huib@science.uva.nl</a></td>
<td>525 7466</td>
<td>Savonije</td>
<td>G.J.</td>
<td><a href="mailto:gertjan@science.uva.nl">gertjan@science.uva.nl</a></td>
<td>525 7497</td>
</tr>
<tr>
<td>Hermsen</td>
<td>W.</td>
<td><a href="mailto:W.Hermsen@sron.nl">W.Hermsen@sron.nl</a></td>
<td>525 7495</td>
<td>Scheers</td>
<td>B.</td>
<td><a href="mailto:bscheers@science.uva.nl">bscheers@science.uva.nl</a></td>
<td>525 7479</td>
</tr>
<tr>
<td>Heuvel van den</td>
<td>E.P.J.</td>
<td><a href="mailto:edvdh@science.uva.nl">edvdh@science.uva.nl</a></td>
<td>525 7493</td>
<td>Schnerr</td>
<td>R.S.</td>
<td><a href="mailto:rschnerr@science.uva.nl">rschnerr@science.uva.nl</a></td>
<td>525 7467</td>
</tr>
<tr>
<td>Horn van den</td>
<td>L.</td>
<td><a href="mailto:vdhorn@science.uva.nl">vdhorn@science.uva.nl</a></td>
<td>525 7479</td>
<td>Spreeuw</td>
<td>J.N.</td>
<td><a href="mailto:hspreeuw@science.uva.nl">hspreeuw@science.uva.nl</a></td>
<td>525 7470</td>
</tr>
<tr>
<td>Horrobin</td>
<td>M.J.</td>
<td><a href="mailto:horrobin@science.uva.nl">horrobin@science.uva.nl</a></td>
<td>525 7478</td>
<td>Stam</td>
<td>D.M.</td>
<td><a href="mailto:dstam@science.uva.nl">dstam@science.uva.nl</a></td>
<td>525 7473</td>
</tr>
<tr>
<td>Horst van der</td>
<td>A.J.J.</td>
<td><a href="mailto:avdhorst@science.uva.nl">avdhorst@science.uva.nl</a></td>
<td>525 7471</td>
<td>Stappers</td>
<td>B.</td>
<td><a href="mailto:bws@science.uva.nl">bws@science.uva.nl</a></td>
<td>525 7486</td>
</tr>
<tr>
<td>Hovenier</td>
<td>J.</td>
<td><a href="mailto:hovenier@nat.vu.nl">hovenier@nat.vu.nl</a></td>
<td>525 7499</td>
<td>Starling</td>
<td>R.L.C.</td>
<td><a href="mailto:starling@science.uva.nl">starling@science.uva.nl</a></td>
<td>525 7471</td>
</tr>
<tr>
<td>Hucht van der</td>
<td>K.A.</td>
<td><a href="mailto:K.A.van.der.Hucht@sron.nl">K.A.van.der.Hucht@sron.nl</a></td>
<td>525 7495</td>
<td>Stolte</td>
<td>L.</td>
<td><a href="mailto:lide@science.uva.nl">lide@science.uva.nl</a></td>
<td>525 7487</td>
</tr>
<tr>
<td>Icke</td>
<td>V.</td>
<td><a href="mailto:icke@strw.leidenuniv.nl">icke@strw.leidenuniv.nl</a></td>
<td>525 7495</td>
<td>Strom</td>
<td>R.G.</td>
<td><a href="mailto:strastrom@science.uva.nl">strastrom@science.uva.nl</a></td>
<td>525 5126</td>
</tr>
<tr>
<td>Iterson van</td>
<td>L.</td>
<td><a href="mailto:liesbeth@science.uva.nl">liesbeth@science.uva.nl</a></td>
<td>525 7489</td>
<td>Tudose</td>
<td>V.M.</td>
<td><a href="mailto:vtudose@science.uva.nl">vtudose@science.uva.nl</a></td>
<td>5257479</td>
</tr>
<tr>
<td>Janssen</td>
<td>G.H.</td>
<td><a href="mailto:gemma@science.uva.nl">gemma@science.uva.nl</a></td>
<td>525 7472</td>
<td>Verhoef</td>
<td>A.P.</td>
<td><a href="mailto:vrohoef@science.uva.nl">vrohoef@science.uva.nl</a></td>
<td>525 7478</td>
</tr>
<tr>
<td>Jong de</td>
<td>T.</td>
<td><a href="mailto:t.de.jong@sron.nl">t.de.jong@sron.nl</a></td>
<td>525 7495</td>
<td>Volten</td>
<td>H.</td>
<td><a href="mailto:hvolten@science.uva.nl">hvolten@science.uva.nl</a></td>
<td>592 5097</td>
</tr>
<tr>
<td>Kaper</td>
<td>L.</td>
<td><a href="mailto:lekk@science.uva.nl">lekk@science.uva.nl</a></td>
<td>525 7474</td>
<td>Waters</td>
<td>L.B.F.M.</td>
<td><a href="mailto:rensw@science.uva.nl">rensw@science.uva.nl</a></td>
<td>525 7468</td>
</tr>
<tr>
<td>Klein Wolt</td>
<td>M.</td>
<td><a href="mailto:klein@science.uva.nl">klein@science.uva.nl</a></td>
<td>525 7494</td>
<td>Weltevrede</td>
<td>P.</td>
<td><a href="mailto:wltvrede@science.uva.nl">wltvrede@science.uva.nl</a></td>
<td>525 7469</td>
</tr>
<tr>
<td>Klis van der</td>
<td>M.B.M.</td>
<td><a href="mailto:michiel@science.uva.nl">michiel@science.uva.nl</a></td>
<td>525 7498</td>
<td>Wiersema</td>
<td>K.</td>
<td><a href="mailto:kwiers@science.uva.nl">kwiers@science.uva.nl</a></td>
<td>525 7471</td>
</tr>
<tr>
<td>Koter de</td>
<td>A.</td>
<td><a href="mailto:dekoter@science.uva.nl">dekoter@science.uva.nl</a></td>
<td>525 7496</td>
<td>Wijers</td>
<td>R.A.M.J.</td>
<td><a href="mailto:rwijiers@science.uva.nl">rwijiers@science.uva.nl</a></td>
<td>525 7488</td>
</tr>
<tr>
<td>Kouwenhoven</td>
<td>T.</td>
<td><a href="mailto:kouwenho@science.uva.nl">kouwenho@science.uva.nl</a></td>
<td>525 7494</td>
<td>Vijnands</td>
<td>R.A.D.</td>
<td><a href="mailto:rudy@science.uva.nl">rudy@science.uva.nl</a></td>
<td>525 7206</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yoon</td>
<td>S.C.</td>
<td><a href="mailto:scyoon@science.uva.nl">scyoon@science.uva.nl</a></td>
<td>525 7479</td>
</tr>
</tbody>
</table>

Astronomical Institute Anton Pannekoek
Pictures front cover:
Top left: LOFAR
Bottom left: Crab Nebula
Top right: Van den Heuvel diagram
Bottom right: ESO Very Large Telescope