Onderzoeksinstituut Sterrewacht Leiden

Research Institute Leiden Observatory

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Faculty of Mathematics and Natural Sciences
University of Leiden
Niels Bohrweg 2
2333 CA Leiden
The Netherlands
www.strw.leidenuniv.nl

In memoriam
Hendrik van de Hulst

November 18, 1918 – July 31, 2000

Hendrik van de Hulst

Hendrik van de Hulst died in Leiden on July 31st, 2000, at the age of 81. He was one of the greatest Dutch astronomers of the past 150 years. In 1944 he had predicted that the amount of neutral atomic hydrogen in interstellar space would be so great as to produce a measurable signal at the radio wavelength of 21 centimeters. This prediction led to a breakthrough in astronomical research. It was a strikingly original contribution to the spectacular blossoming of astronomy which began after the second world war and which continues unabated.

Henk van de Hulst was born in Utrecht, The Netherlands, on November 19, 1918. He was one of the six children born to W.G. van de Hulst, a well-known writer of children's books in Calvinist religious settings. Henk was not the only one of the children to be highly gifted; one of his brothers became a respected painter. Henk remembered growing up in a happy family atmosphere. The belief in the teachings of the Dutch Reformed Church were followed seriously at home and evidently the younger Henk adhered to them too: in his Ph.D. thesis one finds the pious dedication "…to Him who steers everything". Later in his life his religious beliefs loosened, although his knowledge of the Bible became a familiar signature in his discussions. At the most unexpected moments, and to his listeners's general surprise, he could cite an entirely appropriate verse from the Bible in order to put the topic under discussion directly in accurate perspective.

Henk van de Hulst's father was the principal of the elementary school where Henk received his first education. Henk was in rather poor health as a child, and frequently was confined to his house: this situation is difficult to assimilate with the physically powerful man which he later became. But his health problems did not interfere at all with his educational progress. He described how he did all of the problems in the arithmetic books which he was to have in his high school Gymnasium curriculum, during the summer vacation of 1930, before he was even to enter high school. The aptitudes and interests which were evident before he entered his teens made it obvious that he was well-suited to a university education with a strong mathematical emphasis. He was, however, the first in his family to receive a university education, since universities at that time were still largely citadels for the privileged.

It was not immediately obvious that Henk would specialize in astronomy. During his high school years astronomy was just one of his numerous hobbies. He considered attending the Institute of Technology in Delft, but he had been dissuaded from this choice by an engineer who had advised Henk that his talents were too strictly theoretical for a purely technical education. Henk followed this advice and remained grateful for it, yet one can question if his talents did not in fact also embrace mechanical matters. During his entire life he enjoyed finding practical solutions to all sorts of technical problems: he improved the sagging foundation of his daughter's house in Amsterdam, he designed and installed the protective barrier on the dike guarding his vacation lake-house in Friesland, and he prepared an good model for the size and shape of the European instrument that was installed in the Hubble Space Telescope.

The decision to become an astronomer was taken in Henk van de Hulst's second year at the University of Utrecht, and was strongly influenced by the lectures given by M. Minnaert, well-known for his educational talents. But Henk's studies were interrupted in 1939, when he was drafted into military service following the general mobilization shortly before the invasion of The Netherlands and the beginning of the second world war. He was not involved in overt military operations while he was in the army, but upon his discharge the University was not effectively functioning: Minnaert, together with many other well-known Dutch, had been jailed as a hostage in St. Michielsgestel. Henk attempted to study on his own and to take examinations under these circumstances, but Minnaert was constrained by the regulations of his detention to only answer with a few lines. Nevertheless, shortly before he had been taken hostage Minnaert had introduced an important direction in Henk's career, by pointing out a Prize Competition which had been announced by the University of Leiden in 1941. This competition centered on the small particles of dust which had been discovered some ten years earlier in interstellar space but which were still largely a mystery. Scattering of light by these particles of "interstellar smoke" determines much of the appearance of the Milky Way, which had made a deep impression on Henk during the years of the war, when city lights were extinguished. The subject of the prize competition challenged Henk, and he submitted his entry in April, 1942. The jury, which included among others J.H. Oort and H.A. Kramers, did not award the prize but instead offered two honorable mentions, one for Henk van de Hulst (citing "... a mature scientific spirit ...") and one for the entry submitted by D. ter Haar.

The Prize Competition had two particularly important consequences. Henk became acquainted with Jan Oort, and he became deeply interested in the general problem of light scattering in an astronomical context. This interest was soon reflected in his Doctor's thesis, which carried title "Optics of spherical particles". He was awarded the Ph.D., *cum laude*, in June, 1946, with Minnaert as his supervisor. The subject of light scattering remained central to his interests for Henk's entire life. He wrote two monographs on the subject. The first of these - "Light Scattering by Small Particles" - was published in 1957 and was immediately recognized to be a classic; it was republished by Dover in 1981. This book illustrates Henk's best scientific talents. He begins with a very simple statement of the problem, and solves this problem in the most general manner. In the following chapters he continually expands the statement of the problem, offering solutions of increasing, but still straightforward, mathematical complexity, until he arrives at the Mie Theory. But the reader is gradually introduced to the general subject and becomes convinced that the constituent problems can be simply stated and simply solved. The presentation is elegant and clear; the illustrations are so efficient as to be almost self-explanatory; the historical background is given all appropriate attention. For these reasons the book was widely consulted, beyond the confines of its obvious use in an astrophysical context. Van de Hulst himself proudly stated that the book "...was written to explain the light of the Milky Way, but was in fact also used in dairy factories to measure the size of particles of fat in milk". Henk's scientific interest in light scattering led to the establishment of a laboratory in Leiden in the 1970's, where J. M. Greenberg replicated interstellar scattering processes with considerable success.

We return to the year 1944. At that time scientific news from the United States had not reached Europe for several years. But news had arrived earlier which was to fundamental change astronomy. An American engineer, and radio amateur, Grote Reber, had proceeded from the discovery made several years earlier by Karl Jansky, in Jansky's investigation of the source of interference which disturbed long-distance communication systems. Reber had himself constructed a steerable antenna and with this instrument had made a map of cosmic radio emission. The emission was particularly strong in the general direction of the center of the Milky Way. Reber's map, together with the news of an interpretation by two American astronomers that the emission could not be explained in terms of known mechanisms, reached Oort in Leiden. Oort immediately saw the challenge of a new subject of astronomical research, and he also realized that radiation at radio wavelengths would penetrate the cloudy Dutch sky.

At a meeting of the Nederlandse Astronomen Club held at the Leiden Observatory on April 15, 1944, the possibilities and prospects of radio astronomy were discussed for the first time. Oort had asked Henk van de Hulst to consider the possibility of observing a spectral line in the radio regime. At the meeting, Henk gave a talk in which he suggested that neutral atomic hydrogen, which in its hyperfine transition radiates and absorbs at a wavelength of 21 cm, might be expected to occur at such high column densities as to provide a spectral line sufficiently strong as to be measurable. Shortly after the end of the war several groups set about to test this prediction. The 21-cm line of atomic hydrogen was detected in 1951, first at Harvard University followed within a few weeks by Dutch observations made in Kootwijk and by Australian ones made near Sydney. The discovery demonstrated that astronomical research, which at that time was based on observations of conventional light, could be complemented with observations at other wavelengths, revealing a range of new physical processes. Today, in addition to optical and radio astronomy, observations embrace X-rays, gamma rays, and the infrared and ultraviolet regime. Of these "new astronomies" radio astronomy was the first, and its success following the prediction about the 21-cm spectral line has led to some of the most important astronomical discoveries of the past century.

Henk van de Hulst married Wilhelmina Mengerink in 1946; they had two sons and two daughters. Wil also initially studied astronomy in Utrecht, but after meeting Henk she changed her course to study psychology. Although she and Henk had quite different natures, the marriage was a very stable one; Henk always spoke lovingly of his wife and children, confirming the impression which all his acquaintances had of the importance to him of his family.

After receiving his Doctor's degree, Henk and Wil left The Netherlands for the United States, where Henk had been awarded a postdoctoral fellowship at the Yerkes Observatory of the University of Chicago. At Yerkes he developed deep contacts with S. Chandrasekhar, who was later to win the Nobel Prize, and with Gerard Kuiper, one of the numerous American astronomers with a Dutch background and education. Kuiper stimulated Henk's interest in the Solar System, which lead to his work on the dust in the zodiacal belt. Henk certainly had the opportunity to remain in the United States after his postdoctoral period, but Oort convinced him to return to The Netherlands. He was appointed at the University of Leiden, first in 1948 to the rank of Lector, and then to a professorship in 1952. He remained in Leiden throughout his career, becoming Professor Emeritus in 1984. He did return to the United States for several sabbatical leaves, at Harvard, Caltech, and the Institute for Space Studies in New York. He lectured regularly in Leiden, and guided numerous Ph.D. projects. In 1953, Henk co-authored a book with C.A. van Peursen about the foundations of the physical sciences. The authors conclude that it is not possible to give a reliable philosophical definition of the sciences. The book was written at about the same time that Henk dissociated himself from his earlier religious beliefs. It is possible that he had become too sceptical for a strongly-felt rational belief. Was the emotional basis which he had been given not strong enough? A later development points in this direction.

Henk's career took on a new and unexpected turn during a conversation with Oort at the traditional Leiden Sterrewacht coffee time on November 15, 1958, shortly after the first artificial satellite, Sputnik I, had been launched. "Henk", Oort is reported to have said, "I just had a telephone call from ICSU for a meeting in London, but I cannot possibly comply with the request. Could you go in my stead?" "I'd rather not" Henk replied, "because in doing so I would miss my daughter's fourth birthday. By the way, what does ICSU mean, and is it important?" Oort considered it important and Henk went, to return home one week later as the first president of COSPAR, a new, international organisation for peaceful exploitation of the Universe. Later he was to describe this event as "I was launched into a space career". The meeting had been called by the ICSU, the International Council of Scientific Unions, which was worried that, in the coming competition between the U.S. and the Soviet Union, the military aspects of space studies would supersede the scientific ones. That this was eventually not the case (even though the military importance remained great) must have been the result of a variety of reasons, but certainly COSPAR was an important factor. For Henk it was one of the highlights in his career when, at an important congress organized by COSPAR, he presented two astronauts (Glenn from the U.S. and Titov from the Soviet Union) each with a Dutch wooden shoe, cut from wood of the same tree, a gesture the symbolism of which was understood by everybody.

For Henk rationally organizing space research did not restrict itself to this supernational level. From 1960 to 1975 he was closely involved with the start of ESRO, the first European Space Research Organization, and after that, from 1975 to 1986 with ESA, the European Space Agency, the successor to ESRO. Henk held very important positions on the boards of both ESRO and ESA. He was also one of the pioneers of space research in The Netherlands, supervising much of its prosperous development. In 1959, also at his instigation, a committee for space research was formed within the Royal Academy of Sciences (of which he had become a member before he was 40 years old). He was president of this committee (GROC) until 1984, when it was incorporated into a new Institute, SRON, which now builds major instruments for space research under the auspices of the Dutch national science foundation. Around 1965 Henk played an essential role in attracting a group of young Delft engineers, who were to contribute in the subsequent decades to the spectacular growth of Dutch space research, and to whom Henk was the much admired example of the genuine researcher and of a accomplished administrator. The important role that SRON has played in space research since its foundation was confirmed recently by an international visiting committee. Credit for this result is mainly due to Henk van de Hulst, who stated repeatedly that the way one may justify pure research is by providing outstanding quality, a paradigm that is of great importance to his followers.

As a administrator, scientist, and teacher Henk held firm beliefs. He was more open to discussions than many other celebrities of his Dutch generation. He listened to other people's opinions, but he remained resolute and mostly made his own final decisions. He was a strong, physically fit man; level-headed, but with a good sense of humour. He was a philosophical person, with an ever present analytical streak. When talking to him, one always had the feeling that the conversation was simultaneously unraveled and evaluated at a higher and more abstract level. Personal conversations, or discussions in committees, were always characterized by depth and simplicity. The best strategy with him always was the direct approach. He had no desk, only a table, which was almost always empty. There were some documents in a corner, mostly loose sheets, under a stone, which clearly had some importance for him. Other than that, just some pencil stubs. Quality was certainly not in the paraphernalia. In conversations very often precisely-targeted metaphors occurred, frequently drawn from other trades and crafts, such as carpentry or sailing. He often showed his appreciation of his conversation partner, but sparingly. A graduate student expressed his astonishment at realizing that Henk had taken his draft seriously, and noted how much that had encouraged him.

In a conversation about a University colleague, Henk summarized: “This is someone who hasn’t yet found the equilibrium between his hubris and his humility.” He applied this judgment on other occasions, which suggests that he recognized this need for balance in himself as well, and that this was more than a casual observation. This problem may be unavoidable for someone who must have been aware at an early age that he had an exceptional talent for rational analysis, and who had been raised in a religious tradition that emphasizes humility. In the search for his own answer to this dilemma he was certainly helped by a strong sense of the relativity of all things. He was a man with great talents, but without a mission. He labored where he considered himself able to contribute, but had no explicit need to achieve great things. In that respect his personality was different from that of Jan Oort, his immediate colleague and paragon. Henk was never the most audible voice in company, but those who spoke with him were always impressed by his responses and by the points of view he took. Answers to specific questions were often unexpected and to the point. On one occasion he had been talking to some economists at a reception, and when Henk had left one of them asked another participant who this economist might be.

Naturally, his most powerful aspects were clearest in a setting of rational scientists. Thus it was a surprise to his colleagues and pupils when, just about twenty years ago, Henk mentioned that he and his wife Wit had participated in a large European psychotherapy workshop, and that this had made a big impression on him. His wife, who leads psychological group therapies centered on Tibetan meditation, had already been present on several such occasions. Since that time, Henk and Wil would continue to visit these annual workshops; they gave him a satisfaction that he had not known in his younger days and that he now experienced as very meaningful. Surely this new endeavor has deepened his domestic ties yet further.

In 1995 the Dutch artist Carla Roodenberg was commissioned to paint three portraits of Henk: one for the van de Hulst family, one for the Sterrewacht, and one for SRON. Each recipient felt that they had obtained the best of the three; the painter and her model developed a mutual respect that must have contributed to this artistic feat. The works show Henk as we knew him best: contemplative but straightforward, and in robust health. But shortly thereafter a downward trend became apparent. He became thinner and occasionally seemed to be less focused. Almost by accident a calcium deficiency was diagnosed, and its treatment spruced him up, even though he did not seem to return to his former health. Suddenly, in the spring of 1999, he lost considerable weight. That autumn, he came to the Sterrewacht with the news that an inoperable lung carcinoma had been found and that his passing was imminent. He mentioned this quite serenely, adding that he had asked the doctor: “So I don’t have to worry about the millennium bug?” Where-upon the surgeon sadly responded “No, you don’t.” Henk withstood this final fatal episode with the stoic attitude that fitted him so well: rational, and accepting the unavoidable with his head held high. We, bystanders, were assured by him that he had received more from life than most men, and that he was at peace with parting. He was true to himself and to us from beginning to end. He was a most impressive man.

Leiden, August 1, 2000

Harm J. Habing

on behalf of his
colleagues, friends, and students
at the Sterrewacht Leiden.

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Chapter 1

Review of major events

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Chapter 1

The most important event for Leiden Observatory during 2000 was the announcement by the Netherlands Organization for Research (NWO) that Professor Ewine van Dishoeck would receive a Spinoza Prize in early 2001. The Spinoza Prize, the most prestigious Dutch academic award, is accompanied by a cash amount of Dfl 3M to be used by the laureate for research during a five-year period.

There were several other important events during the past year. In May, Leiden Observatory organised a symposium to commemorate the 100th anniversary of the birth of Jan Oort. The symposium had about 150 participants and was attended by our 2000 Oort Professor, Reinhard Genzel. Professor Genzel delivered the Oort Lecture entitled *Black Holes in the Centers of Galaxies: Fact or Fiction* on 27th April 2000 and spent about a month at Leiden. During his visit he gave a series of lectures to our postgraduate students and organised a workshop on *Black Holes: Evidence, Evolution and Future Prospects.* Another highlight of the year was a visit by Professor Simon Lilly to deliver the 2000 Sackler Lecture on 21 November.

ESO's Very Large Telescope became a major for the research of the Sterrewacht, with 3 large VLT programmes and several normal ones having Leiden PIs. Leiden is also heavily involved in many of the projects being undertaken by the Nederlands Onderzoekschool voor Astronomie (NOVA), an association of all the university astronomy departments in the Netherlands. The ramp up of NOVA funding in 2000 resulted in a substantial number of additional postdocs and Ph.D. students at Leiden.

An important component of the NOVA proposal is to develop expertise in optical interferometry, emphasising faint source science. During 2000 the NOVA - ESO VLTI Expertise Centre (NEVEC) was inaugurated. In addition to about 3 FTE funded by NOVA, 4 members of the Leiden scientific staff participated in the project.

Leiden staff members continue to be heavily involved in planning new large facilities such as the Atacama Large Millimeter Array (ALMA), the Next Generation Space Telescope (NGST) and the Low Frequency Radio Array (LOFAR). Although the University and our Faculty are facing severe financial difficulties, Leiden Observatory begun 2001 optimistic for the future.

One sad event overshadowed a generally good year for Leiden Observatory. Henk van de Hulst passed away on 31st July. This was a great loss to us all. Professor van de Hulst was a former director of Leiden Observatory and one of the foremost astrophysicists of the 20th century.

George K. Miley

Scientific Director,
Leiden Observatory

Chapter 2

Research highlights

Sterrewacht Leiden

Research highlights

Chapter 2

The research interests of the Leiden Observatory are very broad, ranging from the solar system to very distant galaxies. Below the highlights of results obtained in 2000 are described.

2.1 The solar system

2.1.1 The outer solar system

Using the 12K CCD camera mounted on the CFHT telescope (Hawaii), Luu in collaboration with Trujillo and Jewitt (Hawaii) completed the first survey to sample the Kuiper Belt's vertical extent. The results show that the characteristic half-width of the Belt (considering only classical Kuiper Belt objects) is surprisingly large: $\delta i \sim 20°$. The results prove that the current Kuiper Belt has been thoroughly excited since formation.

Dirksen and Luu finished their investigation into the detectability of binary systems in the Kuiper Belt using ground-based observations. Considering the several known binary systems in the asteroid belt (and the well known Pluto-Charon binary in the Kuiper Belt), it seems likely that binary systems await discovery in the Kuiper Belt.

2.1.2 Asteroids

The Minor Planet Center in Cambridge, USA has given definitive numbers to 520 asteroids found by van Houten and van Houten-Groeneveld. These asteroids resulted from 4 surveys carried out in 1960, 1971, 1973, and 1977 and included 503 normal asteroids, 11 L4-Trojans and 6 L5-Trojans. About 70 of these objects have been named by the IAU commission *Small Bodies Names Committee* following a proposal by the van Houtens. The total number of astroids the van Houtens discovered now amounts to 1350 numbered minor planets.

2.2 Stars and circumstellar matter

2.2.1 S Dor variables

Van Genderen finished his review paper on S Dor variables (or LBVs, luminous blue variables) in the Galaxy and the Magellanic Clouds. The number of S Dor variables has been increased to 34 confirmed members and 12 candidates. The structure of the S Dor-area on the HR-diagram has been defined and the five types of instabilities, among which one eruptive episode, creating circumstellar nebulae, have been discussed.

Van Genderen, de Groot (Armagh) and Sterken (Brussels) evaluated the physical information on the central star of η Carinae from multi-colour photometry. They believe that some of the probable periodic features in the light and colour curves and in the near-UV could well be interpreted as related to outbursts of mass loss, especially since they occur on supposedly favourable orbital configurations of two, or even three stars.

De Groot (Armagh), Sterken (Brussels) and van Genderen analyzed and discussed nearly 20 years of photometric monitoring of P Cyg, the famous star which experienced a number of eruptions in the 17th century. The star shows currently a weak S Dor activity (slow pulsations) on a time scale of years, and two types of continuous micro-oscillations.

2.2.2 Runaway stars

Hoogerwerf, de Bruijne, and de Zeeuw completed their study on the origin of the nearby OB runaway stars. They used milli-arcsecond accuracy astrometry (proper motions and parallaxes) from Hipparcos and from radio observations to retrace the orbits of the nearby O- and B-type stars and compact objects (neutron stars). The study resulted in a sample of 56 runaway stars and 9 compact objects; the birthplace (parent group) could be determined for 26 of these. In two cases the formation scenario could be determined with near certainty. The runaway star ζ Ophiuchi and the pulsar PSRJ1932+1059 originated about 1 Myr ago in a supernova explosion in a binary in the Upper Scorpius subgroup of the Sco OB2 association. The pulsar received a kick velocity of $\sim$350 km s^{-1} in this event, which dissociated the binary, and gave ζ Oph its large space velocity. This case provides conclusive evidence for the so-called binary-supernova scenario proposed by Blaauw in 1961. The study also showed that the runaway-pair AE Aur and μ Col, and the massive highly-eccentric binary ι Ori were ejected from the nascent Trapezium cluster $\sim$2.5 Myr ago. These runaways are most likely ejected from the Trapezium cluster as the result of a binary-binary encounter, thus providing evidence for the dynamical-ejection scenario proposed by Poveda et al. in 1967. The other runaways studied include the classical runaways 53 Arietis (Ori OB1), ξ Persei (Per OB2), and λ Cephei (Cep OB3), and fifteen new identifications, amongst which a pair of stars running away in opposite directions from the region containing the λ Ori cluster.

2.2.3 Young stellar groups and OB associations

Steenbrugge continued the reduction and interpretation of spectra of O-, B-, and A-type stars in and near the Perseus OB2 association, obtained at Observatoire de Haute Provence. A detailed analysis showed that the wavelength calibration of the instrument suffered from a considerable temporal instability. Using a cross-correlation technique, Steenbrugge determined the radial velocities of a few dozen target stars relative to a set of observed standard stars. A careful analysis of the error budget showed the random errors to be of order 1–3 km s^{-1}. The radial velocities were subsequently used to refine the Hipparcos-based membership list of the group.

De Bruijne, in collaboration with Hoogerwerf and de Zeeuw, completed his work on secular parallaxes for the Hyades open cluster. Secular parallaxes are determined using the "known" space motion of a moving group and the observed proper motions of its members. The relative accuracy of the secular parallaxes is of the same order as that of the proper motions. Secular parallaxes for members of the Hyades are therefore $\sim$3 times more precise than the individual Hipparcos trigonometric parallaxes, providing a unique opportunity to accurately locate these stars in the Hertzsprung-Russell diagram. The colour-absolute magnitude diagram of the cluster shows a very well-defined main sequence, which provides the first unambiguous observational evidence of Böhm-Vitense's prediction that the onset of surface convection in stars significantly affects their broad-band colours (Fig. 2.1). The precision with which the new parallaxes constrain the location of individual members of the cluster in the Hertzsprung-Russell diagram is now limited by (systematic) uncertainties related to the transformations from observed colours and absolute magnitudes to effective temperatures and luminosities.

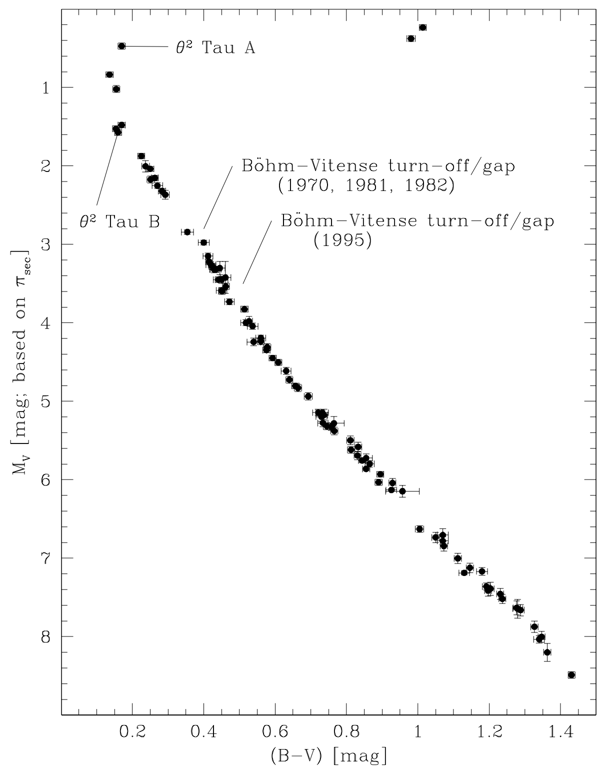

Figure 2.1: Color-absolute magnitude diagram for 92 high-fidelity members of the Hyades cluster. This sample excludes all members beyond 40 pc from the cluster center, double and multiple stars, and stars with suspect secular parallaxes. The absolute magnitudes were computed using the observed V-band magnitudes and secular parallaxes. The arrows indicate the two Böhm-Vitense turn-offs and associated gaps, which are most likely caused by sudden changes in the properties of convective atmospheres. The gaps between B−V=0.15 and 0.20, between B−V=0.30 and 0.35, and the gap around B−V=0.95 mag are caused by the suppression of double, multiple, and peculiar stars from our sample; the region between B−V=0.30 and B−V=0.35 mag, e.g., is occupied by Am-type stars, which have a high incidence of duplicity.

2.2.4 Dust disks around young stars

Habing completed a study of the persistence of dust disks around very young stars on the main-sequence. The program was initiated in 1988 and took more than 60 hours of observations with the PHOT instrument on ISO. It is a joint project of a large consortium with as main participants Dominik (UvA), Jourdain de Muizon and Laureijs (both from the ISO ground station, VILSPA, Spain) and Habing. Most young stars are born with a dust disk, in and from which, one supposes, planets are formed. Some 20% of these disks continue to exist for a long time but some 80% disappear within about 400 million years. The formation of large planets may have caused this disappearance because they alter the gravitational field in the disk. There is a possible connection to the early history of the solar system, when the planets and satellites underwent a "heavy bombardment" that suddenly stopped after a similar time. These results and speculations have been published in a letter to *Nature* in 1999.

2.2.5 Main sequence and old stars

Vlemmings continued his VLBI monitoring of the position of the stellar image amplified by the 1667 MHz circumstellar OH maser of the Mira variable star U Her. The accuracy of the 9 epochs of VLBA observations has already led to the first well-determined parallax of this star (6.09 mas) and to a determination of its proper motion (-17.01, -10.00 mas/yr). In collaboration with Diamond (Jodrell Bank Observatory, UK), Vlemmings detected for the first time circular polarization of circumstellar water masers. The magnetic field around the supergiant S Per is $\approx$270 mG. Vlemmings also develops a Monte Carlo code to model the maser lines in conditions with little symmetry.

In collaboration with Icke and Dominik (UvA), Simis continued her research on dust driven winds from evolved late-type stars. The numerical code written for this purpose is a self-consistent hydrodynamics code for two-fluid time dependent calculations in spherical symmetry. Physical processes included in the model are the nucleation, growth, and thermal evaporation of grains; equilibrium gas chemistry; a microscopic model for gas-grain collisions; first-order radiative transfer; and stellar pulsation driven by the photosphere of the star (inner boundary condition). The computations using the stellar parameters of the extreme carbon star IRC+10216, explained the concentric shells (Fig. 2.2) that have recently been observed around this object. The time scale of the oscillation that drives these rings is of the order of hundreds of years. Responsible for this effect is a subtle mechanism, involving an intricate nonlinear interplay between gas-grain drift, grain nucleation, radiation pressure, and envelope hydrodynamics. Until now, the origin of these shells – observed also in other post-AGB objects and planetary nebulae – was unknown. The role of grain drift turns out to be essential. In previous calculations by other groups the shells were not found because either grain drift, or a self consistent description of the grain chemistry were not part of the model.

The same hydrocode was adapted by Kamp and Simis to study the problem of the metal-poor λ Bootis stars, in which gas could reaccrete after grains have formed. Simis's detailed two-fluid treatment of dust forming flows is ideally suited to the study of such peculiar stars.

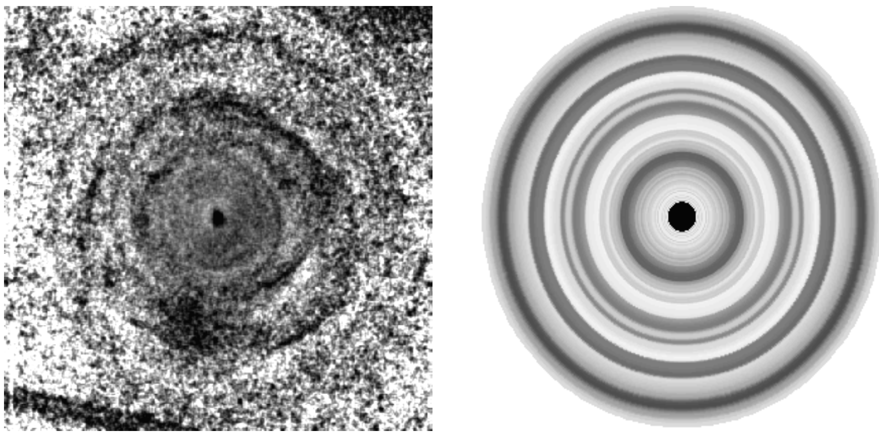

Figure 2.2: *Left panel:* Composite B+V image of the famous carbon star IRC+10216 with an average radial profile subtracted to enhance the contrast (Mauron & Huggins 1999). *Right panel:* An image of the column density distribution of dust from a hydrodynamical simulation of IRC+10216 by Simis. The simulations describe in a self consitent way the coupling of dust, gas and radiation.

They then studied the possibility that the low metallicity is due to selective removal of dust particles and infall from the "purified" gas. First test calculations reveal that gas and dust can become separated in the disk around the star and that metal-poor gas may then accrete onto the stellar surface. Observations to constrain the disk mass around λ Bootis stars were made by Kamp and Messineo in November with the 10m Heinrich Hertz submillimeter telescope in Arizona, a project jointly with Wiesemeyer (IRAM) and Paunzen (Vienna). In collaboration with Holweger (Kiel) high resolution spectroscopic measurements were taken at the Observatoire de Haute-Provence by Kamp and Hempel (Kiel) to study "dusty and dust-free A stars". They find O, Ca, Ba, Y and Fe abundances and the presence of CS Ca II K lines. Together with Paunzen (Vienna) and Iliev (Smolyan, Bulgaria), Kamp determined NLTE nitrogen and sulphur abundances for λ Bootis stars. The results give further support to the general solar abundance pattern of light elements in the atmospheres of these stars.

Icke rekindled the flame of bipolar nebulae, inspired by the remarkable observations that van Winkel (Leuven) made of the Red Rectangle. The inward-curving shocks enclosing the prongs of this X-shaped nebula suggest that the effective adiabatic constant of the gas is close to unity (almost-isothermal flow), due to strong radiative cooling. Simulations of this type of flow produced dramatic results, including the prediction of a Mach-stem feature on the axis of the nebula, which had not been seen before. Subsequent data taken by van Winckel showed that this feature is indeed present in the light of Hα. When this type of flow is computed for ordinary bipolars, the outer shells become strongly unstable, leading to the formation of series of rings and ripples propagating upwards. This is in excellent agreement with the observations (Fig. 2.3).

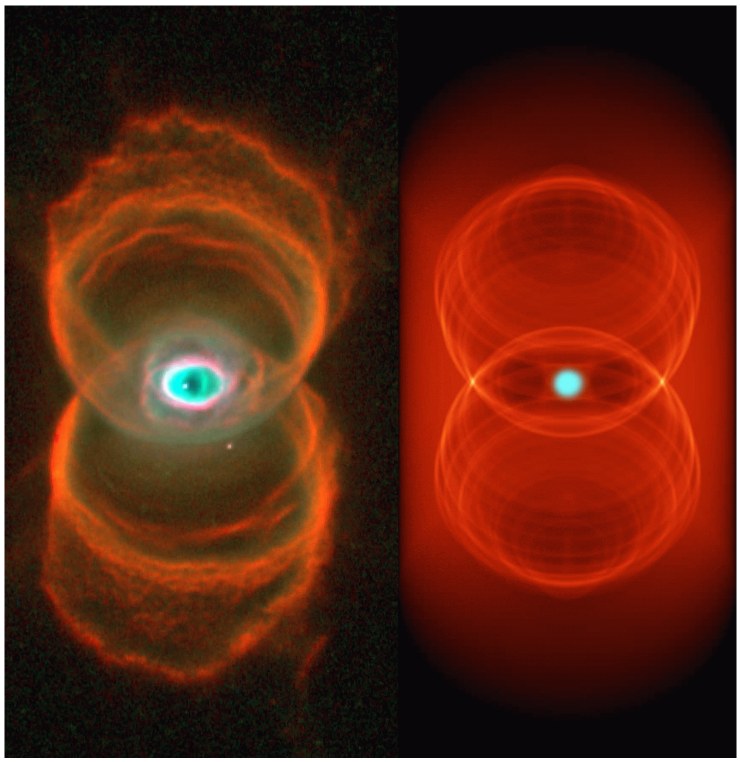

Figure 2.3: *Left panel:* An image of MyCn18, a young planetary nebula, taken with the Wide Field and Planetary Camera 2 (WFPC2) aboard NASA's Hubble Space Telescope (HST). This image is a composite from images of ionized nitrogen (represented by red), hydrogen (green), and doubly-ionized oxygen (blue). *Right panel:* An hydrodynamical interacting wind model with a moderately strongly cooling outer shell. This causes a spectacular sequence of ripples due to a combination of dynamical and thermal instabilities.

Messineo started a programme on the search for 86 GHz SiO maser emission by ISOGAL stars. In collaboration with Habing, Menten (MPI, Bonn), Omont (IAP, Paris) and Sjouwerman (JIVE, Dwingeloo) she observed with the 30m IRAM telescope in Spain a sample of some 60 stars in the inner Milky Way galaxy and detected a maser in two out of three candidate stars. The programme will be continued. The ultimate goal of this project is a description of the kinematics of stars in the inner Galaxy to be used for dynamical studies, e.g. concerning the triaxial mass distribution there.

Mellema (in collaboration with Lundqvist, Stockholm) started detailed numerical modelling of the interaction of the supernova blastwave with the surrounding circumstellar material in SN1987A. This interaction is being closely monitored over a wide range of wavelengths in a large study led by Kirshner (Harvard). It provides an unique opportunity to study the physics of time-dependent shocks. The interaction is studied by combining a numerical hydrodynamic calculation with a detailed, non-equilibrium ionization and cooling calculation. Initial results show that the observed exponential rise in the intensity of various emission lines can be explained.

Mellema (in collaboration with Hyung, Korea Nat. Obs.) worked on an explanation for the high electron temperature in the rings surrounding the Planetary Nebulae NGC 6543. Optical line ratios and line shapes were successfully reproduced using numerical radiation-hydrodynamic modelling. According to these models, the rings were formed by the same process as was proposed by Simis for forming the rings around the carbon star IRC+10216.

2.3 Interstellar matter

The study of parsec-scale structure in the warm interstellar gas by means of multi-frequency radio polarization observations in the 341–375 MHz range is continued by Haverkorn, Katgert and de Bruijn (ASTRON/Groningen). In a field of $\sim 9^\circ \times 11^\circ$, above the Galactic plane, the Rotation Measure (RM) of the medium was determined to lie in the range of about -10 to 10 rad m^{-2} and was seen to vary on scales of a few arcminutes ($\sim$0.5 pc at a distance of 500 pc) to degrees. Coherent RM structures of several tens of parsecs in length are present, as well as abrupt changes in RM over small spatial scales. Rotation Measure values of eighteen polarized extragalactic point sources in the field are comparable to RM's in the diffuse emission.

In Fig. 2.4, two examples of abrupt RM changes are shown. The grey scale denotes polarized intensity in two regions on the sky of about $20' \times 24'$. Overlaid in white are graphs of polarization angle ϕ against wavelength squared, so that the slope of the linear fit is the RM. Each $\phi(\lambda^2)$ graph denotes an independent beam. Rotation Measures change approximately from -3 via -11 to -6 rad m^{-2} in the left hand plot and from 2 to -9 rad m^{-2} in the right hand plot, over spatial scales of a few arcminutes. This RM change indicates abrupt changes in electron density and/or in magnetic field, whereas a "sign" change of RM has to be exclusively due to a sign change in the parallel component of the interstellar magnetic field.

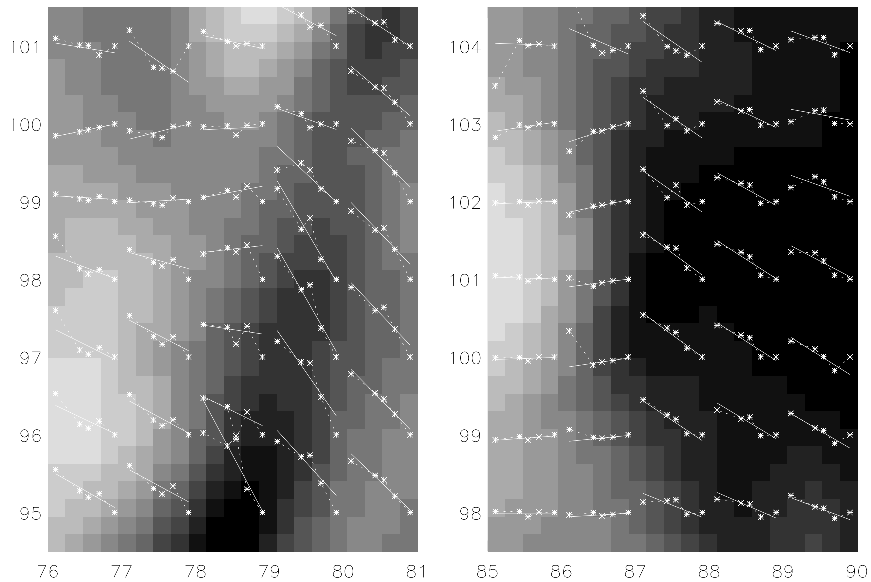

Figure 2.4: Two examples of regions of the sky where sudden Rotation Measure changes occur over one beam width (4′). The grey scale is polarized intensity at 349 MHz oversampled by a factor of 5, where higher P is a lighter color. Overlaid are plots of ϕ against λ^2, one for each independent beam. Along the x-axis and y-axis are beam number.

2.4 The Galaxy

2.4.1 The stellar halo

Helmi and de Zeeuw investigated what the next generation of astrometric satellites will reveal by observing the halo of the Milky Way if this were built from disrupted galaxies. They generated artificial DIVA, FAME and GAIA halo catalogues, in which they searched for the signatures left by the accreted satellites. They developed a method based on the standard friends-of-friends algorithm applied to the space of integrals of motion. They found that this simple method applied to GAIA data can recover about 50% of the different accretion events, even when the exact form of the Galactic potential is unknown. The recovery rate for DIVA and FAME is much smaller, but these missions, like GAIA, should be able to test the hierarchical formation paradigm on our Galaxy by measuring the amount of halo substructure in the form of nearby kinematically cold streams with for example, a two-point correlation function in velocity space.

Helmi, in collaboration with White (MPA, Garching) and Springel (MPA, Garching), analysed high resolution simulations of the formation of a cluster in a ΛCDM cosmology. They studied debris streams originating in such halos and found that their evolution can be explained simply in terms of the conservation of phase-space density. The properties of these streams are consistent with having a phase-mixing origin. After scaling the cluster to a galactic size halo, they found that the velocity ellipsoid in the equivalent of the "Solar vicinity" is formed by roughly a thousand dark matter streams with velocity dispersions smaller than a few tens of $\mathrm{km\,s^{-1}}$. These results imply that the small scale structure present in the dark halo velocity ellipsoid will not strongly affect the signal expected by current and future experiments designed to determine the nature of dark matter in our immediate neighbourhood.

2.5 Nearby galaxies

2.5.1 DENIS survey of the Magellanic Clouds

Cioni completed the catalogue of point sources in both Magellanic Clouds derived from the DENIS survey in the I, J, K_s photometric bands. The DAT tape with over 1 million sources was handed over to the Centre des Données in Strasbourg, from where the data may be retrieved. The images of both clouds are very smooth if you select stars older than roughly 1 Gyr. It also appears that the "tip of the red giant branch" has a very well determined magnitude; this offers a good opportunity to estimate distances to galaxies. Cioni in collaboration with Marquette, started the cross-identification of the DENIS sources with the sources that the EROS project monitored for several years near the optical center region of the Large Magellanic Cloud. Most of the cross-identified sources are variables; some 800 light curves have been obtained.

2.5.2 Ram pressure and shell formation in Holmberg II

Bureau and Carignan (Université de Montréal, Canada) analyzed neutral hydrogen VLA D-array observations of the dwarf irregular galaxy Ho II, a prototype galaxy for studies of shell formation. H I is detected to over 16′ or 4 R_{25}, almost a factor of two better than previous studies. The total H I mass $M_{\mathrm{HI}} = 6.44 \times 10^8\ M_\odot$. The integrated map has a comet-like appearance, with a large but faint component extending to the northwest and the H I appearing compressed on the opposite side. The velocity field shows a clear rotating disk pattern but the gas at large radii is probably not in equilibirum.

Ho II lies northeast of the core of the M81 group of galaxies, along with the dwarfs Kar 52 and UGC 4483. No signs of interaction are observed, however, and Bureau and Carignan argued that Ho II is part of the neighboring NGC 2403 subgroup, infalling towards M81. They also made a case for ram pressure stripping and an IGM in the M81 group. Stripping of the outer parts of the disk would require an IGM density $n_{\rm IGM} > 1.2\times10^{-5}$ atoms cm^{-3} at the location of Ho II. This corresponds to $\sim$1% of the virial mass of the group uniformly distributed over a volume just enclosing Ho II and it is consistent with the known X-ray properties of small groups. The H I tail is consistent with additional turbulent viscous stripping, at least for low IGM temperatures.

2.5.3 The elusive active nucleus of NGC 4945

In collaboration with Marconi, Oliva, and Maiolino (Florence), Moorwood (ESO) and Schreier and Macchetto (StScI), van der Werf continued a near-infrared investigation of the nearby galaxy NGC 4945, using ground-based and HST data. The data reveal a circumnuclear starburst, which produces a superwind creating a conical cavity bounded by denser material. Most remarkable is the total absence of any indication for the presence of an active nucleus in the mid-infrared, while strong and variable hard X-ray emission shows that an active nucleus must be present. An important lesson from this result is that active nuclei may remain hidden even at mid-infrared wavelengths.

2.5.4 Molecular gas and dust in NGC 7469

Papadopoulos, in collaboration with Allen (University of Toronto), analysed sensitive JCMT imaging of dust (850 and 450 μm) and CO J=3–2 emission from the nearby Seyfert galaxy NGC 7469. They show that the gas and dust emission are both dominated by a 30–35 K component, and that in these conditions the H_2 mass is overesimtated by a factor of about 5 if the usual CO-H_2 conversion factor is adopted. In this situation there is no need to invoke the presence of an unseen mass of cold dust, or an abnormally high gas-to-dust ratio.

2.5.5 Molecular gas in the centres of NGC 6946 and M83

Israel and Baas presented a variety of JCMT submillimeter maps (J=2–1, J=3–2, J=4–3 ^{12}CO, 492 GHz [CI]) and measurements (J=2–1, J=3–2 ^{13}CO) of the late type spiral galaxies NGC 6946 and M83 (NGC 5236). Within a few hundred parsec from their nucleus, both galaxies contain a pronounced molecular gas concentration in rapid solid-body rotation. These gas concentrations have nearly identical relative intensities in the ^{12}CO, ^{13}CO and [CI] transitions. However, the very different [CII] intensities illustrate the need for caution in interpreting CO observations alone. In both galaxy centers large amounts of warm and dense molecular gas are present in addition to cooler material. By detailed modelling, Israel and Baas showed that the molecular medium in both galaxies consists of at least two separate components. These are a warm and dense component ($T_{\rm kin}$ = 30–60 K, $n(\rm H_2)$ = 3000–10000 cm^{-3}) and a much more tenuous hot component ($T_{\rm kin}$ = 100–150 K, $n(\rm H_2) \leq 1000$ cm^{-3}). Total atomic carbon column densities exceed CO column densities by a factor of about 1.5 in NGC 6946 and about 4 in M83. Unlike NGC 6946, M83 contains a significant amount of molecular hydrogen associated with ionized carbon rather than CO. The centers of NGC 6946 and M83 contain nearly identical total (atomic and molecular) gas masses of about $3\times10^7\ M_\odot$. Despite their prominence, the central gas concentrations in these galaxies represent only a few per cent of the stellar mass in the same volume. The peak face-on gas mass density is much higher in M83 (120 $M_\odot$ pc^{-2}) than in NGC 6946 (45 $M_\odot$ pc^{-2}). The more intense starburst in M83 is associated with a more compact and somewhat hotter PDR zone than the milder starburst in NGC 6946. This work was part of a large survey of nearby galaxies at submillimeter wavelengths.

2.5.6 Disc-halo interaction in nearby galaxies

Dahlem conducted studies of the interstellar medium in nearby galaxies with massive star formation. He was particularly interested in the feedback effects of high-mass star formation on the ambient interstellar medium. He established that all galaxies with warm dust, as traced by high far-infrared 60-to-100 μm flux ratios of $\geq$0.4, have gaseous haloes. He also found a direct connection between the energy input rate in the disk interstellar matter and the creation of such gaseous haloes. Finally, he employed multi-wavelength observations (primarily radio, X-ray and optical) to show that haloes of galaxies comprise all the ISM phases that are known to exist in their disks.

2.5.7 Dynamical modelling of elliptical galaxies

Verolme continued the modelling of axisymmetric early-type galaxies. She expanded the existing software written by van der Marel (now STScI) for measuring the mass of the central black hole in M32, and demonstrated that application of this software to other galaxies (with different types of data and different mass profiles) is possible. This is important in view of the new integral-field units such as SAURON, which will allow inclusion of two-dimensional kinematical data into the models.

Verolme, Cappellari (Padova), Verdoes-Kleijn and de Zeeuw investigated the nature of the counterrotating core of the E3 galaxy IC1459. The surface brightness distribution for this galaxy was described as a sum of Gaussians, which makes the software much more general than the power-law surface brightness profiles which were previously used. A sum of Gaussians can mimick physical variations in the surface brightness distribution such as ellipticity variations as a function of radius and position angle twists, allowing for an extension to triaxiality. The models for IC 1459 show that the counter-rotating core is a well-separated structure in phase-space, which comprises about 1% of the stellar mass of the galaxy. The black hole mass inferred from the stellar motions appears to be larger than the one derived by Verdoes-Kleijn and collaborators based on HST/FOS spectra of the gas emission. This highlights the importance of an improved understanding of the various methods that are in wide use to determine black hole masses.

Copin and Cretton (MPIA, Heidelberg) continued work on dynamical models for the galaxy NGC 3377, for which they have OASIS and SAURON integral-field spectroscopy.

Jalali (Institute for Advanced Studies, Iran) and de Zeeuw reinvestigated the so-called curvature condition for the existence of self-consistent scale-free galaxy models, originally developed by Zhao for elongated disks. They showed that a slight modification of this condition was warrented, and then allows rapid identification of the region in parameter space (density slope and axis ratio) for which equilibrium models are ruled out. They extended the formalism to scale-free three-dimensional axisymmetric models, and also investigated the separable Shridhar-Touma models.

2.5.8 Hydrodynamical modelling of star formation in colliding galaxies

Pelupessy is continuing the work that Icke and Gerritsen (Groningen, now Océ Venlo) started on star formation in colliding galaxies. The investigation considers the nature, role and importance of the physical processes involved in the formation and merger-driven evolution of galaxies, using Hernquist's SPH code. The novelty of our approach consists of the accurate treatment of interstellar matter physics. The formation and evolution of stars is included, and feedback from supernova explosions as well. The code has been demonstrated to work well on isolated and merging galaxies, automatically producing a realistic multi-phase interstellar medium and a Schmidt-type star formation law. Pelupessy has thoroughly cleaned up the code, and is now invesitgating the small-scale effects of supernova blasts, with a view towards more realistic treatment of mechanical energy input. In the long run, we intend to apply these models to metal-poor galaxies in the early Universe.

2.6 Active galaxies and distant galaxies

2.6.1 Radio-loud galaxies

Verdoes-Kleijn, de Zeeuw, and Baum (STScI) continued their study of the central regions of a complete sample of 21 nearby radio-loud FR I early-type galaxies. The galaxies have velocities less than 7000 $\mathrm{km\,s^{-1}}$ and are classified as Faranoff Riley Type I (FR I) radio galaxies. The primary goal is to obtain a better understanding of the formation, working and evolution of FR I nuclei. They investigated the anisotropy and beaming of the AGN continuum and line emission and the relative orientation of radio jets and the ubiquitous central dust. In collaboration with Carollo and Noel-Storr (Columbia University) they are analysing the HST/STIS spectroscopic follow-up survey of the nuclear emission-gas. These observations are primarily aimed at determining black hole masses and constraining the ionization mechanism of the gas.

2.6.2 Towards interferometric observations of nearby Active Galactic Nuclei

In the standard model for Active Galactic Nuclei (AGNs), the central engine, consisting of a hot accretion disk around a massive black hole, is assumed to be encapsulated by a dusty torus. Arguments for the existence of these tori are based on theoretical considerations and indirect observational evidence such as the spectral energy distributions of AGNs and the polarization properties of Seyfert II nuclei. Heijligers and Röttgering in collaboration with Meisenheimer (Heidelberg) worked on a programme that has the ultimate goal of observing centers of nearby AGN using the MIDI, the 10 micron interferometric instrument to be used with the VLT. The first step in this programme is to obtain spectral energy distribututions for the central regions of nearby bright AGN. With these SEDs Heijligers et al used radiative transfer models to constrain size, orientation and thickness of the tori at 10 micron. Ultimatety these models will be used to optimally plan and subsequently observe the tori with VLTI using the UT1+3 + MIDI.

2.6.3 Fundamental Plane of early type galaxies

Van Dokkum, in collaboration with Franx, Kelson, and Illingworth studied the evolution of the Fundamental Plane of early-type galaxies in the field. The evolution of the Fundamental Plane is a very sensitive measure of the evolution of the mass-to-light ratio, and thereby of the formation redshift of the stellar population. The evolution of the Fundamental Plane of the field early-type galaxies was very similar to that of early-type galaxies in clusters. Figure 2.5 shows the evolution of the M/L_B ratio for the individual field galaxies (top panel), and for averaged galaxies (bottom panel). The open symbols in the bottom panel indicate the cluster samples, and it can be seen that the offset between the the field galaxies and the cluster galaxies is very small. This suggests that the star formation history of field early-type galaxies, and cluster early-type galaxies is very similar. If models are fit to these results, they indicate a mean starformation redshift of $\langle z_* \rangle \gtrsim 1.5$ for the field early-type galaxies.

2.6.4 The nature of Extremely Red Objects

Daddi, Cimatti (Arcetri), Röttgering and their Italian collaborators continued their multi-wavelength study of Extremely Red Objects (ERO's). They carried out mm/submm observations using IRAM and JCMT and VLA radio observations to study the nature of EROs. One othe key questions is what fraction of EROs can be associated with elliptical galaxies at $z \gtrsim 1$ that have formed at high z, and what fraction can be identified with strongly dust reddened star forming galaxies, possibly hosting an AGN. They finished a wide-field survey for extremely red objects, the widest so far, based on NTT IR imaging Ks. This resulted in a complete sample of about 400 EROs with $R-K_s \geq 5$. The distribution of the EROs on the sky is strongly inhomogeneous, being characterized by overdensities and large voids. A strong clustering signal of the EROs is found with an increasing clustering amplitude for the reddest objects. These results are strong evidence that the largest fraction of EROs is composed of high-z ellipticals,

2.6.5 FIRES

Labbé and Franx made significant progress on the Faint InfraRed Extragalactic Survey (FIRES): an ultradeep near-infrared survey of two selected fields, the Hubble Deep Field South (HDFS), and the field around the distant cluster MS1054−03. Over the year all data for the HDFS have been taken, amounting to 100 hours of integration using ISAAC on the ANTU telescope of the VLT. Inspection of the data revealed excellent quality; the deepest groundbased observations so far at these wavelengths. Together with the existing spacebased observations in the optical we can address the fundamental issues of galaxy evolution. Work is underway to analyze the images, and the reduced data and catalogues will be made public as soon as possible.

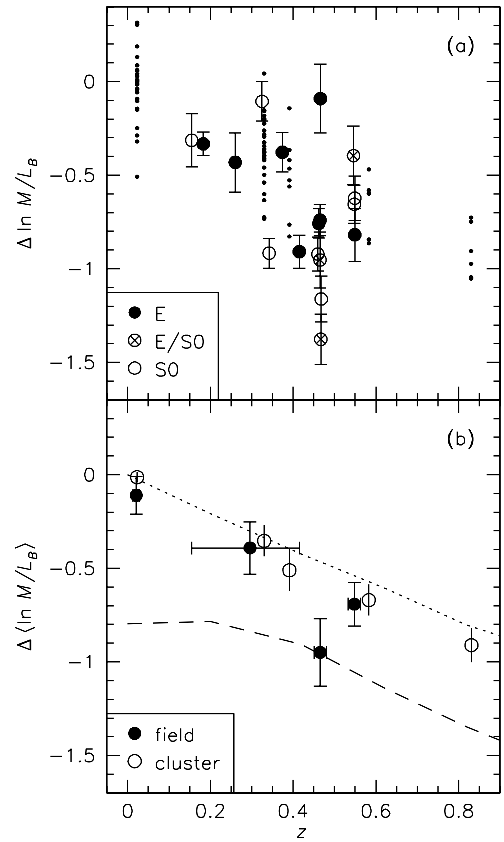

Figure 2.5: The evolution of the $M/L_{\rm B}$ ratio of early-type galaxies measured from the Fundamental Plane. *Top panel:* Large symbols denote field early-type galaxies, small symbols are cluster galaxies. The trend with redshift is very similar for both populations. *Bottom panel:* The average evolution of the field galaxies (closed symbols) and cluster galaxies (open symbols), as a function of redshift. The trend with redshift is very similar. Models imply a formation redshift of $\langle z_* \rangle \gtrsim 1.5$ for the field galaxies ($\Omega_{\rm m}$=0.3, Ω_Λ=0.7), and $\langle z_* \rangle \gtrsim 2$ for cluster galaxies.

The first 20 hours of observations taken on the HDFS are being analyzed by Rudnick (MPA, Heidelberg) and Franx. The photometry has been completed, and a new photometric redshift technique is under development to estimate redshifts.

2.6.6 Hα and dust emission from starburst galaxies in the Hubble Deep Field South

Van der Werf, in collaboration with Rigopoulou (MPE), Franceschini (Padova) and other members of the ELAIS team, used ISAAC at the VLT to obtain Hα spectra of 11 galaxies in the Hubble Deep Field South, at redshifts of 0.4 to 1.4, selected based on 15 μm emission detected with ISOCAM (Fig. 2.6). Inferred star formation rates based on Hα are 2–50 $M_\odot\,\mathrm{yr}^{-1}$, an order of magnitude lower than estimates based on dust emission, underlining the dusty nature of these objects. Remarkably, blue spectra of these galaxies reveal only an evolved starburst (as shown by Balmer lines in absorption), underlining that long wavelengths observations are needed to penetrate the dust in these objects.

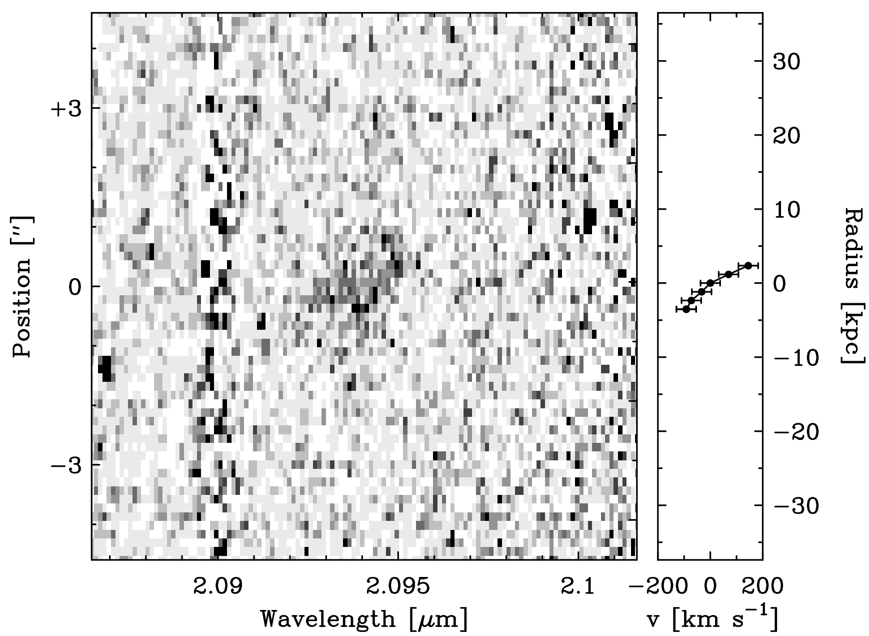

Figure 2.6: Near-infrared long-slit spectrum of redshifted Hα in a star forming galaxy at $z \sim 2.2$, obtained by van der Werf, Moorwood, Cuby, and Oliva with ISAAC at Antu on Paranal. The tilt of the line reveals the central part of a rotation curve.

2.6.7 Star forming galaxies at $z \sim 2.2$

Van der Werf, in collaboration with Moorwood and Cuby (ESO) and Oliva (Florence) completed the analysis of a sample of $z \approx 2.2$ galaxies selected based on their redshifted Hα emission. These objects form the largest homogeneously selected sample of blank-field spectroscopically confirmed star forming galaxies at z=2.2 known to date. Implied star formation rates are in the range 20–35 $M_{\odot}$ yr^{-1}, i.e., significantly higher than local spiral galaxies. Remarkably, one of the galaxies (the only one observed in good seeing conditions) reveals a clear velocity gradient revealing the inner part of a rotation curve (see Fig. 2.6). This result implies well-developed massive system already at z=2.2. When compared to the local B-band Tully-Fisher relation, the system is overluminous by several magnitudes, in agreement with its starburst nature.

2.6.8 A new sample of faint CSS radio sources

The youthfulness (age < a few 1,000 yr) of GHz-Peaked Spectrum (GPS) radio galaxies has been confirmed by several independent research groups for a dozen of objects belonging to this class. Studies of the evolutionary link between GPS radio galaxies and the brightest, host-galaxy-sized Compact Steep-Spectrum (CSS) radio galaxies indicate self-similar growth.

Tschager, Schilizzi (JIVE, Dwingeloo & Leiden), Snellen (IoA, Cambridge & Royal Observatory, Edinburgh), Röttgering and Miley are investigting a sample of faint CSS radio sources. Their working sample comprises 99 sources. They carried out VLBI observations at 1.6 GHz using EVN and MERLIN, and complementary, observations with the VLA in A array at 74 MHz. Combining morphological and spectral information can answer the question whether the self-similar evolution model applies to faint CSS galaxies. Preliminary results underpin the self-similar growth scenario. Consequently, the theory that radio sources build up luminosity in the early GPS/CSS evolutionary stages gains credibility. This piece of information is essential to build evolution model for young radio sources.

2.6.9 Emission line gas of $z \sim 1$ radio galaxies

Best, Röttgering and Longair (Cambridge) finished their analysis of the kinematics and ionization state of the emission-line gas of a sample of 14 3CR radio galaxies with redshifts $z \sim$1. The data used are deep long-slit spectroscopic exposures from the William Herschel Telescope. It is found that the emission-line ratios of small radio sources are in agreement with theoretical shock ionization predictions, and their velocity profiles are distorted. Together with the other emission-line properties, this indicates that shocks associated with the small radio source dominate the kinematics and ionization of the emission-line gas during the period that the radio source is expanding through the interstellar medium. In larger sources the shock fronts have passed well beyond the emission-line regions; the emission-line gas of these larger radio sources has much more settled kinematical properties, indicative of rotation, and emission-line ratios consistent with the dominant source of ionizing photons being the active galactic nucleus.

2.6.10 Extremely distant radio galaxies and their emission line properties

Since radio sources with Ultra Steep Spectra (USS) are efficient tracers of high redshift radio galaxies (HzRGs), de Breuck, Röttgering, Miley and van Breugel (California) have defined three samples of such USS sources using the recently completed WENSS, TEXAS, MRC, NVSS and PMN radio-surveys. The combined sample contains 669 sources with $S_{1400} > 10$ mJy and covers virtually the entire sky outside the Galactic plane ($|b| > 15°$). They carried out deep imaging and optical spectroscopy using the WHT and the KECK telescope. Most are identified as narrow-lined radio galaxies with redshifts ranging from z=0.25 to z=5.19. Ten objects are at $z > 3$, nearly doubling the number of such sources known to date. Four of the USS radio sources are identified with quasars, of which at least three have very red spectral energy distributions. Combined with radio galaxies from the literature de Breuck et al have compiled a sample of 165 radio galaxies to study the properties of the extended emission line regions and their interaction with the radio source over a large range of redshift $0 < z < 5.2$. From the subsequent analysis, they concluded that at high redshifts, there is an increased abundance of hydrogen, both ionized and neutral, which may well be the reservoir of primordial hydrogen from which the galaxy is forming. The nitrogen abundance shows a variation of more than an order of magnitude, with the $z > 3$ radio galaxies occupying the region of relatively low metallicity. From an analysis of the emission line ratios it appears that shock ionization occurs almost exclusively in small radio sources. The is similar to the results of obtained by Best et al. for their sample of $z \sim 1$ radio galaxies.

Overzier, Röttgering, Kurk, and de Breuck, analysed spectroscopic observations of the rest-frame UV line emission around the radio galaxy MRC 2104−242 at z= 2.49, obtained with FORS1 on VLT Antu. The morphology of the halo is dominated by two spatially resolved regions. Lyα emission is extended by $>12''$ in the direction of the radio axis, C IV and He II are extended by $\sim 8''$. The overall spectrum is typical for that of high redshift radio galaxies. The most striking spatial variation is that N V is present in the spectrum of the region associated with the center of the galaxy hosting the radio source, the northern region, while absent in the southern region. Assuming that the gas is photoionized by a hidden quasar, the difference in N V emission can be explained by a metallicity gradient within the halo, with the northern region having a metallicity of $Z \sim 1.5\ Z_\odot$ and $Z \leq 0.4\ Z_\odot$ for the southern region. This is consistent with a scenario in which the gas is associated with a massive cooling flow or originates from the debris of the merging of two or more galaxies.

A significant fraction of Ultra Steep Spectrum (USS) selected high redshift radio galaxy candidates fail to show emission lines in deep Keck exposures, even though some are detected in the continuum. An explanation might be that they are obscured radio AGN in moderately distant galaxies, or that they are young radio galaxies at high redshifts in an exceptionally vigorous stage of their formation. In both cases significant amounts of dust are envisaged. Reuland (Leiden/California), van Breugel (California) and Röttgering carried out a detailed study of one of these objects, WN J0305+3525. This source appears associated with a multi-component system of very faint near-IR objects at a tentative redshift $z \sim 4.21$, and was strongly detected at both sub-mm and mm wavelengths using the JCMT and IRM telescopes. This supports the view that WN J0305+3525 a highly obscured high redshift radio galaxy, and it appears to be one of the most luminous in its class.

2.7 Clusters of galaxies and large scale structure

2.7.1 Weak lensing of low mass groups

Hoekstra, in collaboration with Franx, Kuijken, Carlberg, Yee, and others of the CNOC2 team has measured the weak lensing signal of low mass galaxy groups. Several fields of the CNOC2 survey were imaged, and groups were identified based on the redshift and spatial distribution. The weak lensing signal was detected at the 99% confidence limit. The average mass-to-light ratio of the groups was estimated at $254\pm110\, h\, (M/L)_\circ$ in the B-band, corrected for luminosity evolution. For a universe without a cosmological constant, this implies a matter density of 0.19±0.10, in good agreement with other estimates.

2.7.2 The ENACS cluster survey

With Biviano (Trieste), Thomas and Mazure (Marseille), Katgert has continued his study of the distribution and kinematics of various types of galaxies in clusters. The ultimate goal of this work is to understand the relations between the various types of galaxies during the formation and evolution of a cluster. This work is based on the ENACS survey, which yielded more than 5600 redshifts for galaxies in about 100 clusters. Due to the inhomogeneity of literature data for cluster galaxies, those data were not used in the present analysis.

For about half of the galaxies in the ENACS clusters, CCD images were obtained. These have been used to determine the morphological type of those galaxies, and to quantify the properties of their brightness distributions. The morphological types were compared with galaxy types derived from the ENACS spectra and the two types are quite strongly correlated. However, the spectra of elliptical and S0 galaxies are so similar that these galaxy types cannot be distinguished on the basis of their spectra. Late spirals can be classified with high reliability from the spectrum alone. Early spirals can also be classified from the spectrum, if it is known from imaging that one deals with a spiral galaxy.

For the early-type galaxies with CCD-imaging, the brightness distribution was represented by multi-gaussian expansion. This yields an accurate estimate of the half-light radius, which can be combined with estimates of the internal velocity dispersion in analysis of the Fundamental Planes in several clusters. The velocity dispersions are derived from the ENACS spectra, and are calibrated with long-slit data.

Using only the galaxies with types from CCD imaging, the evidence for segregation of morphology with density and with radius was investigated. The well-known differences between the radial distributions of early- and late-type galaxies were confirmed. It appears that the early spirals have a radial distribution that is very similar to that of S0's and ellipticals. Whereas the late spirals avoid the central regions of their clusters alltogether, the fractions of the other galaxy types change hardly with radius, except that the proportion of (in particular the bright) ellipticals increases towards the centre. On the other hand, at fixed distance from the centre, the fraction of ellipticals and S0's increases with relative projected density (referred to the mean cluster profile). The early spirals do not share this behaviour: their fraction decreases with relative projected density, as does the fraction of the late spirals.

Biviano (Trieste), Katgert and Thomas used all galaxies with types (estimated either from imaging or from the spectrum) to study the 2-D distributions of normalized projected distance, R, from the cluster centre and relative normalized velocity, v, for the various galaxy types. It appears that the 2-D distributions of galaxies in and outside local substructure are different for all galaxy classes. Among the galaxies outside substructure (the majority), there are at least 4 subsets with different (R,v)-distributions, viz bright ellipticals, E+S0, $S_{\rm early}$ and $S_{\rm late}$. The latter include the galaxies with emission lines. Rather surprisingly, the galaxies within substructure do not all have the same (R,v)-distributions. The implications of these results are being studied.

2.7.3 A proto cluster around the powerful radio galaxy PKS 1138−262 at z =2.156

Kurk, Röttgering, Miley, and Pentericci (Heidelberg) carried out a detailed study of the environment of the powerful radio galaxy PKS 1138−262 at z =2.156. Radio, optical and X-ray observations of this objects have suggested that this galaxy is a massive galaxy in the center of a forming cluster. The field was imaged with the Very Large Telescope in a broad band and a narrow band encompassing the redshifted Lyα emission. Subsequent VLT spectroscopic observations of candidate Lyα-excess objects led to the discovery of 14 galaxies (see Fig. 2.7) and one QSO at approximately the same distance as the radio galaxy. All galaxies have redshifts in the range z=2.16±0.02, centered around the redshift of the radio galaxy, and are within a projected physical distance of 1.5 Mpc from it. The velocity distribution suggests that there are two galaxy subgroups having velocity dispersions of $\sim$ 500 km s^{-1} and $\sim$ 300 km s^{-1} and a relative velocity of 1800 km s^{-1}. If these are virialized structures, the estimated dynamical masses for the subgroups are $\sim$9 and $\sim$4 $\times$ 10^{13} $M_{\odot}$ respectively, implying a total mass for the structure of more than 10^{14} $M_{\odot}$. The new observations, together with previous results, suggest that the structure of galaxies around PKS 1138−262 is likely to be a forming cluster.

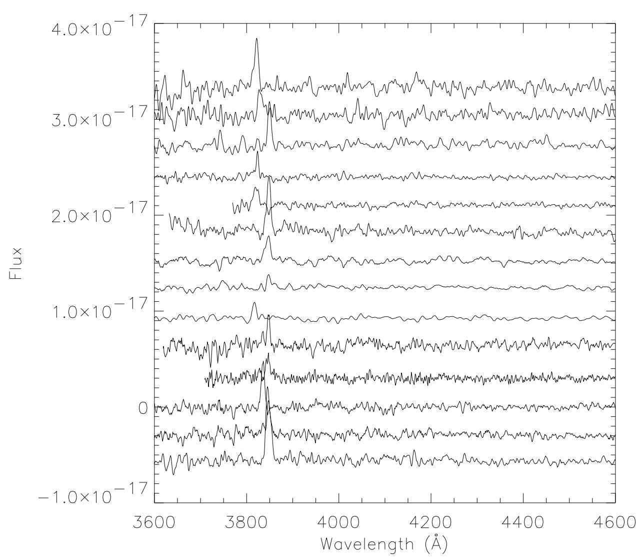

Figure 2.7: The emission spectra of the 14 confirmed galaxies at redshift z=2.16±0.02. The flux is in erg s^{-1} cm^{-2} A^{-1} and for clarity each spectrum is offset, relative to the ordinate, by multiples of 3, 10 and 18 s^{-1} cm^{-2} A^{-1}.

2.8 Molecular astrophysics

2.8.1 Tracing the evolution of high-mass protostars

Van der Tak and Boonman, in collaboration with van Dishoeck, Evans (Texas) and Blake (Caltech), continued their studies of deeply embedded massive young stars and their relation to other observational phenomena associated with high-mass star formation, such as luminous infrared sources, ultracompact H II regions, hot molecular cores and masers. A dozen sources, selected on infrared and millimeter properties, have been observed with the JCMT and OVRO, complementing full ISO-SWS spectra. Systematic increases in the gas/solid ratios, abundances of evaporated molecules and fraction of heated ices (see laboratory section) are found with increasing temperature, suggesting an evolutionary scenario in which this "global heating" plausibly results from the gradual dispersion of the envelopes with time, reducing the ratio of envelope to stellar mass.

Together with Doty (Denison Univ., USA/visitor Leiden), van der Tak, Boonman and van Dishoeck modeled the gas-phase chemistry and gas/solid ratios toward these objects, based on the temperature and density structure of the envelopes derived in earlier work. The models overproduce the observed gas-phase values of molecules such as H_2O and CO_2. Both observational and chemical effects are being considered as causes of this discrepancy.

2.8.2 The cosmic ray ionization rate toward massive protostars

Van der Tak and van Dishoeck used their recent models of the envelopes of seven massive protostars to analyze observations of H_3^+ infrared absorption and HCO^+ submillimeter emission lines toward these stars, and to constrain the cosmic-ray ionization rate ζ. The HCO^+ data give best-fit values of ζ=$(2.6\pm1.8)\times10^{-17}$ s^{-1}, in good agreement with diffuse cloud models and with recent Voyager/Pioneer data, but factors of up to 7 lower than found from the H_3^+ data. No relation of ζ with luminosity or total column density is found, so that local (X-ray) ionization and shielding against cosmic rays appear unimportant for these sources. The difference between the H_3^+ and HCO^+ results and the correlation of $N(H_3^+)$ with heliocentric distance suggest that intervening translucent clouds contribute significantly to the H_3^+ absorptions in the more distant regions.

2.8.3 Detection of highly abundant, hot HCN in massive protostars

Boonman, in collaboration with Stark (MPI-Bonn), van der Tak, van Dishoeck and de Lange and Laauwe (SRON-Groningen), have detected for the first time the rotational HCN J=9–8 line in the vibrationally excited state ν_2=1 in a massive star-forming region (see Fig.2.8). These observations have been performed with the new MPIfr/SRON 800 GHz receiver on the JCMT, which had its first light in April 2000. Together with the also detected HCN J=9–8 line in the ground state, this forms the missing link between the cold gas in the outer parts of the molecular envelope seen in emission, and the hot ($T > 300$ K) gas, seen in absorption with the ISO-SWS. The high spectral resolution of the observations shows that the hot gas is not associated with the molecular outflow or shocks. Models indicate that the HCN gas is located in the inner hot part of the envelope, with an abundance of $\sim 10^{-6}$, about 100 times higher than that of the cold gas. This abundance is consistent with the ISO observations and can be explained with high-temperature chemistry, in which atomic oxygen is driven into water. This suggests that in this source a hot core is being born.

2.8.4 H_2O and O_2 in clumpy molecular clouds

Recent observations with the SWAS satellite indicate abundances of gaseous H_2O and O_2 in dense molecular clouds which are significantly lower than found in standard homogeneous chemistry models. Spaans (RuG) and van Dishoeck have investigated the thermal and chemical balance of inhomogeneous PDRs, in which the abundances of H_2O and O_2 are computed for various density distributions, radiation field strengths and geometries. It is found that a “clumpy” medium lowers the column densities of H_2O and O_2 compared to the homogeneous case by more than an order of magnitude at the same A_V. O_2 is particularly sensitive to the penetrating ultraviolet radiation. This mechanism can quantitatively explain the H_2O and O_2 abundances found in the large SWAS beam for extended molecular clouds, but additional freeze-out of oxygen onto grains is needed in dense cold cores.

2.8.5 H_2 emission from disks around pre-main sequence and Vega-type stars

Thi, van Dishoeck, Blake (Caltech) and collaborators used the ISO-SWS to search for H_2 pure-rotational line emission from the disks around low and intermediate mass pre-main-sequence stars as well as young Vega-like objects. The sources were selected to be isolated from molecular clouds and to have circumstellar disks revealed by millimeter interferometry. Warm ($T \approx 100$–200 K) H_2 gas is detected around many sources, including possibly the Vega-like objects. The detection of H_2 in the latter sources was unexpected and was reported in a letter to Nature, which featured on the cover of the January 4, 2001 issue (Fig. 2.9). Since H_2 is a necessary ingredient to make gaseous Jupiter-type planets, the detection of H_2 in

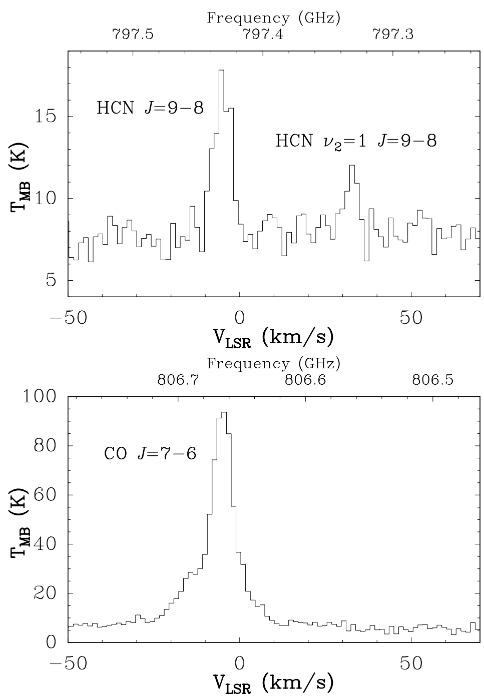

Figure 2.8: Spectrum of the ν_2=0 J=9–8 and the vibrationally excited ν_2=1 J=9–8 line of HCN at 797.434 GHz and 797.330 GHz, respectively, toward the massive protostar GL 2591 obtained with the JCMT by Boonman et al. *Top panel:* The CO J=7–6 line at 806.652 GHz was also observed and is shown for comparison. *Bottom panel:* The latter spectrum shows clearly the presence of a wing component whereas the HCN J=9–8 lines do not show such a component.

objects with ages up to 20 Myr implies a longer timescale for giant planet formation than thought before. The presence of gas in the disks can also affect the dust dynamics.

The inferred mass of the warm H_2 gas ranges from $\sim 10^{-4}\,M_\odot$ up to $8\times10^{-3}\,M_\odot$, and can constitute a non-negligible fraction of the total disk mass. Complementary single-dish ^{12}CO 3–2, ^{13}CO 3–2 and ^{12}CO 6–5 observations have been obtained with the JCMT. These transitions probe cooler gas at $T \approx$ 20–80 K. Most objects show a double-peaked CO emission profile characteristic of a disk in Keplerian rotation. The derived cold gas masses are factors of 10–200 lower than those deduced from 1.3 mm dust emission assuming a gas/dust ratio of 100, in accordance with previous studies. These findings confirm that CO is not a good tracer of the total gas content in disks since it can be photodissociated in the outer layers and frozen onto grains in the cold dense part of disks. In contrast, H_2 can shield itself from photodissociation even in low-mass "optically thin" disks and can therefore survive longer.

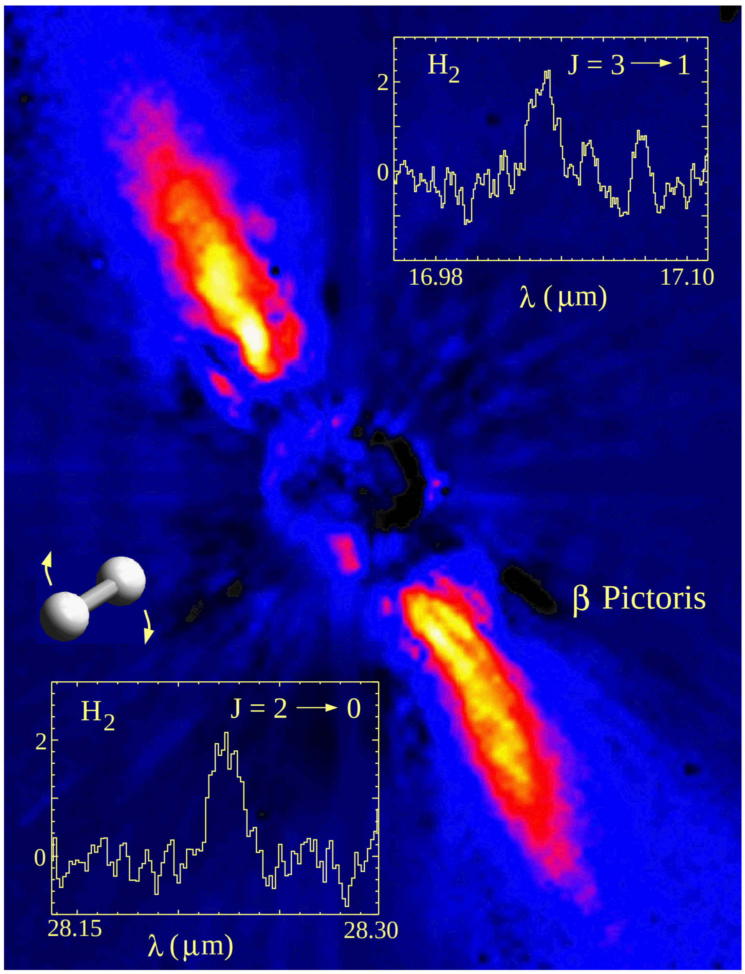

Figure 2.9: Spectra of the lowest pure rotational H_2 transitions of the β Pictoris, 49 Ceti, and HD 135344 debris disks obtained with the ISO-SWS by Thi et al.

2.8.6 Chemistry in circumstellar disks

Van Zadelhoff, together with van Dishoeck, Thi and Blake (Caltech), finished their observations and modeling of submillimeter emission lines from circumstellar disks. High-excitation lines of various (organic) molecules have been detected with the JCMT, complementing OVRO imaging of lower excitation lines. Radiative transfer calculations of the molecular excitation and emission from circumstellar disks have been developed and are used to test the vertical and radial temperature and density profiles of disk models in the literature.

Van Zadelhoff, in collaboration with van Dishoeck, continued his work on a code for 2D cylindrically-symmetric photon-dominated regions, with applications to circumstellar disks. This code has been coupled to a time-dependent chemistry code in collaboration with Aikawa (Kobe Univ., Japan). The abundances in disks around pre-main sequence stars have been calculated. The next step is to combine them with the submillimeter radiative transfer codes. Interestingly, both the chemical and molecular excitation models indicate that the observed emission arises from a warm, intermediate layer in the disks.

2.8.7 The gas temperature of disks around A-stars

Kamp, in collaboration with van Zadelhoff, calculated the gas temperature in debris disks around the main-sequence A-stars β Pictoris and Vega. The non-detection of CO as well as the detection of H_2 in the case of β Pictoris can be explained using the standard gas-to-dust ratio of 100 and 2D disk models, taking into account both the stellar and the interstellar ultraviolet flux. The most important heating mechanisms are pumping of the oxygen fine-structure levels by infrared photons from dust and viscous heating due to grain drift velocities. Depending on the chemical composition of the disk, fine-structure line cooling of C^+ and O and CO molecular line cooling are the most relevant cooling processes in these disks. The gas temperature differs significantly from the dust temperature, but stays in all models well below 300 K.

2.8.8 SIRTF legacy program

Van Dishoeck, in collaboration with Evans (Univ. of Texas/Leiden, PI), Blake and others, wrote a SIRTF Legacy proposal entitled *From Molecular Cores to Planet-Forming Disks*, which was awarded 400 hrs of SIRTF time. About 25 square degrees of molecular cloud area will be mapped from 3.5–70 μm and complete 5–40 μm spectra will be obtained for at least 150 objects ranging from deeply embedded protostars to T Tauri stars with tenuous disks. Pontoppidan started his Ph.D. thesis on this topic by collecting a large data base of young stellar objects in the regions to be mapped as potential targets for spectroscopy.

2.9 Raymond & Beverly Sackler Laboratory

This section summarizes the research carried out in the Raymond & Beverly Sackler Laboratory for Astrophysics. It is closely linked with the Molecular Astrophysics research described in the previous section. The research activities in 2000 consisted of two components: continued experiments with existing equipment and the development of two new ultra-high vacuum set-ups (SURFRESIDE and CRYOPAD).

2.9.1 Low-temperature crystallization

Schutte investigated the viability of the so-called low temperature crystallization phenomenon. This effect was observed by colleagues at the NASA-Goddard (USA) in samples which are deposited on fluffy structures of dust particles composed of material similar to amorphous quartz which were aggregated on top of a 10 K substrate. A possible problem in these experiments is the low thermal conductivity between the particles, which could result in temperatures in the aggregates which are considerably in excess of the temperature of the substrate. To test whether a similar crystallization phenomena could occur under controlled conditions, Schutte used an amorphous quartz glass plane-parallel window as a substrate and investigated by infrared spectroscopy whether the deposited ices have crystalline characteristics. In contrast with the Goddard experiments, the ices produced on the quartz substrate were consistently amorphous in structure. This shows that the low temperature crystallization phenomenon will not occur on dust particles in interstellar space. These experiments are relevant to the interpretation of ISO data on crystalline ices and silicates obtained by the group of Waters (UvA).

2.9.2 The origin of the 6.85 μm feature

A strong absorption band at 6.85 μm has been detected in the ISO spectra of most protostellar sources, as studied by Keane and Tielens (SRON/RUG). The carrier of this band has so far remained unidentified, but possible suggestions in the literature include the ammonium ion and carbonates. To test this hypothesis, Schutte, in collaboration with colleagues from NASA-Goddard (USA), studied the processing of H_2O–CO_2–NH_3–O_2 ice mixtures by ultraviolet and MeV proton irradiation. In both cases a strong infrared feature due to NH_4^+ was produced at 6.85 μm, which matches well the interstellar feature. The implied NH_4^+ abundance is typically $\sim$10% relative to H_2O. The negative counterions, including the carbonate ions, do not produce any significant infrared structure and can therefore not be detected. The ubiquitous presence of the 6.85 μm feature toward protostars indicates that the ices in their surroundings have been energetically processed. The high implied abundance of NH_3, the precursor of NH_4^+, indicates that the gas that gave rise to the ices contained a high fraction of atomic nitrogen.

2.9.3 Extraterrestrial amino acids in the Orgueil meteorite: a cometary origin?

Ehrenfreund and collaborators at UCSD (San Diego, USA) searched for amino acids in meteorites and investigated their parent body. This work is important to understand the link between different small bodies, such as comets, asteroids and meteorites, and helps to reconstruct the origin of our solar system. Carbonaceous chondrites are of particular interest, since they may have efficiently seeded the early Earth with prebiotic compounds necessary for the origin of life. Analyses of a pristine interior piece of the CI carbonaceous chondrite Orgueil by high-performance liquid chromatography have found that β-alanine is by far the most abundant amino acid, followed by glycine. Other α-amino acids, including alanine, are present only in trace amounts. Carbon isotopic measurements of β-alanine and glycine indicate that these amino acids are extraterrestrial in origin. They are identical to those found in another CI carbonaceous chondrite Ivuna, but very different from those found in the CM carbonaceous chondrites Murchison and Murray, suggesting that the CI chondrites come from a different type of parent body, perhaps an extinct comet.

2.9.4 The photostability of amino acids in space

Amino acids are basic components of proteins, essential constituents of all organisms. Ehrenfreund and collaborators at NASA-AMES (USA) tested the stability of amino acids against ultraviolet photolysis. Two biological and two non-biological amino acids have been irradiated in frozen Ar, N_2, and H_2O to simulate conditions in the interstellar gas and on grains. The experimental results indicate that amino acids in the gas phase will likely be destroyed during the lifetime of a typical interstellar cloud. In regions with relatively low UV radiation, amino acids may be present as transient gas-phase species. Their survival in interstellar icy grain mantles and on the surface of comets and planets is also strongly limited. These results provide important constraints for the survival and transfer of amino acids in space environments, and thus their possible availability for prebiotic chemistry.

2.9.5 Analysis of organic material produced by photolysis of interstellar ice analogues

Muñoz-Caro and Schutte performed infrared spectroscopy of interstellar ice analogues during and after ultraviolet photoprocessing. The ice mixture H_2O:NH_3:CH_3OH:CO:CO_2 = 2 :1:1:1:1 was adopted as the standard for the ice mantle composition in dense clouds, based on recent ISO observations. Previous studies have shown that one of the main products of photolysis of such mixtures is the complex 3-dimensional molecule hexamethylenetetramine (HMT: $(CH_2)_6N_4$). Infrared spectroscopy allows quantitative analysis of the production rate of this species under various simulated interstellar and early Solar System conditions. This work serves as preparation for the ESA-Rosetta mission to comet Wirtanen. Detection of HMT in the comet nucleus could trace the ambient ultraviolet field in the early Solar System.

2.9.6 SURFRESIDE

The Surface Reaction Simulation Device (SURFRESIDE) was conceived and designed to study chemical reactions occurring on interstellar ice grain mimics. The experiment combines Ultra High Vacuum (UHV) surface science techniques with atomic and molecular beams. In mid-2000, Fraser started working with SURFRESIDE. Forgoing a collection of unforeseen equipment failures, the construction of the experiment is now nearing completion. A number of design modifications have been incorporated into the experiment, including a redesign of the pumping system and molecular dosing lines, modifications to the "grain-mimic" sample, installation of the main mass spectrometer, infrared windows, temperature control system and sample thickness monitoring system, modifications to the cryostat such that it is fully UHV compatible, and a redesign of the cryogenic shield on the sample. These modifications allow the system to reach base pressures around 2×10^{-10} torr (only 1000 times greater than the pressure in many dense molecular clouds, and a 1000 times better than the existing old equipment in the laboratory).

2.9.7 CRYOPAD

Schutte, together with Fraser, van Broekhuijzen and de Kuiper from the Huygens mechanical workshop, started the design phase of the second new set-up, the CRYOgenic Photoproduct Analysis Device (CRYOPAD). This set-up is designed to analyse in detail the volatile molecules that are produced by energetic processing (i.e., ultraviolet radiation or charged particles) of ices with a composition analogous to ices in space. These data will be of great value for understanding the origin of the molecules found in warm star-forming regions and "hot cores", where molecules are evaporating off the grains. The experience gained with the design of SURFRESIDE proved very valuable. The design is currently being finalized, components are ordered and construction will start next year.

2.10 Projects: Theory, instrumentation and surveys

2.10.1 General purpose hydro-code in three dimensions

Icke and Mellema started a nationwide initiative (in collaboration with van de Weygaert in Groningen and Langer in Utrecht) with the aim of developing a robust general-purpose hydrocode in three dimensions. This is, so to speak, the "final frontier" of hydrodynamics. They started detailed investigations into the pros and cons of various existing techniques, including relatively new methods such as the "BGK"-technique. The results show that Mellema's adaptation of the Roe-solver is probably superior, especially when used in conjunction with LeVeque's "transverse waves" method. The generation of adaptive grids, which are indispensible in 3D hydro, is now under active study in our group. Van de Weygaert's Voronoi-Delaunay methods are mathematically optimal, but it remains to be seen whether they can be implemented in a way that is computationally efficient. Mellema is experimenting with Beowulf-cluster adaptations of his hydrocodes.

2.10.2 NOVA-ESO VLTI Expertise Centre (NEVEC)

A fundamental goal of the European Southern Observatory (ESO) Very Larger Telescope (VLT) programme is to combine the radiation from a number telescopes into the VLT Interferometer (VLTI), giving a spatial resolution of a few tens of milli-arcsec at 10 micron to 1 milli-arcsec in the visible. Dutch participation in the VLTI programme is an important part of the NOVA program. There are several components to Dutch participation in the VLTI program, all of which attempt to exploit the strengths of Dutch astronomy and to build up the expertise which will optimise scientific use of the facility.

MoU with ESO

To be an official partner in the program with guaranteed observing time requires a contribution to ESO additional to the normal subscription. On May 31, 1999 a memorandum of understanding (MoU) was signed by the Director of NOVA and the Director General of ESO guaranteeing additional Dutch contributions to the

VLTI project, through the NOVA ESO VLTI Expertise Centre and a cash contribution, and providing for Dutch membership of the VLTI Implementation Committee.

NOVA has funded a new national expertise centre in optical/infrared interferometry in astronomy as a joint venture with ESO (NEVEC: NOVA - ESO Expertise Centre for VLTI). The goals of the expertise centre are:

- The development of instrument modelling, data reduction and calibration techniques for VLTI, concentrating on optimising VLTI for studies of faint objects

- The accumulation of expertise relevant for second-generation VLTI instrument

- Provision of education in VLTI

NOVA has guaranteed funding for a minimum of 18 staff years of scientists and engineers to work at NEVEC during the period from 1999 to 2004. At least 10 staff years will be devoted to carrying out a set of tasks to be defined jointly by NOVA and ESO.

Instrument contribution (MIDI)

NEVEC is leading the development of the software for the first science instrument of the VLTI, the Mid-Infrared Interferometric instrument (MIDI) and has committed 5 staff years to this effort. The Principal Investigator of MIDI is the Max Planck Institut für Astronomie at Heidelberg (MPIA), with the Netherlands and France as consortium partners. The collaboration of NOVA with MPIA amounts to a ~30% share in development of MIDI (NEVEC for software development, and from ASTRON in constructing the MIDI cold-bench).

Dutch VLTI team

Dutch participation in VLTI is being guided by a national team which meets twice per year, consisting of de Graauw (SRON, Groningen), Jaffe (Leiden), van Kerkwijk (Utrecht), Le Poole (Leiden), Miley, (Leiden - Chair), Noordam (ASTRON, Dwingeloo), Röttgering (Leiden), Pel (Groningen), Schilizzi (JIVE, Dwingeloo), Waters (Amsterdam) and Bakker (Leiden).

NEVEC's current activities

Four astronomers and two software engineers were recruited. Percheron came to Leiden from a position in US industry. Meisner is an optical engineer who obtained his Ph.D. from the University of Minnesota. Mennesson obtained his Ph.D. under the supervision of Léna and Mariotti and has recently accepted a position at NASA/JPL to work on the Terrestrial Planet Finder, and Bakker worked on evolved stars, worked 3 year in industry and has accepted the position of project manager of NEVEC. In addition, two software engineers are involved in NEVEC activities. De Jong combines an appointment with a position in industry and Hartmann, a consultant who was awarded a contract by NEVEC to develop components of the MIDI software package. Valuable additional expertise was provided by Cotton (NRAO), an experienced radio interferometrist and one of the chief architects of AIPS, who spent a sabbatical at Leiden. D'Arcio from SRON who works on space interferometry. In addition, substantial contributions to the NEVEC efforts were provided by Miley (10%), Le Poole (75%), Jaffe (70%), Röttgering (20%), and Waters (20%). Also two graduate students (Heijligers and van Boekel) contribute in NEVEC activities by modelling of VLTI observations of extra-galactic and galactic targets respectively.

NEVEC activities have primarily focused on MIDI operating analysis and software development, the PRIMA tender and the Pre-PRIMA survey. Current efforts are directed to the VLTI calibration program, VINCI commissioning, next generation VLTI instrument and fringe tracking algorithms. In 2000 a very successful international interferometric summer school was organised with established lecturers and about 75 attendants.

2.10.3 Darwin

ESA's Darwin mission will be an interferometric mission capable of detecting and characterizing in the infrared earth-like planets orbiting nearby stars. It will further carry out an ambitious astrophysics programme with the aim of understanding the formation and evolution of planets, stars, active and normal galaxies. It will do this with a sensitivity comparable to NGST, but with a resolution a factor 10–50 higher than NGST. The planned steps towards launch in 2014 include an ambitious technology programme, two precursor missions (SMART2 and SMART3) and a system level study.

D'Arcio, Röttgering, den Herder and Le Poole worked on a number of aspects related to the design of Darwin. The main emphasis of the work carried out is related to concepts for imaging large fields and co-phasing the whole interferometric array. These studies are being carried out in close collaboration with Leiden observatory, Delft University, TNO/TPD, ESA and ESO. The long-term goal is a Netherlands participation in the DARWIN mission at a significant level with an emphasis on astrophysical imaging.

Le Poole and Röttgering are collaborating on research on phase shifting for nulling interferometers for ESA's forthcoming IRSI/Darwin satellite with the optics group of the Technical Physics Department of the TU Delft (TUD) led by Prof. Braat. And the space-engineering department of TNO/TPD (Hoekstra, Snijders, Braam and others).

Röttgering, in his role as IRSI-Darwin Science Team member, organized several meetings to explore possible collaborative projects involving the synergy between VLTI and space interferometry, including a workshop to bring together the various groups involved in optical interferometry in the Netherlands under the umbrella of an informal working group, the Dutch Joint Aperture Synthesis Team (DJAST). Besides participants from NEVEC and Leiden Observatory, representatives were present from SRON, TNO/TPD, Fokker Space, ESA and TU Delft, TNO/FEL, SRON and NIVR.

2.10.4 OmegaCam camera for the VLT Survey Telescope (VST)

OmegaCam is planned as the first instrument for the VLT Survey Telescope (VST) on ESO's Paranal site. It is expected to operate for a period of ten years, and at least during the first 3–5 years of operations of the VST the OmegaCam is foreseen to be the only instrument on this telescope. OmegaCam is a 16,384 × 16,384 pixel (16k × 16k) imaging camera which will image a field of 1 square degree of sky.

The instrument is envisaged to execute dedicated observing programmes defined by individual users or teams. About 2/3 of the available observing time will be allocated by ESO's OPC. The remaining time is labeled as guaranteed time for the consortia involved in the construction of the telescope and the camera. Both small dedicated programmes, and bulk wide field sky surveys, are expected.

The VST and OmegaCam are built to provide an observing facility for the purpose of selecting targets for follow-up observations at the VLT, but also to conduct stand-alone observing programmes that require wide-field imaging. The camera and its associated data reduction will facilitate accurate photometry and astrometry over its entire field of view, following the requirements on the VST and its instrumentation. Primary Performance Characteristics for the VST wide-angle CCD camera are laid out in the Memorandum of Understanding (MoU) between OmegaCam and ESO.

The OmegaCam Consortium consists of: (i) NL – NOVA Kapteyn – PI Prof. K. Kuijken: Observation and calibration scenarios, data reduction. (ii) I – Osservatorio Padua – Dr. E. Cappellaro: Instrument software. (iii) D – Sternwarte München – Prof. R. Bender: Mechanical, electronics (Napoli). (iv) ESO – ODT Dr. O. Iwert: dewar and detectors.

The Dutch (NOVA) part of the consortium is split over two location: Kapteyn Sterrewacht, Groningen and the Leiden Observatory. In Groningen the following people are involved: (i) Dr. E.A. Valentyn – co-I, NOVA programme manager, (ii) Dr. K. Begeman – data reduction- crowded fields and (iii) Drs. D.R. Boxhoorn – data reduction- oodb. In Leiden the following people are involved: (i) Dr. E. Deul – pipeline coordinator, (ii) Dr. P. van der Werf – co-I and (iii) Dr. R. Rengelink – data reduction-pipeline DFS.

The Dutch group is responsible for the Observation and Calibration Scenarios, data reduction and builds on the experience gained in similar projects such as Denis and the ESO Imaging Survey. In Leiden major developmental work is done on the pipeline of data reduction software.

2.10.5 SAURON

De Zeeuw, Bureau, Copin and Verolme are members of the SAURON team that has built a panoramic integral-field spectrograph for the 4.2m William Herschel Telescope on La Palma, in a collaboration which involves groups in Lyon (Bacon) and Durham (Davies). The instrument is called SAURON (Spectroscopic Areal Unit for Research on Optical Nebulae), and records 1577 spectra simultaneously, with full sky coverage in a field of 33 by 44″, additional coverage of a small "sky" field 1.9′ away, spatial sampling of $0.94'' \times 0.94''$, and an instrumental dispersion of 90 km s^{-1}. SAURON is funded in part by a grant from ASTRON/NWO to de Zeeuw, and was built at the Observatoire de Lyon. First light was obtained on February 1, 1999.

SAURON is used for a multi-year program to measure the kinematics and line-strength distributions for a representative sample of 72 nearby early-type galaxies (ellipticals, lenticulars, and Sa bulges, in clusters and in the field), carefully put together by Bureau. Two observing runs in 2000 expanded the available sample from 15 to 31. The maps reveal significant deviations from axisymmetric kinematics, including minor axis rotation, and s-shaped emission-line gas distributions. Copin developed Fourier-based methods to quantify the rich structure in the kinematic maps.

SAURON observations of the E3 galaxy NGC 4365 provided the first full map of a dynamically decoupled core, with the central region of the galaxy rotating approximately around the minor axis, and the bulk of the object rotating around the long axis. The line-strength distributions show that the core and body of the galaxy have had essentially the same starformation history, and that the triaxial structure has been in place for over 12 Gyr.

The SAURON observations of the representative sample will be complemented with high spatial resolution observations of the nuclei. Dynamical modeling and analysis of the linestrength maps in terms of age and metallicity of the stellar populations, will provide black hole masses, intrinsic shapes, and internal structure as a function of Hubble type.

2.10.6 SINFONI

SINFONI (SINgle Faint Object Near-infrared Investigation) is a collaboration between the European Southern Observatory (ESO), the Max-Planck-Institut für extraterrestrische Physik (MPE) and the Nederlandse Onderzoekschool Voor Astronomie (NOVA). SINFONI combines a cryogenic near-infrared (J,H and K-bands) integral field (image slicer) spectrograph ($R \sim 3000$) with an adaptive optics unit and will be installed at the VLT at the end of 2003. A laser guide star facility will enable nearly diffraction-limited imaging over the whole sky. A seeing-limited mode is also available. Leiden astronomers strongly involved in SINFONI are van der Werf, Franx, de Zeeuw and Katgert. Van der Werf is Principal Investigator of the NOVA components of SINFONI. The NOVA contribution consists of:

- software related to the performance of the SINFONI adaptive optics unit, in particular when operated with a laser guide star, and software for reconstruction of the Point-Spread-Function (PSF) based on data of the wavefront sensor alone;
- help with the commissioning of the instrument at Paranal, and the preparation thereof;
- enhancement of the spectrograph with a 2048^2 detector and a higher spectral resolution ($R \sim 10000$) option.

Most of the NOVA-SINFONI effort is carried out at Leiden, the remainder being done at ASTRON (Dwingeloo). The Leiden effort will ramp up significantly in the period 2001–2002. The SINFONI project is of great importance for the development of adaptive optics experience in the Netherlands. This has already given rise to contacts with TNO-TPD and ESO, discussing the posibilities for developing "advanced adaptive optics" in the Netherlands.

2.10.7 The DENIS survey

The DENIS Point Source catalogue towards the Magellanic Clouds has been completed at the end of the year 1999 and is now available through the Centre des Donées Stellaire in Strasbourg (CDS). The catalogue covers an area of of 19.87×16 square degrees centered on the Large Magellanic Cloud (LMC) and 14.7×10 square degrees centered on the Small Magellanic Cloud (SMC) and contains about 1,300,000 sources towards the LMC and 300,000 sources towards the SMC detected in at least two of the three DENIS photometric bands (I, J, K_s). 70% of the detected sources are true members of the Magellanic Clouds, respectively and consist mainly of red giants, asymptotic giant branch stars and super-giants.

2.10.8 The European Large Area ISO Survey (ELAIS)

Van der Werf, Papadopoulos, and Miley continued their collaboration with the ELAIS team (P.I.: Rowan-Robinson, Imperial College of Science, Technology and Medicin, London) on the European Large Area ISO Survey (ELAIS). This survey is the largest open time program on the Infrared Space Observatory (ISO), mapping 12 deg^2 at 15 and 90 μm, 6 deg^2 at 7 μm and 1 deg^2 at 175 μm. A milestone in 2000 was the publication of the paper describing the parameters of the survey, and the preliminary results. The ELAIS project is supported by a TMR network of the EC.

2.10.9 ESA's STJ detector

Perryman completed work on the light curve of UZ Fornacis, observed at the WHT with the ESA STJ (superconducting tunnel junction) detector, in a study involving collaborators from the ESA Space Science Department, and Mullard Space Science Laboratory. The detector provides high time-resolution photon counting capability, at the same time providing energy resolution – the first such detector of its kind in the optical, proposed by Perryman and colleagues in ESA in 1993. The observations show high-resolution, energy-dependent structure during ingress and egress of this magnetic CV system, allowing constraints to be placed on the accretion stream parameters and the white dwarf geometry.

2.10.10 IFMOS

Van der Werf and de Zeeuw are involved in the IFMOS (Integral Field Multi Object Spectrograph) studies for the Next generation Space Telescope (NGST). These are ESA-funded studies with Le Fèvre (Marseille) as Principal Investigator and including a number of European top institutes in the field of astronomical instrumentation.

2.10.11 HIPPARCOS and GAIA

ESA concluded its study of a possible follow-up mission to HIPPARCOS, called GAIA. This will allow mapping the three-dimensional structure and content of the Galaxy by measuring more than a billion stars with microarcsec level positional precision. Perryman chaired the Science Advisory Group and lead the entire GAIA effort in his capacity of ESA study scientist for GAIA, while de Zeeuw coordinated the scientific case, together with Gilmore (Cambridge). The formal presentation of the GAIA Mission at ESA Headquarters in September was followed by selection of GAIA as ESA's Cornerstone 6, to be launched no later than 2012.

2.10.12 SETI

Ollongren, in collaboration with D. Vakoch of the SETI institute, Mountain View, California worked on a method for clarifying the logic contents of messages for ETI at a meta level. Using concepts from constructive type theory they show that logical conclusions are then constructively provable.

2.11 History of astronomy

In January 2000 van der Heijden started as promovendus on a project in history of astronomy, titled *Frederik Kaiser (1808–1872) and the modernisation of Dutch astronomy*. She is supervised by Visser (Institute for History and Foundations of Science, Utrecht, and adjunct professor ("bijzonder hoogleraar") via Teylers Stiching at Sterrewacht Leiden) and Habing. The project is sponsored by the Sterrewacht Leiden, Teylers Stichting and the Schuurman Schimmel-van Outeren Stichting.

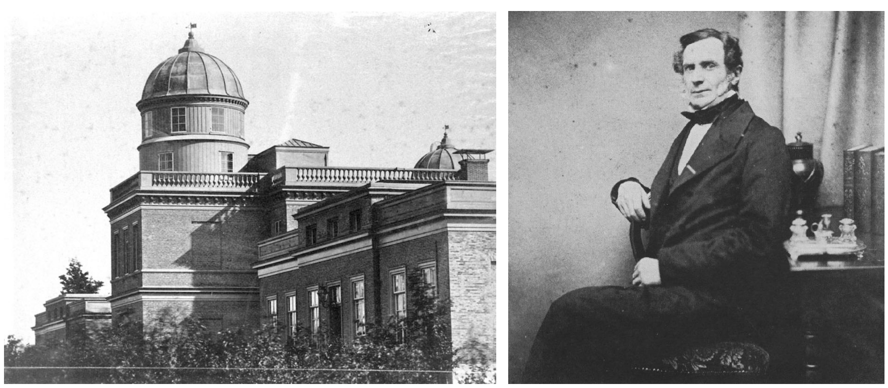

Figure 2.10: *Left panel:* The old observatory building. *Right panel:* Frederik Kaiser.

Van der Heijden's subject, Frederik Kaiser, was the director of Leiden Observatory from 1837 until his death. Kaiser put astronomy in Leiden and the Netherlands back on the world map, by (among others) the foundation of a new, up-to-date observatory building and the introduction of statistics and precision measurements in daily practice at the observatory. Figure 2.10 shows the historic observatory building located at the centre of Leiden and Frederik Kaiser. Furthermore, Kaiser was known among the public as the author of some bestsellers on popular astronomy.

The work will not be a mere biography, but an analysis of Kaiser's activities in research, organisation and popularisation, in a context of national and international developments in astronomy and scientific culture. In the past year van der Heijden compiled an overview of Kaiser's scientific and popular works, as well as a list of biographies and obituaries, from which she is now distilling an image of Kaiser as he was seen by his contemporaries. Furthermore she has made a preliminary inventory of the Kaiser Archives at the Sterrewacht. These archives have been well kept, but have never been put in order. Van der Heijden is now working on a list of correspondents as found in the Kaiser Archives and other archives in the Netherlands and elsewhere.

Chapter 3

Education, popularization and social events

Education, popularization and social events

Chapter 3

3.1 Educational matters

3.1.1 Organization

Prof. Burton served as the Director of Education until his early retirement in August 2000, and was succeeded as Director of Education by Prof. Franx in September 2000. The director of Education is advised by the Committee of Education, which advises on issues concerning education, courses, and monitors the progress of all undergraduate students. The committee meets regularly with the Committee of Physics Education, to discuss topics of common interest.

The astronomy curriculum is defined by the "Examen commissie" (Committee of Examination). In September 2000, its members were Prof. Franx (chair), Dr. Israel, Prof. Nienhuis (Physics), Dr. van der Werf and Prof. de Zeeuw.

Three staff members are advisors to the students: Dr. van der Werf (first and second year students), Dr. Israel (third year students), and Dr. Jaffe (senior students). The advisors speak to the students on a regular basis, and discuss their progress, and plans. The advisors play a critical role in helping the students to study effectively. The students in the first year are divided in three groups, and these groups meet regularly with a stafmember, called a "mentor". The mentors for the academic year 2000/2001 were Dr. Israel, Dr. Röttgering and Dr. Schutte. The students can exchange their experiences in these mentor groups. The university requires that each first year student collect a minimum number of credit points. This minimum is set at half of the total credit points for a year. The mentor groups can play an important role in helping the students to achieve this goal.

3.1.2 Graduate School

The School of Sciences has initiated a *Graduate School of Sciences*. Students with an appropriate bachelors degree can apply to the Graduate School to enroll for the Masters programme, which will take two years. The Graduate School will start functioning in the summer of 2001. Flyers, advertisements, and a general website have been prepared in the fall of 2000. The website can be accessed on the web at `http://www.fwn.leidenuniv.nl/gs/`. For the coming few years, mostly foreign students are expected to enroll. Dutch students will follow a separate curriculum, comprising both the bachelor and master programme in 5 years.

3.1.3 Bachelors/Masters Programme

All traditional undergraduate programmes at universities in the Netherlands will be divided in a Bachelors programme, lasting 3 years, and a Masters programme. Students starting in 2002 will enroll in these new programmes. All member countries of the European Union have committed themselves to use the same structure for their programmes. The preparations for the new curricula in astronomy have started in 2000. The final programmes need to be defined at the end of 2001. The astronomy Masters programme will be a two-year programme.

3.1.4 Enrollment

In the year 2000, 28 new students enrolled for astronomy at the first year level. Most of these had just finished high school, two of them in Belgium. Our programme is known outside the Netherlands, and it attracts foreign undergraduate students. The astronomy enrollment has stayed at a constant level in the last 20 years. In recent years, the proportion of female students has increased.

3.2 Degrees awarded in 2000

3.2.1 Master's degrees ("doctoraal diploma's")

In 2000 six students passed the final examination for the Doctoraal (M.Sc.) Degree in Astronomy. They are:

Date	Name
February 29	I.F.L. Labbé
June 27	F. Wesseling
August 29	R.L.C. Bouter
August 29	M.J. Kamerbeek
October 31	K.C. Steenbrugge
October 31	A. van der Meer

3.2.2 Ph.D. degrees

In 2000 six graduate students successfully defended their theses in the Senate Room of the Academie on the Rapenburg, and were awarded the Ph.D. degree. They are:

Date	Name (thesis advisor)	Title
May 25	J. de Bruyne (de Zeeuw/Perryman)	*Astrometry from space: a Hipparcos study of young stellar groups*
May 25	R. Hoogerwerf (de Zeeuw/Perryman)	*Hipparcos and the nearby OB associations: space astrometry and high-mass star formations*
June 28	A. Helmi (de Zeeuw/White)	*The formation of the Galactic halo*
September 20	F. van der Tak (van Dishoeck/Evans)	*The embedded phase of massive star formation*
September 27	P.M. Veen (Habing/van Genderen/ van der Hucht)	*Intriguing variability of WR 46 and "dusty" Wolf-Rayet stars*
November 8	C. de Breuck (Miley/Röttgering/van Breugel)	*Very distant radio galaxies: search techniques and emission line properties*

The Ph.D. theses are also listed in Appendix X.

3.3 Courses and teaching activities

3.3.1 Regular courses given by the observatory staff in 2000

Compulsory courses

Semester	Course title	Teacher
1	Introduction to Astrophysics	J. Luu
2	Astronomy Lab 1	R. S. le Poole
3	Elementary Astronomy	H. J. Habing
4	Presentation 1	H. J. Habing
4	Astronomy Lab 2	F. P. Israel
5	Stars	A. M. van Genderen
5	Presentation 2	A. M. van Genderen
5	Observational Techniques 1	C. van Schooneveld
5	Radiative Processes	V. Icke
6	Observational Techniques 2	P. van der Werf
6	Astronomy Lab 3	H. J. A. Röttgering
6	Galaxies	M. Franx
6	Presentation 3	M. Franx
7	Introduction Observatory	E. R. Deul
7–10	Student Colloquium	G. K. Miley

Regular advanced courses

Semester	Course title	Teacher
7,9	Active Galaxies	P. T. de Zeeuw
8,10	Cosmology	P. Katgert
7,9	Interstellar Matter	E.F. van Dishoeck

Incidental advanced courses

Semester	Course title	Teacher
7,9	Communication ETI	A. Ollongren
8,10	Stellar Dynamics	W. J. Jaffe

3.3.2 Astronomy and Physics Kaleidoscope

Freshman students were introduced to current research projects being carried out by Astronomy and Physics personnel in a series of lectures held in January, February, and March.

Date	**Speaker**	**Title**
January 27	Prof. Dr. P.T. de Zeeuw	*SAURON, zwarte gaten, en de structuur van melkwegstelsels*
February 3	Prof. Dr. J. van der Waals	*Gashydraten: van wetenschappelijk curiosum tot veelbelovende energiebron?*
February 10	Prof. Dr. G.K. Miley	*Probing the early Universe with distant radio galaxies*
February 17	Prof. Dr. J. van Ruitenbeek	*Elektrische stroom door een enkel atoom*
March 9	Prof. Dr. E. van Dishoeck	*Kraamkamers van sterren en planeten*
March 23	Prof. Dr. C. Beenaker	*Toevalsmatrices*

3.3.3 Oort graduate lectures: galaxies in the infrared: from hardware to results

Prof. R. Genzel

"Monsters vs. Babies: Penetrating to the Heart of Active Galaxies" (May 16)
"Unravelling the Properties of Interstellar Media and Starbursts" (May 18)
"Inward Bound: High Resolution Techniques in Infrared and Submillimeter Astronomy" (May 23)
"Star Formation in the Young Universe: From ISO to FIRST" (May 24)

3.4 Popularization and media contacts

Boonman

"De Geschiedenis van de Leidsche Sterrewacht" (NVWS Scheveningen, February 25)
"De Geschiedenis van de Leidsche Sterrewacht" (NVWS Leeuwarden, September 30)

de Bruijne

"Een uniek zwart gat" (Radio Rijnmond, January 14)
"The search for extra-Solar planets" (University College Utrecht, February 8)
"Hipparcos" (Vereniging voor Sterrenkunde Midden-Limburg (Roermond), May 7)

van Dishoeck

"Chemie in de ruimte: een uniek laboratorium" (PAC Symposium Chemistry UU, March 3)
"Spinoza 2000" (NWO persbericht, August 31)
"Astrochemica van Dishoeck wint Spinoza premie" (Mare, August 31)
"Leidse winnaar Spinozaprijs" (Leidsch Dagblad, August 31)
"Van Dishoeck wint Spinozaprijs" (Persbericht UL, August 31)
"Spinoza 2000 winnaars" (NRC, August 31)
"Radio interview" (Radio 1, August 31)
"Radio interview" (VPRO, August 31)
"TV interview" (RTL4 news, August 31)
"Spinoza premie voor NOVA onderzoekster" (NOVA persbericht, August 31)
"Gluren naar de planeten-kraamkamer" (Leidsch Dagblad, September 1)
"Hoe moleculen tot planeet klonteren" (Volkskrant, September 2)
"Van Dishoeck bestudeert geschiedenisboek van heelal" (Leids Nieuwsblad, September 5)
"Scheikundige tussen de sterren" (Mare, September 7)
"Spinoza premie voor NOVA onderzoekster" (SRONieuws, September issue)
"Spinoza premie voor Ewine van Dishoeck" (Impact, September issue)
"In een exotisch lab tussen de sterren" (Leidraad, October)
"Spinoza premie voor vioolspelende astronome" (Technisch Weekblad, October 18)
"NWO 2000 Spinoza prize to van Dishoeck" (AAS Newsletter 102, October issue)
"Chemie met Sterren" (Chimica, 35/1, November, p. 7–9)
"Dutch Noble prize winners announced" (Physics Today, December)

Franx

“De toekomst van de Sterrenkunde”, (Diligentia, January 17)
“Ontwikkelingen in de Sterrenkunde”, (Sterrenwacht Quasar, Hoeven, June 4)

Habing

“Hebben andere sterren ook planeten?” (Assen, January 11)
“Studievoorlichting” (Gymnasium, Velsen Zuid, February 10)

Haverkorn

“Rimpelingen in de Kosmische Achtergrondstraling” (Breda, February 16)
“Magneetvelden in de Melkweg” (Utrecht, February 22)
“Rimpelingen in de Kosmische Achtergrondstraling” (Eindhoven, March 23)
“Magneetvelden in de Melkweg” (Venlo, March 24)
“Magneetvelden in de Melkweg” (Leiden, April 18)
“Magneetvelden in de Melkweg” (Roermond, October 2)
“Magneten in het Heelal” (Deurne, September 30)
“Magneetvelden in de Melkweg” (Eindhoven, October 19)
“Rimpelingen in de Kosmische Achtergrondstraling” (Utrecht, November 21)
“Rimpelingen in de Kosmische Achtergrondstraling” (Alkmaar, November 24)

de Heij

“Interstellaire materie - Tussen dood en leven” (Nijmegen, March)
“Interstellaire materie - Tussen dood en leven” (Dordrecht, July)
“Interstellaire materie - Tussen dood en leven” (Haarlem, November)
“Interstellaire materie - Tussen dood en leven” (Utrecht, December)

Helmi

“Space Science Enters New Millennium Amid a Renaissance” (Space.com, January 1)
“A Crushing End for Our Galaxy ” (Science magazine, January 7)

Hoogerwerf

“OB association” (Alkmaarse Weer- en Sterrenkundige Vereniging “Metius”, October 27)

Icke

“Hoezo millenniumprobleem?” (Radio Rijnmond, January 3)

"Einstein voor beginners" (Theater AdHoc, Maastricht, January 7)
"Millennium-software" (Haagsche Courant, January 10)
"Interview" (Radio West, January 10)
"Tijdreizen" (Rails, January 13)
"Winteravondlezing" (Haagse Vestiging UL, January 19)
"Ons beeld van het Heelal" (Comenius, January 20)
"Lerarencursus ANW" (Space Expo, January 24)
"Apen in de ruimte" (Eindhovens Dagblad, January 25)
"Interview" (VPRO, January 31)
"Ideeënfabriek" (Haagse Vestiging UL, February 9)
"Het oerknalmodel" (Studium Generale UL, February 15)
"Interview" (VPRO Blauwe Licht, March 1)
"Ideeënfabriek" (Haagse Vestiging UL, March 8)
"ICT in de sterrenkunde" (LIACS, March 24)
"Het weer in het Heelal" (RTL4, March 11)
"Vragen in de sterrenkunde" (KRO, March 15)
"Kunst en Wetenschap" (Eersel, March 22)
"Natuurkunde in het VWO" (Wolters Kluwer, March 23)
"Sterrenkunde" (Weekendschool, Amsterdam, March 26)
"Sterrenkunde" (Montessorischool Zeist, March 30)
"Kernfusie in de Oerknal" (Studiever. Scheikunde UL, March 30)
"Sterrenkunde" (Weekendschool, Amsterdam, April 2)
"Kosmologie vandaag" (Studium Generale, Nijmegen, April 18)
"Kunst en sterrenkunde" (Sandberg Instit, Amsterdam, April 26)
"Gastles sterrenkunde" (Fioretti College, May 8)
"De vorm van de ruimte" (Studium Generale, Utrecht, May 12)
"Lerarencursus ANW" (Nemo, Amsterdam, May 15)
"Interview" (De Baak, Noordwijk, May 23)
"Dying suns" (NL Supercomputer Day, Noordwijk, May 26)
"Ideeënfabriek" (Haagse Vestiging UL, May 30)
"Botsende sterrenstelsels" (ANW course, Leiden, June 8)
"Het uitdijend heelal" (Rectorendag, Leiden, June 10)
"Interview" (Elseviers Weekblad, June 14)
"Planetaire nevels" (VPRO-tv, August 9)
"Het einde van de Zon" (VPRO Zuiderlicht, September 5)
"Bessensap" (NWO, Amsterdam, September 25)
"Een geweldige tijd!" (VARA/Witteman, October 1)
"$E = \frac{1}{2}mv^2$" (Studium Generale, UL, October 05)
"Wegen door het Heelal" (Ministerie V&W, October 10)
"Vijf jaar na DeciBel" (KPN Telecom, October 11)
"Cosmology, not philosophy" (Studium Generale, VU, October 23)

“Een geweldige tijd! – discussie” (VARA/Witteman, November 4)
“Tussen science en science fiction” (Studium Generale, UU, November 13)
“Lerarencursus ANW” (Planetarium Artis, November 14)
“De Leidse Aratea” (Kopstukken, UL, November 16)
“Dagelijkse quantummechanica” (Studium Generale, KUB, November 23)
“Leidse sterrenkunde” (Cleveringa Lezing, Genève, November 27)
“Dagelijkse quantummechanica” (Rotary Club, Leiden, December 7)
“Sonic Acts” (Paradiso, Amsterdam, December 7)

Israel

“Leven in het heelal” (Ruimtevaart Dispuut Delft, March 1)
“Exoplanets” (Bussiness News Radio, March 31)
“Rondleiding NSE” (VOS, Noordwijk, September 23)
“Rondleiding NSE” (Strw, Noordwijk, October 27)

Katgert

“Supernovae en het Uitdijend Heelal” (NVWS Symposium Amsterdam, October 14)
“De Big Bang” (Dies Leidse Biologen Club, November 23)
“How to bluff your way into ... the Big Bang” (Studium Generale TU Delft, November 27)

Katgert-Merkelijn

“Oort’s contributions to Astronomy” (TU Eindhoven, Studium Generale, February 7)

Kurk

“De Oerknaltheorie” (Eindhoven, April 20)
“De Oerknaltheorie” (Venlo, April 28)
“De Oerknaltheorie” (Oostzaan, October 26)
“Geschiedenis van de sterrenkunde: van Aristoteles tot Newton” (Leiden, December 12)
“Geschiedenis van de sterrenkunde: van Aristoteles tot Newton” (Roermond, December 18)

Ollongren

“Communicatie-aspecten met buitenaardse intelligentie” (Haarlemse Weer- en Sterrenkundige Kring, Haarlem, january 20)
“Communicatie met buitenaardse intelligentie” (Vereniging voor Weer- en Ster-

renkunde TRIANGULUM (erkend door NVWS), Apeldoorn, Oktober 18)
"Communicatie met buitenaardse intelligentie" (Nederlandse Vereniging voor Weer- en Sterrenkunde, Afdeling Arnhem, November 15)
"Communicatie met buitenaardse intelligentie" (Nederlandse Vereniging voor Weer- en Sterrenkunde, Afdeling Twente, Enschede, November 22)
" 'Hallo, hier Aarde', Wetenschap buigt zich over communicatie met buitenaardse beschaving, de logische sleutel van Alexander Ollongren" (NRCHandelsblad, Wetenschap en Onderwijs, May 13, article by Dap Hartmann)

Le Poole

"Presentatie NEVEC Raad van Toezicht Sterrewacht" (Leiden, May 16)
"Adaptive Optics, Dispuut Christiaan Huygens" (Leiden, June 22)
"Interview with David van Noortwijk (cineast) on the life of Prof. Gerard P. Kuiper" (Leiden, June 27)
"Voordracht Leidsche Weer- en Sterrenkundige Kring: NEVEC" (Leiden, Sept. 11)

Schutte

"Interstellaire materie en organische moleculen in de ruimte" (Alkmaar, April 28)

Thomas

"Eigenschappen van melkwegstelsels in clusters" (NVWS Haarlem, November 24)

van der Tak

"Alcohol helpt astronomen jonge sterren dateren" (NWO Nieuwsbrief, April issue)
"Alcoholnevel verraadt leeftijd sterren" (Mare, April 13)
"Alcohol helpt sterrenkundigen" (Leidsch Dagblad, May 17)
"Sterren dateren met alcohol" (Nederlands Tijdschrift voor Natuurkunde, May issue)
"Alcohol helps astronomers date stars" (Photonics spectra, October issue)

Vlemmings

"VLBI: Het Globale Netwerk van Radiotelescopen" (Roermond, September 20)
"VLBI: Het Globale Netwerk van Radiotelescopen" (Alkmaar, November 27)

van Zadelhoff

"Het ontstaan van lage massa sterren." (Leiden, May 16)

3.5 The "Leidsch Astronomisch Dispuut 'F. Kaiser' "

The "Leidsch Astronomisch Dispuut 'F. Kaiser' " is an association founded by five astronomy students on March, 1st, 1993. Its major goal is to improve the contact between undergraduate students and the Observatory. The association is named after the founder of the Old Observatory, Frederik Kaiser. His birthday and dying day are commemorated every five years. The activities are open to all astronomers and astronomy students. The current board, consisting of Roderik Overzier, Glenn van de Ven, Stijn Wuyts and Leonie Snijders, tries to prolongate the success of the previous years. The main activities are studentenlezingen, the sterrewacht-borrels, instruction courses at the Old Observatory and the famous Sterrewachtbarbecue in June.

The association also contributes to the popularization of astronomy by giving tours at the Old Observatory and assisting on "open dagen". Every last Friday of the month a Sterrewacht Borrel is organized, for students and staff to meet informally. Since 1994 tours at the Old Observatory are given for first and second year undergraduate students in order to make them aware of the rich history of astronomy in Leiden. Other activities for this group of students to make them feel at home at the Observatory, include borrels and lectures by senior students. Each year an exuberant dinner is organized just for members, this year at restaurant "Oudt Leyden". This year the Dispuut organized its biggest event ever: an excursion to the total solar eclipse in France on August 11. There were 65 participants, mostly students. Current information about the Association, its activities and plans for the future is available on their new website at `http://www.strw.leidenuniv.nl/~kaiser`.

3.5.1 "Studentenlezingen"

Date	**Speaker (affiliation)**	**Title**
February 24	Dr. J.J.M. Sleutels (Perception Cognition Ontology, Faculty of Philosophy, Leiden University)	*Do stars know their mathematics?*
December 7	Prof. Dr. A. Ollongren (LIACS, Leiden University)	*CETI: Communication with Extra Terrestrial Intelligence*

3.5.2 Tours old observatory

For the popularization of astronomy, for which there is a broad interest, the "Leidsch Astronomisch Dispuut 'F. Kaiser' " is happy to organize tours at the Old Observatory, located in the historical center of Leiden. To honor the glorious past of the oldest academic observatory in the world, the association gives tours along the historical telescopes and tells the visitors the stories that come with the building and the instruments on request. It also provides visitors lectures about astronomy. Topics include history of astronomy in Leiden, extra-terrestrial life, the solar system, the universe and distance measurements in astronomy.

Date	**Group**	**Speaker(s)**
January 13	Ashram College	Maurits Hartendorp, Ivo Labbé
January 23	small group	-
February 4	schoolclass	-
February 11	small group	-
February 12	small group	Maurits Hartendorp
February 13	small group	-
February 18	birthday party	Guido Kosters
March 16	small group	-
April 7	Eurometaal	Maurits Hartendorp
April 29	Oranje Nassau College	Maurits Hartendorp, Jasper Arts
June 5	small group	-
August 6	Japanese group	Roderik Overzier
August 27	NATO	Maurits Hartendorp, Guido Kosters, Roderik Overzier
September 28	Scoutinggroup	Maurits Hartendorp
October 9	small group	Roderik Overzier
October 9	birthday party	Roderik Overzier
November 16	schoolclass	Roderik Overzier

Appendix I

Observatory staff December 31, 2000

Sterrewacht Leiden

Observatory staff December 31, 2000

Appendix I

Professors

Prof. Dr. W.B. Burton
Prof. Dr. E.F. van Dishoeck
Prof. Dr. M. Franx
Prof. Dr. H.J. Habing
Prof. Dr. V. Icke
Prof. Dr. G.K. Miley
Prof. Dr. P.T. de Zeeuw

Adjunct professors

Prof. Dr. R.T. Schilizzi (JIVE, for J.H. Oort Fund)
Prof. Dr. V. Icke (UL, Beta Plus Foundation, at University of Amsterdam)
Prof. Dr. M.A.C. Perryman (ESTEC, for Leiden University Fund)
Prof. Dr. R.P.W. Visser (UU, Teyler's Professor)

Associate professors and assistant professors

Dr. F. Baas
Dr. A.M. van Genderen
Dr. F.P. Israel
Dr. W. Jaffe
Dr. P. Katgert
Dr. J. Lub
Dr. J. X. Luu
Drs. R. S. Le Poole
Dr. H.J.A. Röttgering
Dr. W.A. Schutte
Dr. P.P. van der Werf

Postdocs and project personnel

Dr. L. d'Arcio	postdoc (SRON)
Dr. M. Bureau	postdoc (NWO)
Dr. P. Ehrenfreund	postdoc (NOVA)
Dr. N. Förster-Schreiber	postdoc (NWO)
Dr. H. Fraser	postdoc (NOVA)
Dr. M. Jarvis	postdoc (EU/TMR)
Dr. J.K. Katgert-Merkelijn	assistant-editor (A&A)
Dr. I. Kamp	postdoc (EU/Marie Curie)
Dr. J. Meisner	research scientist (NEVEC/NOVA)
Dr. G. Mellema	postdoc (KNAW)
Dr. S. Mengel	postdoc (EU/TMR)
Dr. P.P. Papadopoulos	postdoc (EU/TMR)
Dr. I. Percheron	research scientist (NEVEC/NOVA)
Dr. R. Rengelink	S/W postdoc (NOVA/Omegacam)
Dr. F. Schöier-Larsen	postdoc (UL)

Guest collaborators

Drs. M.J. Betlem
Dr. J.B.G.M. Bloemen (SRON)
Dr. Y. Copin (Sauron/Lyon)
Dr. M. Dahlem (ESTEC)
Dr. J. Roland (CNRS, France)
Dr. I. Salamanca (EU/Marie Curie)
Dr. P. Sonnentrucker (ESTEC)
Dr. W. Verschueren (Antwerp, Belgium)

Emeriti

Prof. Dr. A. Blaauw	emeritus professor
Dr. L.L.E. Braes	emeritus assistant professor
Prof. Dr. J.M. Greenberg	emeritus professor
Dr. M.S. de Groot	guest collaborator
Dr. I. van Houten-Groeneveld	guest collaborator
Dr. C.J. van Houten	guest collaborator
Dr. K.K. Kwee	guest collaborator
Prof. Dr. A. Ollongren	emeritus professor
Prof. Ir. C. van Schooneveld	emeritus professor
Dr. J. Tinbergen	emeritus associate professor

Ph.D. students

The Dutch system distinguishes between three different types of funding individual Ph.D projects: "assistant research trainee" or "AIO", "research trainee" or "OIO", and "grant-graduate student" or "beurspromovendus".

Drs. A. Boonman	OIO
Drs. F. van Broekhuizen	AIO (NOVA)
Drs. M.R. Cioni	AIO
Drs. V. de Heij	AIO
Drs. J.M.T. van der Heijden	AIO (funded 50% by Schuurman Schimmel-van Outeren Foundation)
Drs. B. Heijligers	AIO (funded 50% by Fokker Space)
Drs. M. Haverkorn	OIO
Drs. J. Jörgensen	AIO (NOVA)
Drs. K. Kraiberg-Knudsen	AIO (NWO)
Drs. D. Krajnovic	AIO (NOVA)
Drs. J. Kurk	AIO
Drs. I. Labbé	AIO (NWO)
Drs. P. Lacerda	AIO (NWO)
Drs. M. Messineo	AIO (NOVA)
Drs. G. Muñoz Caro	Beurspromovendus (Max Planck)
Drs. I. Pelupessy	AIO (NWO)
Drs. M. Reuland	AIO (UL/Livermore)

Drs. K. Pontoppidan	AIO (NOVA)
Drs. R. Ruiterkamp	OIO (SRON)
Drs. C. Shen	AIO (World Lab)
Drs. W.F.D. Thi	AIO
Drs. T. Thomas	AIO
Drs. W. Tschager	AIO
Drs. B. Venemans	AIO (NOVA)
Drs. E. Verolme	AIO
Drs. G. Verdoes-Kleijn	AIO (UL/STScI)
Drs. W. Vlemmings	OIO
Drs. G. van Zadelhoff	AIO
Drs. F. Favata	guest collaborator (ESTEC)
A. Holl	guest collaborator (Hungary)
Drs. S. de Koff	guest collaborator
Drs. Y. Simis	guest collaborator

NEVEC staff

Dr. L. d'Arcio	postdoc (SRON)
Dr. Ir. E. Bakker	NEVEC manager
Dr. D.A.P. Hartmann	scientific programmer
Dr. J. de Jong	scientific programmer
Dr. I. Percheron	research scientist
Dr. J. Meisner	research scientist

Computer staff

Drs. T. Bot	programmer
Dr. E.R. Deul	manager computer group
Dr. D. J. Jansen	scientific programmer
A. Vos	programmer

Technical staff employed by NFRA

R.J. Pit	telescope and electronics technician (La Palma)

Technical and administrative staff

K. Weerstra	administrative officer (NFRA)

Secretarial staff

K. Kol-Groen	secretary
J.G.C. Slegtenhorst	secretary
J.R. Soulsby-Pitts	secretary
M. Zaal	secretary

Astronomy & Astrophysics office

Prof. Dr. H.J. Habing	editor
Dr. J.K. Katgert-Merkelijn	assistant editor
F. Sammar	student assistant
B. Smit	secretary
Dr. A. Verpoorte	editorial assistant

NOVA office

Prof. Dr. P.T. de Zeeuw	director
Dr. W.B. Boland	adjunct directeur (0.5) (NWO/NOVA)
R.T.A. Witmer	financial controller (0.2) (UL/FWN)
M. Zaal	management assistant

Senior students

J. Arts
W. Claus (Gent)
B. van Dam
G. Dirksen
F. Faas
M. Hartendorp
R. Heijmans
O. Janssen
M. Kloppenburg
G. Kosters
T. Kouwenhoven
R. Meijerink
M. van Mil
J. Novozamsky
R. Overzier
S.J. Paardekoper
W. van Reeven
F. Samar
D. Schitzeler
(U. Shimron)
M. Smit
L. van Starkenburg
G. van de Ven
A. Verhoeff
S. Veijgen
A. van der Wel

Visitors in 2000

	from	**to**
Prof. Dr. N. Evans (Univ. Texas)	January 17	July 17
Prof. Dr. P.O. Vandervoort (Univ. Chicago)	March 17	June 13
Dr. R. Ortiz (NWO beurs, Sao Paolo)		April 1
Dr. S. Doty (Denison University)	May 15	August 15
Prof. Dr. R. Genzel (J.H. Oort Fonds)	April 16	May 24
Dr. W.D. Cotton (NWO beurs, NRAO)		July 1
Prof. Dr. J. van Gorkum (Columbia Univ.)	July 1	August 31

Staff changes in 2000

	coming	**leaving**
Drs. B. Heijligers (UL, Fokker)		January 1
Drs. P. van der Heijden (UL, SSvH St)	January 1	
Dr. B. Menesson (NEVEC)	January 7	August 31
Drs. F. van der Tak (NWO)		January 31
Drs. R. Hoogerwerf (NWO)	January 31	
Dr. I. Kamp (EU Marie Curie)	February 1	
Dr. J. de Jong	February 1	
Dr. L. d'Arcio (SRON)	February 1	
Drs. R. Dijkstra (NWO)	February 16	
Drs. I. Labbé (NWO)	March 1	
Drs. K. Kraiberg-Knudsen (NWO)	April 1	
T. Bot (UL)	April 1	
Dr. P. Best (EU TMR)		April 26
Dr. H. Fraser (UL/NOVA)	May 1	
Dr. H.-S. Zhao (UL)		May 31
Dr. F. Schöier-Larsen (UL)	July 1	
Dr. G. Mellema (KNAW)	July 1	
Drs. Y. Simis (UL)		July 14
Dr. I. Salamanca (EU fellow)		July 31
Drs. P. Lacerda (NWO)	August 1	
Dr. A. Helmi (UL)		August 31
Dr. R. Klessen (UL)		August 31
Dr. P. Papadopoulos (EU TMR)		August 31
	November 1	
Drs. D. Krajnovic (UL/NOVA)	September 1	
Drs. I. Pelupessy (NWO)	September 1	
Drs. B. Venemans (UL/NOVA)	October 1	
Drs F. van Broekhuizen (UL/NOVA)	October 1	
Dr. M. Jarvis (EU TMR)	October 1	
Drs. A. Verpoorte (AandA)	October 16	
Drs. K. Pontoppidan (UL/NOVA)	November 1	
Drs. J. Joergensen (UL/NOVA)	November 1	
Dr. N. Foerster-Schreiber (NWO)	December 1	
Dr. E. Bakker (NEVEC)	December 31	

Appendix II

Committee membership

Sterrewacht
Leiden

Committee membership

Appendix II

II.1 Observatory committees

Board of directors

G.K. Miley (scientific director)
M. Franx (director of education)
H.J. Habing (vice-director)
J. Lub (secretary)

Observatory management team

G.K. Miley (chair)
H.J. Habing (vice-chair)
E. Deul
M. Franx
J. Lub
F.P. Israel
N. van Wijngaarden (administration)
J. Drost (minutes)

Research committee

E.F. van Dishoeck (chair)
M. Bureau
W.B. Burton (until September 1)
M. Franx
V. Icke
W. Jaffe
J. Luu (as of September 1)
H.J.A. Röttgering

Astronomy education committee

M. Franx (chair, until September 1)	P. Katgert (chair, as of September 1)
A. Boonman	K. Kol
F. P. Israel	P.P. van der Werf
W. Jaffe	P.T. de Zeeuw
C. van Breukelen	T.P.C. Nieuwenhuizen
B. Clauwens	G. van de Ven
M. Kriek	A.M. Weymans

Astronomy examination committee

M. Franx (chair as of September 1)	P.P. van der Werf
F.P. Israel	P.T. de Zeeuw
G. Nienhuis	

Library committee

W. Jaffe (chair)	A.M. van Genderen
J. Lub	M. Messineo

Computer committee

P. Katgert (chair)	
P. Best (until March)	F. van der Tak
Y. Simis	P.P. van der Werf
J. Soulsby	P.T. de Zeeuw

Research institute scientific council

E. Deul
E.F. van Dishoeck
M. Franx
A.M. van Genderen
H.J. Habing
V. Icke
F.P. Israel
W. Jaffe
P. Katgert
J. Lub
F. Baas
J. Luu
G.K. Miley
R.S. Le Poole
M.A.C. Perryman
H.J.A. Röttgering
R.T. Schilizzi
W. Schutte
R.P.W. Visser
P.P. van der Werf
P.T. de Zeeuw

Institute council

E. Deul (chair)
F.P. Israel
A. van der Meer
E. Verolme (secretary)
V. de Heij (secretary)
W. Jaffe
J. Soulsby

Public contact committee

V. Icke (chair)
V. de Heij
W. Vlemmings
F.P. Israel
P. van der Heijden

Graduate student review committee

H.J. Habing (chair)
M. Franx
W. Boland (NWO)
P.P. van der Werf

Social committee

G. Dirksen
M. Haverkorn
G. Mellema
R. Overzier
R. Le Poole
M. Zaal

II.2 University committees

Burton

Member, Overlegcommissie Opleidings Directeuren, Faculteit W & N
Member, Gemeenschappelijke Opleidings Commissie, Natuur- en Sterrenkunde

van Dishoeck

Member, Faculty Research Committee (WECO)
Member, Raad van Toezicht, Leiden Institute of Physics (LION)

Franx

Member, Committee of Education Directors, School of Sciences (as of September 1)

van Genderen

Member, lecture scheduling committee

Habing

Member, special advisory board of Dean
Member, Organisational committee for the celebration of the 425th birthday of Leiden University
Member, Board of the Space Research Organization in the Netherlands (SRON) (until August 1)
Member, KNAW subcommission for the recognition of research schools in physics, mathematics and astronomy
Chair, Chamber for Astronomy, VSNU
Chair, Nederlandse Astronomen Club

Icke

Member, Belvédére Steering Committee
Member, Committee ICT & WO
Member, Wervingsoverleg W & N
Member, LAPP-Top Steering Committee

Israel
Member, Joint Education Committee Physics and Astronomy

Jaffe
Member, Board Centre for scientific computing in Leiden
Member, Faculty Library Committee

Lub
Member, Public Relations Comittee Faculty W&N

Luu
Member, Sackler committee

Miley
Member, Overlegcommissie Wetenschappelijke Directeuren Faculteit W & N

Ollongren
Member, Committee Higher Education for Elderly People

Perryman
Member, Committee, NOVA Graduate School in Astronomy

Le Poole
Member, Search Committee for new chair Technical Astronomy/Optical Interferometry

Schutte
Chair, Safety Committee Huygens Laboratory, Oortgebouw, and Kamerlingh Onnes Laboratory

van der Werf
Organist, Academy Auditorium

de Zeeuw

Member, Advisory Committee Lorentz Professor, Leiden University
Member of the Board, Department of Mathematics, Leiden University
Member, Advisory Committee Kloosterman Professor, Leiden University
Chair, Advisory Committee Oort Professor, Leiden University
Member, Faculty Committee on Development of New Academic Tenure System
Member, Education committee, Sterrewacht Leiden
Member, Computer committee, Sterrewacht Leiden

Appendix III

Science policy functions

Science policy functions

Appendix III

Burton

Chairman, Editorial Board, Astrophysics and Space Science Library, Kluwer Academic Publishers

Director, Leids Kerkhoven–Bosscha Foundation (until September 1)

Director, Jan Hendrik Oort Foundation (until September 1)

Director, Leids Sterrewacht Foundation (until September 1)

Chairman of Board, Expertisecentrum for Astronomical Image processing

Chairman, Appointment Advisory Committee, Oort Visiting Professorship (until September 1)

Member, Supervisory Committee, Oort Adjunct Professorship

Member, Board of Curators, Adjunct Professorship in Cosmology, Beta Plus Foundation, University of Amsterdam

Member, Appointment Advisory Committee, Leiden University Foundation Adjunct Professorship

Deul

Member, DENIS project team

Member, EIS project team

van Dishoek	Member, JCMT Board
	Member, SRON Science Advisory Committee
	Member, SRON Board
	Vice-chairman, ALMA Science Advisory Committee
	Member, ESA Astronomy Working Group
	Member, ESA–NGST Science Study Team
	Member, NASA–NGST Ad Hoc and Interim Science Working Groups
	Chairman, IAU Working Group on Astrochemistry
	Member, Organising Committee of IAU Commission 34 on Interstellar Matter
	Chairman, Working Group 5 on Molecular Data, IAU Commission 14
	Member, FIRST–HIFI Science team
	Member, VLT–VISIR Science team
	Member, U.K. Royal Society of Chemistry, Astrophysical Chemistry Committee
	Member, Scientific Advisory Board of New Astronomy
	Member of the Board, J.C. Kapteyn and Pastoor Schmeits Foundations
	Member, Scientific Organising Committee, Joint Discussions 1 and 3, IAU General Assembly, Manchester, UK
Ehrenfreund	Member, Working Group: Laboratory studies of cosmic material; International Space Science Institute ISSI
	Member, European Exobiology Network Core Steering Group
	Member, IAU Working Group on Astrochemistry
	Member, ESSC/ESF Working Group Life Science/Exobiology 2000
	Convener, European Geophysical Society 2000, Session: Laboratory Space Studies in the new millenium
	Convener, COSPAR 2000: Session: Extraterrestrial organic chemistry: From the interstellar medium to the origin of life
	Discipline Editor, Planetary and Space Science

Franx	Member, ESO Science and Technology Committee Member, STC working group 2nd generation VLT instruments Member, ESO contact committee Member, Advanced Camera for Surveys Science Team Member, Nova Fellowship committee Member, Nova Instrument Steering Committee Member, Sinfoni Science Team Member, ESO-Omegacam science team
Fraser	Member, Young Physicists Committee, Institute of Physics, UK
van Genderen	Member, Secretary, Dutch Program Committee for the Dutch 90-cm telescope on La Silla, Chile Member, Indonesia/Netherlands Astrophysics Collaboration, as part of the Cultural Exchange between the two countries
Habing	Editor-in-Chief, Astronomy & Astrophysics Chairman Advisory Commitee on Astronomy, Board of the Exact Sciences, NWO
Icke	Member, National Committee on Astronomy Education Member, Minnaert Committee (NOVA Outreach) Member, Netherlands Astronomical Society Education Committee Member, *Natuur & Techniek* Editorial Council Member, Board of Directors, National Science Museum NEMO
Israel	Member, IAU Commissions 28 and 51 Member, Editorial Board Euro Physics News, European Physical Society Member, Noordwijk Space Expo Foundation (NSE) Exposition Committee

Katgert	Secretary/Treasurer, Leids Sterrewacht Fonds Secretary/Treasurer, Jan Hendrik Oort Fonds Secretary/Treasurer, Leids Kerkhoven-Bosscha Fonds
Lub	Director, Leids Sterrewacht Foundation Director, Leids Kerkhoven–Bosscha Foundation Director, Jan Hendrik Oort Foundation Substitute Member ESO Observing Programs Committee Member ESO Contact Committee Secretary Nederlands Comité Astronomie Secretary Kamer Sterrenkunde van de VSNU
Miley	Chairman, Space Telescope Users Committee Chairman, Netherlands National VLTI Team Principal investigator, NOVA/VLTI Programme Member, ESO Visiting Committee Member, Dutch National Science Team, VISIR Member, Science Team, Advanced Camera for Surveys on the HST Member, Board of Stichting ASTRON Member, Board of NOVA Member, Board of EARA Member of the KNAW Leiden PI, EU TMR Programme: European Large Area ISO Survey (ELAIS) Leiden PI, EU TMR Programme: Formation and Evolution of Galaxies Representative, NOVA/VLTI Implementation Committee Member, ESO Observing Programme Committee Cosmology Panel
Ollongren	Member, SETI Committee International Astronautical Academy Member, IAU Commissions 7, 33 and 56
Perryman	Chairman, GAIA Science Advisory Group Member, Council European Astronomical Society

Le Poole	Project Scientist NEVEC
	Member, Management Team NEVEC
	Member, Dutch VLTI Team
	Member, Dutch Joint Aperture Synthesis Team
	Member, MIDI Team
Röttgering	Deputy coordinator of the European Association for Research in Astronomy (EARA)
	Leiden coordinator of the EU programme *Training and Mobility of Researchers, The Formation and Evolution of Galaxies*
	Principal investigator Leiden, European Research and Training Network *The Physics of the Intergalactic Medium*
	Member, Dutch Joint Aperture Synthesis Team (DJAST)
	Member, Netherlands VLTI team
	Member, Mid-Infrared interferometric instrument for VLTI (MIDI) Science Team
	Member, NASA's Terrestrial Planet Finder Science Team
	Member, Science Advisory Group on ESA's InfraRed Space Interferometer DARWIN
	Member, LOFAR Study committee
	Member, VISIR Science team
	Member, Omegacam Science team
	Member, Panel of LUF Internationaal Studie Fonds (LISF)
	Member, XMM Large Scale structure Consortium
	Member, ASTRON Observing Programme Committee
	Member, Scientific organising committee, Leiden Summer school School on Space and Ground Based Optical/InfraRed Interferometry
	Member, Scientific organising committee of conference *Emission lines from Jet Flows*, Isla Mujeres, Mexico
Schilizzi	Director, Joint Institute for VLBI in Europe
	Member, Editorial Board, Experimental Astronomy

Schutte

Member, Working Group: *The role of laboratory experiments in the characterisation of cosmic material*, ISSI, International Science Institute, Bern, Switzerland

van der Werf

Member, ESO User's Committee

Principal Investigator, NOVA-SINFONI

Member, EC - TMR Network *Sky surveys with ISO*

Member, European Large Area ISO Survey (ELAIS) team

Team Leader, EC - RT Network *Probing the origin of the extragalactic background* (POE)

Member, Next Generation Space Telescope IFMOS Study team

Member, SINFONI Science team

Member, VISIR Science team

Co-investigator, HIFI

Member, steering committee ISO data centre Groningen (DIDAC)

Member, JCMT Advisory Panel

Member, NOVA wide-field imaging team

Member, NOVA millimetre interferometry team

Member, Preliminary Design Review board, SINFONI adaptive optics unit

Member, Conceptual Design Review board, ESO-MACAO for VLTI

de Zeeuw

Member, Scientific Advisory Board of *New Astronomy*

Vice-chairman, Space Telescope Institute Council

Member, Commission 28 (Galaxies) of the International Astronomical Union

Member, ESA Science Advisory Group for the GAIA Mission

Member, IFMOS Study Consortium for ESA contributions to NGST

Chairman, Isaac Newton Group Board

Chairman, Interim Visiting Committee STScI

Member, OPTICON Board

Member, SINFONI Science Team (MPE&ESO)

Leiden University Member Representative to AURA

Member, ESO/OPTICON Science Working Group for Extremely Large Telescopes

Member, SOC of Conference on *Stellar Dynamics: From Classic to Modern*, St. Petersburg

Member, National Committee Astronomy

Member, Steering Committee Lorentz Center

Member, Board of Directors, Leids Kerkhoven Bosscha Fonds

Member, Board of Directors, Leids Sterrewacht Fonds

Member, Board of Directors, Oort Foundation

Member, Scientific Advisory Committee, SRON

Member, Advisory Committee for Astronomy, NWO

Member, Evaluation Committee for Space Research in the Netherlands, NWO&KNAW

Director, Netherlands Research School for Astronomy, NOVA

Appendix IV

Visiting scientists

Sterrewacht Leiden

Visiting scientists

Appendix IV

Name	Dates	Institute
Dr. M. Capellari	Jan 3 – Feb 6	University of Padova, Italy
Dr. M Putman	Jan 4 – 7	Mount Stromlo, Weston Creek, Australia
Dr. P. Rosati	Jan 13 –14	ESO, Garching, Germany
Dr. S. Charnley	Jan 13 – 26	NASA AMES, USA
Prof. Dr. N. Evans	Jan 17 – Jul 17	University of Texas, TX, USA
G. Rudnick	Feb 7 – 11	MPA Heidelberg, Germany
Y. Shirley	Feb 9 – 20	University of Texas, TX, USA
F. Menanteau	Feb 14 – 15	Cambridge University, UK
B. Terzić	Feb 17 – Aug 1	University of Florida, FL, USA
Drs. G. Wilson	Mar 1 – Jun 30	Mount Stromlo, Weston Creek, Australia
Dr. A. Biviano	Mar 13 – Mar 20	Osservatorio Astronomico di Trieste, Italy
Dr. D. Jaffe	Mar 13 – 20	University of Texas, TX, USA
Prof. Dr. P. Vandervoort	Mar 15 – Jun 15	University of Chicago, IL, USA
Dr. M. Capellari	Apr 15 – May 6	University of Padova, Italy
Prof. Dr. W. Evans	Apr 17 – 29	Oxford University, UK, USA
Drs. R. Moody	Apr 21 – May 19	Mount Stromlo, Weston Creek, Australia
Dr. S. Blais-Ouelette	Apr 24 – May 2	Lawrence Livermore National Laboratory, CA, USA

Name	Dates	Institute
Prof. Dr. C. Hunter	Apr 24 – May 6	Florida State University, FL, USA
Dr. J. Horn	May 1 – 5	University of California at LA, CA, USA
Dr. J. Rawlings	May 8 – 12	University of California at LA, CA, USA
Dr. A. Lim	May 10 – 17	UCL London, UK
Dr. F.C. van den Bosch	May 10 – 12	University of Seattle, WA, USA
Drs. G. Rudnick	May 15 – 18	MPIA, Heidelberg, Germany
Dr. S. Doty	May 15 – Aug 1	Metropolitan State College, Denver, CO, USA
Prof. Dr. L.A. Aguilar	May 22 – 27	Observatorio Astronomico Nacional, San Ysidro, CA, USA
F. Heitsch	Jun 1 – Jun 4	MPIA, Heidelberg, Germany
Drs. H. Cottin	Jun 9	Université Paris XII, France
Drs. C. Szopa	Jun 9	Université Paris XII, France
Prof. Dr. W. Shane	Jun 13	University of California, CA, USA
Dr. D. Chochol	Jun 18 – 23	Skanaté Pleso Observatory, Slovakia
Dr. P. Lundqvist	Jun 24 – Jul 1	Stockholm Observatory, Sweden
Dr. A. Moorwood	Jun 26	ESO, Garching, Germany
Drs. G. Rudnick	Jun 26 – Jul 7	MPIA, Heidelberg, Germany
Prof. Dr. H.W. Rix	Jun 26	MPA Heidelberg, Germany
Prof. Dr. J. van Gorkom	Jul 1 – Aug 31	Columbia University, New York, NY, USA
Dr. S. Ridgeway	Jul 3 – 7	NOAO, Tucson, USA
Dr. B. Leibundgut	Jul 3 – 14	ESO, Garching, Germany
I. Montilla	Jul 3 – Aug 31	TUD, Delft, The Netherlands
Dr. M. Spaans	Jul 5 – Aug 31	Center for Astrophysics, Cambridge, MA, USA
Dr. N. Förster Schreiber	Jul 10 – 12	Centre d'études astrophysiques, Saclay, France
Prof. Dr. D. Johnstone	Jul 15 – Sep 1	University of Toronto, Canada
Dr. R. Ivison	Jul 17 – 28	University College London, UK
Dr. H. de Ruiter	Jul 17 – 31	Osservatorio Astronomico di Bologna, Italy
Dr. R. van der Marel	Jul 19 – Aug 26	STScI Baltimore, MD, USA

Name	Dates	Institute
Dr. L. Sjouwerman	Jul 31	JIVE, Dwingeloo, The Netherlands
Dr. M.A. Jalali	Jul 31 – Sep 12	Sharif University of Technology, Zanjan, Iran
F. Heitsch	Jul 31 – Aug 6	MPIA, Heidelberg, Germany
Dr. J. Blommaert	Aug 1 – 3	VILSPA, Madrid, Spain
I. Matsuyama	Aug 7 – 16	University of Toronto, Canada
Prof. Dr. T. Gehrels	Aug 17	Lunar Planetary Laboratory, Tucson, AZ, USA
M. Metzger	Aug 28	Caltech, Pasadena, USA
Dr. Y. Aikawa	Aug 29 – Sep 23	Kobe University, Tokyo, Japan
Dr. N. S. van der Bliek	Sep 11 – 15	CTIO, La Serena, Chile
Prof. Dr. N. Evans	Sep18 – 24	University of Texas, TX, USA
Dr. V. Debattista	Oct 4 – 6	University of Basel, Switzerland
Dr. E. Dartois	Oct 16 – 20	IRAM, Grenoble, France
Prof. Dr. M. Walmsley	Oct 23 – 27	Osservatorio Astronomico di Arcetri, Firenze, Italy
Dr. P. van Dokkum	Oct 23 – 28	Caltech, California, USA
G. Rudnick	Oct 27 – Dec 1	MPIA, Heidelberg, Germany
Dr. W. van Breugel	Nov 6 – 9	LLNL, Livermore, CA, USA
Dr. R. Hudec	Nov 18 – 24	Ondrejov Observatory, Prague, Czech Republic
D. G. Fabricant	Nov 24 – 27	SAO, Cambridge, MA, USA
Prof. Dr. H.W. Rix	Nov 30	MPA Heidelberg, Germany
Dr. A. Moorwood	Nov 30	ESO, Garching, Germany
Dr. E. Dartois	Dec 20 – 22	IRAM, Grenoble/IAS Paris, France

Appendix V

Lectures, colloquia and workshops

Sterrewacht Leiden

Lectures, colloquia and workshops

Appendix V

This appendix includes the endowed lectures given by distinguished speakers, the regular colloquia series as well as the programmes of workshops held in Leiden.

V.1 Endowed lectures

Date	**Speaker (affiliation)**	**Title**
April 27	Prof. R. Genzel (MPE, Garching)	Oort lecture: *Black Holes in the Centres of Galaxies: Fact or Fiction?*
August 15	Prof. M.A.C. Perryman (Leiden)	*Invited Discourse at the International Astronomical Union General Assembly 24, Manchester; UK*
November 21	Prof. S. Lilly (Herzberg Institute of Astrophysics, Victoria, Canada)	Sackler lecture: *Evolution of Galaxies*

V.2 Scientific colloquia

The Leiden Observatory Colloquia are generally held weekly, on Thursday afternoon at 16:00 hours, preceded by an Astronomers' Tea at 15:30 hours. In 2000 the colloquium series was organized by Paul van der Werf and Jane Luu.

Date	Speaker (affiliation)	Title
January 27	R. Vermeulen (NFRA, Dwingeloo)	*The sub-kpc environment of young extra-galactic radio sources*
February 3	L. Pentericci (MPIA, Heidelberg)	*The most distant radio galaxies: probes of massive galaxy formation*
February 10	K. Dullemond (MPA, Garching)	*Two-dimensional radiative transfer in circumstellar nebulae*
February 17	R. Morganti (NFRA, Dwingeloo)	*Radio plasma and ionized gas in radio galaxies: a lively cohabitation?*
February 24	I. Salamanca (Sterrewacht, Leiden)	*Type IIn Supernovae*
March 2	L. Koopmans (Kapteyn Laboratorium, Groningen)	*Microlensing of multiply imaged compact radio sources: evidence for MACHOs at* $z \approx 0.4$
March 9	N. Evans (University of Texas, Austin)	*Can we prove that stars form by gravitational collapse?*
March 16	C. Beenakker (Universiteit Leiden)	*Quantum chaos*
March 23	H. Dickel (University of Illinois)	*Molecules in interstellar space*
March 30	P. Westbroek (Gaia Science Centre, Leiden)	*Life as a geological force*
April 6	N. Langer (Universteit Utrecht)	*Progenitor models for Type Ia supernovae*
April 13	P. Diamond (Jodrell Bank)	*Making movies of stars: VLBI studies of the structure, evolution and physics of circumstellar envelopes*
May 1	S. Blais-Ouellette (Lawrence Livermore National Laboratory)	*Accurate Parameters of the Mass Distribution in Spiral Galaxies*
May 18	R. Hoogerwerf (Sterrewacht, Leiden)	*The origin of runaway stars*
May 23	H. J. Fraser (Leiden University)	*From Gases to Dust: Surface Interactions in the Interstellar Medium*
June 8	P. Veen (Sterrewacht, Leiden)	*Intriguing variability of WR46 and of dusty Wolf-Rayet stars*

Date	Speaker (affiliation)	Title
June 15	J.H.J. de Bruijne (ESA/ESTEC)	*Astrometry from space: a Hipparcos study of young stellar groups*
June 22	A. Helmi (Sterrewacht, Leiden)	*The formation of the galactic halo*
June 29	P. Best (University of Edinburgh)	*The nature of radio galaxies and clusters in the early universe*
July 20	R. Klessen (Sterrewacht, Leiden)	*Towards a consistent picture of star formation*
October 5	V. Debattista (University of Basel)	*Dynamical Friction and the Dark Matter Content of Barred Galaxies*

V.3 Student colloquia

Date	Speaker	Title
February 9	Ivo Labbé	*A protogalaxy at z=2.72 gravitationally lensed by the cluster MS 1512+36*
June 26	Frodo Wesseling	*The Shroud Around NGC 1052*
August 17	Roderik Bouter	*OH-IR stars and Wolf-Rayet stars*
August 18	Katrien Steenbrugge	*Determining radial velocities of the early type stars in the Perseus OB2 association*
August 21	Danny Pronk	*Finding H_0, dark matter and a supermassive black hole with gravitational lensing*
August 24	Martijn Kamerbeek	*The evolution of dusty galaxies*
October 16	Arjen van der Meer	*DREAM, an enhanced observing mode for SCUBA*

V.4 Workshops

V.4.1 Oort Workshop 2000

From April 17 to 20, a workshop entitled *Black Holes: Evidence, Evolution and Future Prospects* was organized in the Lorentz Center by the 2000 Oort professor Genzel, together with van Dishoeck. The workshop had an interdisciplinary character, with topics ranging from astronomical observations to theoretical physics. Evidence for massive black holes near the center of galaxies was extensively discussed, and the first evidence for accelerations of stars near the black hole in the centre of our own Galaxy was presented by Ghez (UCLA). The theory of stellar mass black holes such as observed in X-ray binaries, the physics near black holes, and the role that black holes play in cosmic evolution, were reviewed. Highlights also included the review talk by 't Hooft (UU) on black holes and particle physics, and by Schultz (MPI, Potsdam) on gravitational waves. The programme for the workshop follows:

Date	**Speaker (affiliation)**	**Title**
April 17	Genzel (MPE-Garching)	*Black Holes near Centers of Galaxies*
	Ghez (UCLA)	*New observations of SgrA*: evidence for accelerations*
	Moran (Harvard)	*Evidence for Massive Black Holes: VLBI Observations*
	P.T. de Zeeuw (Leiden)	*Evidence for Massive Black Holes in Nearby Galactic Nuclei*
	R. Bacon (Lyon)	*A Supermassive Black Hole and Asymmetries in the M31 Double Nucleus*
	Discussion session I	
	R. van der Marel (StScI)	*Intermediate Mass Black Holes*
	K. Rauch (Johns Hopkins)	*Black Holes in Nuclear Clusters: Pinpointing the Point Mass*
	H. Netzer (Tel Aviv)	*M-L Relationship for Active and Dormant Black Holes*

April 18	R. Sunyaev (MPIA-Garching)	*The ways to distinguish an accreting black hole from a neutron star in a low mass X-Ray binary: theory versus observations*
	E.P.J. van den Heuvel (UvA)	*X-ray Binaries, Gamma Ray Bursts and the formation of stellar mass black holes*
	Discussion session II	
	A. Loeb (Harvard)	*Was the Universe First Ionized by Stars or Quasars?*
	M. Haehnelt (MPIA-Garching)	*Cosmic Evolution of Massive Black Holes*
	G. Hasinger (Potsdam)	*X-ray Observations of Black Holes*
	Discussion session III	
April 19	R. Narayan (Harvard)	*Physics of Black Hole Accretion at Low Mass Accretion Rates*
	R. Blandford (Caltech)	*Adiabatic Accretion and Mass Loss*
	Discussion session IV	
	A. Fabian (Cambridge)	*Broad iron lines and accretion disks around black holes*
	Discussion session V	
April 20	E. Maoz (Nasa-Ames Research Center)	*Stellar Dynamical Constraints on Alternatives to Supermassive Black Holes*
	G. 't Hooft (Utrecht)	*Black Holes and Particle Physics*
	B. Schutz (MPI-Potsdam)	*Listening to black holes with gravitational waves*
	Final discussion	*How to go from here?*
	Informal discussion	
	End of workshop	

V.4.2 NOVA/LEIDEN/NEVEC/ESO/ESA Workshop: Summer school on Space and Ground based Optical & Infrared Interferometry

The Leiden Observatory organised conjointly with NOVA, NEVEC, ESA and ESO a Workshop on *Space and Ground based Optical & Infrared Interferometry* (September 18–22), with the goal of contributing to the formation of the young generation researchers who, eventually, will design and use the existing and future optical/IR interferometers. The programme was as follows below. The workshop notes are available at `http://www.strw.leidenuniv.nl/~nevec/summerschool_2000/`.

Date	**Speaker (affiliation)**	**Title**
Sept 18	Lena (Paris)	*Principles of interferometry*
	Quirrenbach (UCSD)	*Interferometry and astrometry*
Sept 19	Quirrenbach (UCSD)	*Overview of existing instruments around the world*
	Haniff (MRAO)	*The COAST interferometer*
	Paresce (ESO), Waters (Amsterdam)	*A science overview of optical interferometry*
Sept 20	Léger (IAS), Lund (Alcatel)	*The Infrared Space Interferometer: Darwin*
	LePoole (Leiden)	*Global astrometry with GAIA*
Sept 21	Glindemann (ESO)	*A VLTI overview*
	Leinert (MPIA)	*MIDI: the VLTI mid-infrared instrument*
	Cotton (NRAO)	*What the experience of radio-interferometry tells us*

V.4.3 ALMA Science Advisory Committee Meeting

During March 10 and 11, the first North-American – European ALMA Science Advisory Committee meeting took place in Leiden, chaired by Evans (Univ. of Texas/Leiden) and hosted by van Dishoeck. More than 30 scientists, including representation from Japan, reviewed for two days the various scientific and technical aspects of the joint 2-way ALMA project.

V.4.4 FIRST-HIFI Consortium Meeting

From March 23 to 24, Leiden Observatory hosted a two-day consortium meeting to review the design and development of the heterodyne receivers for the HIFI instrument on FIRST, as well as the science case and preparatory studies. This meeting was attended by about 30–50 scientists from about 10 European countries and from North America.

V.4.5 ALMA Science and Technology Day

On April 7, Leiden Observatory hosted an ALMA *Science and Technology Day*, organized by van Dishoeck. The purpose of the meeting was to discuss the ALMA science case from the Dutch perspective, stimulate science with (sub)millimeter arrays in general, inform the community at large on the status of the project and the technical developments for ALMA in the Netherlands, and stimulate interaction between Dutch scientists and technical groups. The meeting was attended by more than 60 participants from the universities and technical institutes.

V.4.6 Star Formation with the SIRTF satellite

During July 10 and 14, a workshop was organized by Evans (Univ. of Texas/Leiden) and van Dishoeck at the Lorentz Center to discuss studies of the formation of stars and planets using the Space Infrared Telescope Facility (SIRTF). A group of experts on star and planet formation was assembled to plan a Legacy program in this area. The activities included presentations on the various areas of research, the selection of a preliminary list of targets, and planning for the processing of data. The resulting proposal, *From Molecular Cores to Planet-Forming Disks*, was one of the 6 Legacy programs selected in November 2000. The workshop at the Lorentz Center was instrumental in the success.

V.4.7 Modelling Interstellar Chemistry

From October 16 to 27, a two-week workshop on the modelling of interstellar chemistry was organized by Millar (UMIST, UK), with participation from several Leiden staff members, postdocs and PhD students. The topics included laboratory studies, future observational instrumentation, radiative transfer, computational techniques, bistability in chemical models, hydrodynamics of reactive flows, gas-grain interactions and theoretical chemistry. Discussion groups were aimed on issues ranging from the chemistry of oxygen to the provision of codes and fundamental data to the wider community. Also, test calculations were set up during the meeting to investigate the consistency among different codes.

V.4.8 ISOGAL coordination

From April 10 to 14, a workshop was held in the Lorentz Center on *coordination of the ISOGAL research*, organized by Habing and Messineo. ISOGAL is a mid-infrared survey of selected fields along the Galactic Plane and Bulge performed with the ISO satellite by a large consortium of astronomers spread over at least 4 continents.

The purpose was to coordinate the work of the ISOGAL teams and all the ISOGAL-related researches. The data reduction was reviewed and plans were developed for the publication of the new catalogues. The workshop was attended by 22 people. The programme was as follows:

Speaker (affiliation)	**Title**
Bertoldi Frank (MPIFR, Bonn)	*Young stellar objects and diffuse emission*
Blommaert Joris (VILSPA, Madrid)	*ISOGAL CVF measurements of the Bulge fields*
Bressan Alessandro (Padova Observatory)	*Spectra and colors of Mgiant stars*
Burgdorf Martin (VILSPA, Madrid)	*Results from GPSURVEY*
Cohen Martin (Univ. of California)	*The SKY model*
Cioni Maria Rosa (Leiden Observatory)	
Egan Michael (AFRL/VSBC, Hanscom AFB, USA)	
Gilmore Gerry (Institute of Astronomy, Cambrigde)	*Galactic Structure*
Glass Ian (SAAO, South Africa)	*Properties of Semi-regular Variables from ISOGAL and MACHO Observations*
Gredel Ronald (MPIA, Heidelberg)	
Groenewegen Martin (MPE, Garching)	
Habing Harm (Leiden Observatory)	*AGB and RGB stars*
Loup Cecile (IAP, Paris)	
Messineo Maria (Leiden Observatory)	
Omont Alain (IAP, Paris)	*General features of AGB stars in ISOGAL data*
Ortiz Roberto (Leiden Observatory)	
Picaud Sebastien (Observatoire de Besan con)	
Robin Annie (Observatoire de Besan con)	
Schultheis Mathias (IAP, Paris)	

Speaker (affiliation)	**Title**
Schuller Frederic (IAP, Paris)	*Young stellar objects in the field (l;b)=(−0.27;−0.03)*
Simon Guy (IAP, Paris)	*Status of the data reduction, calibration and croscorrelation*
Winnberg Anders (Onsala Space Observatory, Onsala)	

Appendix VI

Participation in scientific meetings

Participation in scientific meetings

Appendix VI

This appendix lists the attendance of Leiden Observatory staff members at various meetings, together with the titles of presentations (in *italics*) made at the meetings.

Boonman

ISO beyond the Peaks (Villafranca del Castillo, Spain; February 2–4)

"Gas-phase H_2O and CO_2 towards massive protostars"

Young Astrophysicists meeting 2000: Expanding Your Universe (London, UK; March 6)

High Mass Star Formation: An origin in clusters? (Volterra, Italy; May 31–June 3)

"H_2O and CO_2 absorption toward massive young stars"

"First results from the MPIfR/SRON 800 GHz receiver: HCN J=9–8 & CO J=7–6 emission from massive protostars"

Dynamics of Molecular Collisions Relevant to the Evolution of Interstellar Matter (Rehovot, Israel; September 11–15)

"H_2O and CO_2 absorption toward massive young stars"

Copin

Euro3D meeting (Munich, Germany; December 7–8)

"SAURON: a panoramic integral field spectrograph"

Deul

New Era Wide-field Astronomy (Centre for Astrophysics, Preston, UK; August 21–24)
"Observing and data-mining with OmegaCAM"

Survey Systems #1- OPTICON (Royal Observatory Edinburgh,UK; November 2–3)

van Dishoeck

Interstellar H_3^+ (London, UK; February 9–10)
"Limits on the Cosmic Ray Ionization Rate from H_3^+ Observations toward Massive Protostars"

Fourth Tetons Conference on Stars, Galactic Structure and the Interstellar Medium (Grand Tetons, USA; May 29–June 1)
"Chemistry in Quiescent and Star-Forming Molecular Clouds Objects (invited lecture)"

IAU General Assembly, Joint Discussion 1 on Laboratory Astrophysics (Manchester, UK; August 9–11)
"Overview of Mid-Infrared Observatories (invited talk)"

IAU General Assembly, Joint Discussion 3 on Massive Star Birth (Manchester, UK; August 8)
"Chemistry in the Envelopes around Massive Young Stars (invited talk)"

Synchrotrons, Accelerators and Laboratory Astrophysics (Aarhus, Denmark; August 30)
"Atoms, Ions and Molecules in Interstellar Space (invited review)"

Molecular Dynamics in the Interstellar Medium, Summer School (Rehovot, Israel; September 11–15)
"Molecular Processes during Star- and Planet formation (invited lecture)"

The promise of FIRST (Toledo, Spain; December 12–15)
"Molecular Line Surveys of Star-Forming Regions with FIRST (invited review)"

Ehrenfreund

PROSSI Workshop: Photolysis and radiolysis of outer solar system ices (Balti-

more, USA; March 27–29)
“Energetic and thermal processing of interstellar ices”

First Astrobiology Meeting (NASA AMES, USA; April 3–5)

European Geophysical Society (Nice, France; April 25–29)
“Laboratory studies in support of future missions to Mercury”

The role of laboratory experiments in the characterization of cosmic material (Bern, Switzerland; May 8–12)
“Observations of interstellar ices”

Solid State Astrochemistry (Erice, Italy; June 5–16)
“Observations of extraterrestrial ices: Techniques and Results”
“Ice in the laboratory; Future telescopes and space missions”

XII Recontres de Blois: Frontiers of Life (Blois, France; June 25–July 1)
“Interstellar organic chemistry and the origin of life”

ILEUWG Meeting (ESTEC, The Netherlands; July 3–7)
“Exobiology on the Moon”

COSPAR 2000 (Warsaw, Poland; July 17–23)
“Laboratory simulations of ices and organic molecules”
“Extraterrestrial amino acids in the Orgueil meteorite”

IAU General Assembly, The Transneptunian Population (Manchester, UK: August 7–20)
“Composition of comets and interstellar dust”

Observation, Analysis and Theory of Astronomical and Laboratory Spectra (Canterbury, UK: September 6–8)
“Ices observed with ISO”

European Exobiology Network (Paris, France; October 18–19)
“Astrobiology in the Netherlands”

ESSC/ESF Workshop on Life Science (Strasbourg, France; November 28–30)

From the interstellar medium to the solar system (Bern, Switzerland; December 7–8)
“Ices and organic molecules in the interstellar medium, comets and meteorites”

Franx

Galaxy disks and disk galaxies (Rome, Italy; June 12–16)
“Evolution of early-type galaxies”

TMR meeting in Galaxy Evolution (Durham, UK; September 5–9)
"Very deep NIR imaging of the Hubble Deep Field South"

Deep Fields meeting (ESO, Garching, Germany; October 8–12)
"Very deep NIR imaging of the Hubble Deep Field South"

Science with Omegacam (Ringberg, Germany; October 16–18)
"Very deep NIR imaging of the Hubble Deep Field South"

Fraser

The 5th International NATO Advanced Study Summer School in Astrochemistry (Erice, Italy; June 5–16)
"From Gases to Dust: Surface Interactions in the Interstellar Medium"

EuroSummer School on Molecular Dynamics and Collisions in the ISM (Weizmann Institute for Science, Rehovot, Israel; September 10–16)
"The desorption properties of H_2O-ice under interstellar conditions"

The 47th International Symposium of the American Vacuum Society (Boston, USA; October 2–6)
"From Gases to Dust: Ice in an Interstellar Environment"

van Genderen

P Cygni 2000; 400 years of progress (Armagh, Northern Ireland; August 21–23))
"η Carinae: Physical information from photometry"

Greenberg

Deep Impact Crater workshop (Boulder, Colorado, USA; January 31–February 7)

COSIMA Rosetta project meeting (Glorenza/Glurns, Italy; April 9–13)

Leonid Meteor workshop (Tel Aviv, Israel; April 16–22)
"The composition and structure of cometary matter and meteorids"

Solid State Astrochemistry, Int. school of Space Chemistry, 5th course (Erice, Italy; June 5–15)
"Interstellar dust"
"Dust model"
"Comet Dust"

25th Session International Seminars on Planetary Emergencies: Defence against Cosmic Hazards (Erice, Italy; August 18–24)

Synchrotrons, Accelerators and Laboratory Astrophysics (Aarhus, Denmark; August 29–September 1)
"From the laboratory to comets to the origin of life"

Workshop on Life (Modena, Italy; September 3–8)
"Comets and the origin of life"

First steps in the origin of life in the Universe - 6th Trieste conference on Chemical Evolution (Trieste, Italy; September 18–22)
"When and how quickly did life emerge on earth?"

17th World Laboratory meeting (CERN, Geneva, Switzerland; October 13–14)
"Dust evolution in protostellar regions"

Habing

Symposium on the occasion of the 70th birthday of L. Woltjer (Rome, Italy; May 3–5)

Haverkorn

Astrophysical Turbulence (Santa Barbara, USA; May 8–12)
"Parsec-scale galactic structure, from radio polarization data"

IAU General Assembly (Manchester, UK; August 10–16)

Heijligers

MIDI Science meeting (Nice, France; June 1–2)
"Active Galactic Nuclei; Exploring the dust torus unification scheme with VLTI"

MIDI Science meeting (Heidelberg, Germany; November 26–30)
"Active Galactic Nuclei; Exploring the dust torus unification scheme with VLTI"

The far-infrared and submillimeter spectral energy distributions of active and starburst galaxies (Groningen; April 27 – 29)

Helmi

Star 2000: Dynamics of Star clusters and the Milky Way (Heidelberg, Germany;

March 20–24)

“Halo debris streams as relicts from the formation of the Milky Way”

Disk galaxies and galaxy disks (Rome, Italy; June 12–16)

“The formation of the Galactic halo”

Victoria computational cosmology conference (Victoria, Canada; August 21–25)

“The phase-space structure of a cluster halo: Insights into our Galactic halo”

Icke

Strongly correlated systems in physics (Nikko, Japan; May 24–30)

“Formation of large-scale structure in the Universe”

Historical development of modern cosmology (Valencia, Spain; September 18–22)

“Correlations in a random Universe”

Kamp

Nederlandse Astronomen Conferentie (Dalfsen, The Netherlands; May 10–12)

“Vega: Ongoing accretion from the circumstellar disk?”

EARA workshop: Disks, Extrasolar Planets and Brown Dwarfs (Paris, France; July 17–18)

“Modelling the disk of β Pictoris”

HAeBe workshop (Amsterdam The Netherlands; October 25–27)

“The gas temperature in the disks around young A stars”

MCFA national meeting (Utrecht, The Netherlands; November 17)

IAU General Assembly (Manchester, England; August 7–15)

“The gas temperature in the disks around young A stars”

Jahrestagung der Astronomischen Gesellschaft (Bremen, Germany; September 18–23)

"Gas/dust separation in protoplanetary disks around A stars"

Katgert

IAU General Assembly (Manchester, UK; August 7–15)

Katgert-Merkelijn

IAU General Assembly (Manchester, UK; August 7–15)

Knudsen

The far-infrared and submillimeter spectral energy distributions of active and starburst galaxies (Groningen; April 26)

Danish Physics Society, Annual Meeting (Nyborg, Denmark; June 8–9)
"Submillimeter Selected Quasar in the Field of A478 (Poster)"

Deep Millimeter Surveys: Implication for Galaxy Formation and Evolution (Amherst, MA, USA; June 19–21)
"Submillimeter Selected Quasar in the Field of A478 (Poster)"

IAU – 24th General Assembly (Manchester, UK; August 10–18)

Joint 2000 annual meeting of European TMR and RTN networks (Galaxy Formation and Evolution + Intergalactic Medium) (Durham, UK; September 5–10)

Kurk

Euroconference, The Evolution of Galaxies, I - Observational Clues (Granada, Spain; May 23–27)
"A Search for clusters around high redshift radio galaxies"

General Assembly 24 of the IAU (Manchester, UK; August 14–18)

TMR Galaxy Evolution/RTN Intergalactic Medium annual meeting (Durham, UK; September 5–9)
"A proto-cluster of galaxies at z=2.2"

Emission Lines from Jet Flows (Isla Mujeres, Mexico; November 13–17)

"Observations of radio galaxy MRC 1138-262: a giant halo of Lya and Ha emitting ionized gas"

Labbé

IAU Symposium 201: New Cosmological Data and the Values of the Fundamental Parameters (Manchester, UK; August 7–11)

IAU Symposium 204: The Extragalactic Infrared Background and its Cosmological Implications (Manchester, UK; August 15–18)

IAU Symposium 205: Galaxies and their Constituents at the Highest Angular Resolution (Manchester, UK; August 15–18)

"A z = 2.72 galaxy gravitationally lensed by the cluster MS 1512+36: reconstruction and near-infrared spectroscopy"

TMR-Network Meeting on the IGM and Galaxy Formation (Durham, UK; September 5–9)

ESO Workshop on Deep Fields (Garching, Germany; October 9–12)

Lub

41th meeting SAIT (Rome, Italy; April 10–14)

"Physical Properties of Pulsating Variable Stars (invited talk)"

24th General Assembly of the IAU (Manchester, U.K.; August 7–18)

Luu

Disks, Planetesimals, and Planets (Tenerife, Spain; January 24–28)

"The Kuiper Belt and other circumstellar disks"

Meisner

Interferometry in Optical Astronomy (SPIE/ESO, Munich, Germany; March 27–31)

"Coherent estimation of complex fringe visibility: a generalized approach"

Mellema

Two–dimensional Time–dependent Radiation Transfer (UCL, London, UK; December 20)
"Ray–tracing in numerical hydrodynamics"

Messineo

YERAC (Granada, Spain; September 17–20)
"Late type stars in the Galactic Bulge and SiO masers"

Muñoz Caro

Expanding your Universe 2000 (London, England; March 5)
"Last results on the analysis of UV photolysis products of interstellar ice analogs"

International School of Space Chemistry (Erice, Italy; June 5–16)
"UV photolysis of hydrocarbons under simulated dense and diffuse cloud conditions"

Pontoppidan

Herbig AeBe Stars: Between Accretion and Debris (Amsterdam, The Netherlands; October 24–27)

Le Poole

SPIE conference: Interferometry in Optical Astronomy, Radio Telescopes, and Research Prospects from 8-10 meter-class telescopes (München, Germany; March 27-31)
"10-m interferometry on the VLTI with the MIDI instrument: a preview"

Röttgering

LOFAR Science meeting (Charlottesville, USA; February 21–25)
"Dutch Science Issues"

XMM Large Scale Survey consortium meeting (Saclay, France; February 29 – March 1)
"Science with radio survey"

SPIE conference: Interferometry in Optical Astronomy, Radio Telescopes, and Research Prospects from 8-10 meter-class telescopes (München, Germany; March 27-31)
"Scientific potential of infrared interferometry from space"

The far-infrared and submillimeter spectral energy distributions of active and starburst galaxies (Groningen; April 27 – 29)

Meeting MIDI science group (Nice, France; July 1–2)

Michelson Interferometry Summer School (Berkeley, USA; August 21-25)
"Active Galactic Nuclei and Distant Galaxies"

Annual meeting of the EU-TMR network "Formation and Evolution of galaxies" (Durham, UK; Sept 8 – 10)
"Active Galactic Nuclei"

Presentation of the Cornerstone study results (Paris, France, Sept 12 –13)
"Science with the Darwin interferometer"

Meeting of the Terrestrial Planet Finder Science Working Group (Pasadena, USA; Sept 26 – 27)

Science with VST Omega Cam (Tegernsee, Germany, October 16 – 18)
"The distant universe and some plans for Omegacam"

Emission lines from Jet Flows (Isla Mujeres, Mexico, November 13 – 17)
"The evolution of the emission line regions in Radio galaxies, from $z = 2$ to 5"

Meeting MIDI science group (Heidelberg, Germany; November 27 – 28)

Terrestrial Planet Finder preliminary Architecture Review (San Diego, USA; December 12 – 14)

Ruiterkamp

2nd EXPOSE Investigators Meeting (Orleans, France; Februar 24–25)
"ORGANIC project status"

Photolysis and Radiolysis of Outer Solar System Ices (Baltimore, USA; March 27–29)
"The CO/CO_2 equillibrium in irradiated ices"

European Geophysical Society; XXV General Assembly (Nice, France; April 25–29)

"Laboratory Simulations of Interstellar and Planetary Ices"
"Organic Molecules on Mars"

1st Astrobiology Science Conference (California, USA; April 3–5)

ESA ISS Experimentors meeting (Sorrento, Italy; September 10–15)
"Evolution of Organic Matter in Space; a long duration exposure experiment on ISS"

First Steps in the Origin of Life in the Universe, 6th Trieste conference on chemical evolution (Trieste, Italy; September 18–22)
"Laboratory Simulations of Organic Molecules on the Martian Surface"

Schutte

Photolysis and Radiolysis of Outer Solar System Ices (Laurel, USA; March 27–29)

33rd COSPAR Scientific Assembly (Warsaw, Poland; July 16–23)
"Production of Organic Molecules in Interstellar Ices"

Workshop: The role of laboratory experiments in the characterization of cosmic material (Bern, Switzerland; May 8–12)
"AmmoniumBicarbonate, a new candidate for the 6.8 micron absorption band towards embedded Young Stellar Objects"

International Astronomical Union 24th General Assembly (Manchester, United Kingdom; August 8–13)
"Probing the nature of grain surface chemistry and ice photochemistry by laboratory simulation"

Shen

International School of Space Chemistry, Solid State Astrochemistry (Erice, Sicily, Italy; June 5–16)

Simis

Nederlandse Astronomen Conferentie (Dalfsen, the Netherlands; May 10–12)
"Quasi-periodic shells in dust forming AGB winds"

Post-AGB objects (proto-planetary nebulae) as a phase of stellar evolution (Torun, Poland; July 5–7)

"Two fluid models of AGB winds"

van der Tak

Young Astrophysical Chemistry Meeting (London, UK; March 6)
"Physical and chemical structure of massive star-forming regions"

Nederlandse Astronomenconferentie (Dalfsen, The Netherlands; May 10–12)
"Physical and chemical structure of regions of massive star formation"

High-mass star formation: an origin in clusters? (Volterra, Italy; May 31– June 3)
"Physical and chemical structure of regions of massive star formation"

Thi

EARA Workshop 2000, Disks, Extrasolar Planets and Brown Dwarfs (IAP, France; July 17–18)
"Gas evolution in protoplanetary disks"

Observation, analysis and Theory of Astronomical and Laboratory Spectra, A joint meeting of CCP7 and the Astrophysical chemistry Group of The Royal Society of chemistry (University of Kent at Canterbury, UK; September 6–8)
"Gas evolution in protoplanetary disks"

Herbig Ae/Be stars: between accretion and debris (Astronomical Institute 'Anton Pannekoek', University of Amsterdam, the Netherlands;October 25–27)
"Gas evolution in protoplanetary disks"

Thomas

IAU: XXIVth General Assembly (Manchester, UK; August 7–18)

VC3: Victoria Computational Cosmology (Victoria, Canada; August 21–26)
"Galaxy types and morphological segregation"

Tschager

The birth and early years of extragalactic radio sources (Puerto de la Cruz, Tenerife, Spain; January 10–12)
"The GHz-Peaked Spectrum radio galaxy 2021+614: detection of slow motion in a Compact Symmetric Object"

The 5th European VLBI Network Symposium on New Developments in VLBI Science and Technology (Onsala, Sweden; June 29– July 1)
"A method to measure structural changes in GHz-Peaked Spectrum radio galaxies"

Fields and Particles in Radio Galaxies (Oxford, UK; August 3–5)

32nd Young Radio Astronomer's Conference (Granada, Spain; September 17–20)
"The GHz-Peaked Spectrum radio galaxy 2021+614: detection of slow motion in a Compact Symmetric Object"

Vlemmings

5th EVN Symposium (Gothenborg, Sweden; June 29 – July 2)
"Amplification of the Stellar Image by Circumstellar OH masers"

XII Tenerife Winter School: Astropolarimetry (Tenerife, Canary Islands; November 12–25)
"Circular Polarization of Circumstellar Water Masers"

van der Werf

The far-infrared and submillimeter spectral energy distributions of active and starburst galaxies (Groningen; April 27 – 29)
"Lessons from lensed Lyman break galaxies: can dusty Lyman break galaxies produce the submillimetre counts and background?"

Deep millimeter surveys (Amherst, U.S.A.; June 19–21)
"Can dusty Lyman break galaxies produce the submillimetre counts and background? Lessons from lensed Lyman break galaxies"

Starburst galaxies near and far (Ringberg, Germany; September 10–15)
"Starbursts in ultraluminous infrared galaxies - fueling and properties"

The promise of FIRST (Toledo, Spain; December 12–15)
"Extragalactic astrophysics with HIFI"
"Gas and dust in nearby galaxies, protogalaxies and high-z abundances - panel summary"

van Zadelhoff

EARA Workshop 2000, Disks, Extrasolar Planets and Brown Dwarfs (IAP, France; July 17–18)

"Submillimeter lines from circumstellar disks"

IAU Symposium 202, Planetary Systems in the Universe (Manchester, UK; August 7–10)
"Submillimeter lines from circumstellar disks around pre-main sequence stars"

Modelling Interstellar Chemistry (Leiden, the Netherlands; October 16–27)
"Chemistry in PPDs: inclusion of accurate radiation field and dependence on physical models of the disk"

Time-Dependent Two-Dimensional Radiative Transfer (UCL, UK; December 15)
"The Inclusion of Radiative Transfer in Circumstellar Disk Chemistry"

de Zeeuw

Conference STAR 2000 (Astronomische Geselschaft, Heidelberg, Germany; March 22)
"Young Stellar Groups, Runaway Stars and Pulsars"

Presentation to OPTICON Board (Strasbourg, France; October 13)
"The Science Case for Extremely Large Telescopes"

Appendix VII

Observing sessions abroad

Sterrewacht Leiden

Observing sessions abroad

Appendix VII

Boonman

JCMT (Mauna Kea, Hawaii; April 13–21)
JCMT (Mauna Kea, Hawaii; October 25–29)
NASA/IRTF (Mauna Kea, Hawaii; October 30–November 2)

Bureau

NTT (La Silla, Chile; January 1–3)
WHT (La Palma, Spain; February 14–20)
WHT (La Palma, Spain; March 27–April 3)
ATCA (Narrabri, Australia; April 19)
NTT (La Silla, Chile; May 31–June 2)
WHT (La Palma, Spain; September 1–4)
NTT (La Silla, Chile; October 29–31)

Cioni

ESO (La Silla, Chile; January 11–20)

Copin

WHT (La Palma, Spain; September 1–5)

van Dishoeck

IRTF (Hawaii, USA; December 3–4)
JCMT (Hawaii, USA; December 5–7)

Ehrenfreund

NRAO 12m (Tucson, USA; May 21–25)

Habing

IRAM (Pico Veleta, Granada, Spain; August 18–23)

Hartman

ESO (La Silla, Chili; September 17–26)

Israel

SEST (ESO La Silla, Chile; May 8–19)

Jarvis

INT (La Palma, Spain; November 23–30)

Kamp

1.52m telescope of the Observatoire de Haute-Provence (St. Michel, France; January 17–23)
10m Heinrich Hertz telescope (Mt. Graham, USA; November 3–14)

Knudsen

WHT (La Palma, Spain; July 27–30)
JCMT (Hawaii, USA; December 14–21)
William Herschel Telescope (La Palma, Spain; July 27–29)
James Clerk Maxwell Telescope (Mauna Kea, Hawaii; December 5–23)

Labbé

W.M. Keck Observatory (Hawaii, USA; March 27–28)

Lacerda

WHT (La Palma, Spain; June 7–12)

Lub

Dutch Telescope (La Silla, Chile; September 4–13)

Luu

Keck Telescope (Mauna Kea, Hawaii, USA; February 12–14)
Kitt Peak 0.9m (Kitt Peak, Arizona, USA; August 6–11)

Messineo

IRAM 30m (Pico Veleta, Spain; August 21–27)
HHT (Mt. Graham, Arizona, USA; November 6–10)

Miley

Keck Telescope (Hawaii, USA; January 27–February 3)
VLT (Paranal, Chile; February 28–March 4)
NTT (La Silla, Chile; September 18–25)

Papadopoulos

JCMT (Mauna Kea, Hawaii; May 5–29)
VLA (Socorro NM, USA; June 1–10)
Nobeyama Radio Observatory (Nobeyama, Japan; December 1–15)

Ruiterkamp

NRAO 12-Meter (Arizona, USA; May 21–25)
SMTO (Arizona, USA; June 25–28)

Tschager

INT (La Palma, Spain; January 26–February 2)
INT (La Palma, Spain; February 23–March 2)
WHT (La Palma, Spain; August 5–8)

van der Werf

WHT (La Palma, Spain; July 27–29)

Appendix VIII

Working visits abroad

Sterrewacht Leiden

Working visits abroad

Appendix VIII

Boonman

ISO Data Centre (Villafranca del Castillo, Spain; August 21–25)

Bureau

IAC (La Laguna, Spain; February 25–28)
Kapteyn Laboratorium (Groningen, The Netherlands; March 8–9)
Observatoire de Marseille (Marseille, France; April 29–May 24)
Observatoire de Lyon (Lyon, France; May 13–16)

Cioni

IAP (Paris, France; May 16–22)
IAP (Paris, France; June 7–9)
MPA (Heidelberg, Germany; July 11–18)
IAP (Paris, France; September 20–26)
ESO (Munich, Germany; October 4–6)
Bologna Observatory (Bologna, Italy; October 13–28)

Deul

Kapteyn Laboratorium (Groningen, The Netherlands; February 9)
IAP (Paris, France; February 23–25)
Kapteyn Laboratorium (Groningen, The Netherlands; April 7–9)
Kapteyn Laboratorium (Groningen, The Netherlands; June 27)
Kapteyn Laboratorium (Groningen, The Netherlands; July 20)
Kapteyn Laboratorium (Groningen, The Netherlands; August 16)

Kapteyn Laboratorium (Groningen, The Netherlands; November 9)

van Dishoeck

European Space Agency (Paris, France; January 24)
European Space Agency (Paris, France; February 29)
European Southern Observatory (Garching, Germany; April 3)
Max-Planck Institut (Stuttgart, Germany; April 12)
ESTEC (Noordwijk, The Netherlands; May 15)
Herzberg Institute for Astrophysics (Victoria, Canada; May 22–23)
Max-Planck Institut (Stuttgart, Germany; June 29)
ESTEC (Noordwijk, The Netherlands; September 5)
University of California (Berkeley, USA; September 8–10)
European Space Agency (Paris, France; September 12–14)
Space Telescope Science Institute (Baltimore, USA; September 27–29)
Max-Planck Institut für Radioastronomie (Bonn, Germany; October 2–3)
Max-Planck Institut für Extraterrestrische Physik (Garching, Germany; October 10)
European Southern Observatory (Garching, Germany; October 11)
Rensselaer Polytechnic Institute (Troy, USA; October 30)
University of California (Berkeley, USA; October 31–December 8)

Ehrenfreund

NASA AMES Research Center (Mountain View, USA; February 27–April 18)
MPI Bonn (Bonn, Germany; October 1)
TU Berlin (Berlin, Germany; November 2–3)
MPI Bonn (Bonn, Germany; November 20)

Franx

ESO, STC meeting (Garching, Germany; January 24–25)
University of Cambridge, TMR meeting, (UK, January 18–20)
Caltech (Pasadena, CA, USA; April 1–7)
ESO, STC meeting, (Garching, Germany; May 9–12)
Edinburgh, Opticon/ELT meeting, (UK, September 25–26)
ESO, working group on surveys, (Garching, Germany; October 13)
Harvard-Smithsonian Center for Astrophysics, (Cambridge, USA; November 8–11)
Columbia University (New York, USA; Nov 11–13)
Hopkins University (Baltimore, USA; Nov 13–16)
ESO, STC meeting, (Garching, Germany; December 5)
University of California, (Santa Cruz, USA; December 6–8)
Caltech (Pasadena, CA, USA; December 10–14)

Fraser

Natural History Museum / UCL (London, UK; August 15–16)
School of Chemistry (University of Nottingham, UK; August 16–26)
Department of Physics (Tel Aviv University, Israel; September 17)
Department of Physics (Hebrew University of Jerusalem, Israel; September 18–19)
Department of Space Sciences and Engineering (University of Virginia, USA; October 9–12)

Greenberg

Institute Low Temperature Science (Sapporo, Japan; May 13–August 15)

Habing

IAP (Paris, France; February 29, May 19, July 21, August 28)
Stockholm Observatory (Stockholm, Sweden; May 6)
ISO Ground Station (Vilspa, Spain; June 1–3)
Editions de Physiques (Paris, France; June 19)

Hartmann

CfA (Cambridge, MA, USA; August 6–15)

Haverkorn

ASTRON (Dwingeloo, The Netherlands; April 4–6)
ASTRON (Dwingeloo, The Netherlands; October 10–12)
ASTRON (Dwingeloo, The Netherlands; October 31–November 2)

de Heij

ATNF (Epping, Australia; June 2–27)

Heijligers

Astronomical Observatory Padua (Padua, Italy; June 3–6)
Max Planck Institut für Astronomie (Heidelberg, Germany; October 23–26)

Israel

Board Meeting EPN (Dublin, Ireland; March 25)

Jaffe

ESO (Garching, Germany; February 27–29)
MPIA (Heidelberg, Germany; March 20–22)
Observatoire du Paris (Meudon, France; April 2–4)

MPIA (Heidelberg, Germany; July 18–21)
ESO (Garching, Germany; July 24–26)
MPIA (Heidelberg, Germany; November 2–8)

Jarvis

Oxford Astrophysics(Oxford, UK; December 21–22)

de Jong

MPIA (Heidelberg, Germany; March 21–22)
MPIA (Heidelberg, Germany; July 27–28)
ASTRON (Dwingeloo, The Netherlands; December 6–7)

Kamp

Institute for Theoretical Physics and Astrophysics (Kiel, Germany; April 10–14)

Katgert

Osservatorio Astronomico (Trieste, Italy; January 27–February 4)
Max Planck Instut für extraterrestrische Physik (Garching, Germany; July 14)
Osservatorio Astronomico (Trieste, Italy; September 11–17)

Katgert-Merkelijn

Board meeting A&A (Stockholm, Sweden; May 5–7)
Visit EDPsciences (Paris, France; June 18–19)

Labbé

Caltech (Pasadena, USA; March 19–27)

Lub

Osservatorio Astronomico Monte Porzio (Rome, Italy; April 2–15)

Mellema

Stockholm Observatory (Saltsjöbaden, Sweden; December 2–9)

Meisner

MPIA (Heidelberg, Germany; January 10-12)
MPIA (Heidelberg, Germany; July 18-23)
MPIA (Heidelberg, Germany; October 24-27)

Messineo

IAP (Paris, France; January 21)
VILSPA (Madrid, Spain; February 7–19)
IAP (Paris, France; May 19)
JIVE (Dwingeloo, The Netherlands; June 21)
IAP (Paris, France; July 21)
VILSPA (Madrid, Spain; August 14–18)

Miley

Space Telescope Users Committee (Baltimore, USA; February 24–28)
Space Telescope Users Committee (Baltimore, USA; April 4–9)
Space Telescope Users Committee (Baltimore, USA; May 30–June 3)
ESO OPC (Garching, Germany; June 5–7)
Space Telescope Users Committee (Baltimore, USA; September 13–18)
Space Telescope Users Committee (Baltimore, USA; October 5–6)
ESO, Visiting Committee (Chile; October 16–22)
ESO, Visiting Committee (Garching, Germany; November 13–17)
ESO, NEVEC Meeting (Garching, Germany; November 22)
ESO, Implementation Committee (Garching, Germany; December 4)
ACS/HST Science Team Meeting (Baltimore, USA; December 13–17)

Muñoz Caro

Bremen University (Bremen, Germany; August 23–25)
MPI für Aeronomie (Katlenburg-Lindau, Germany; September 11–13)
Bremen University (Bremen, Germany; September 13)

Papadopoulos

National Observatory of Athens (Athens, Greece; September 30– October 10)
University College London (London,UK; October 15–30)

Le Poole

ESO (Garching, Germany; February 29)
Koninklijke Sterrewacht Brussel (Uccle, Belgium; March 10)
ESO (Garching, Germany; March 24)
ESO (Garching, Germany; April 3)
Observatoire de Geneve (Geneve, Suisse; May 2–3)
ESO (Garching, Germany; July 4–5)
ESO (Garching, Germany; July 28)
PRIMA Bosscha Observatory (Lembang, Indonesia; Octobert 26–December 4)

Röttgering

Osservatorio Astronomico (Padua, Italy, June 4 – 5)
Osservatorio Astrofisico di Arcetri (Arcetri, Italy, June 6 – 7)

Ruiterkamp

Nasa Ames Research Center (Moffett Field, California, USA; February 27–April 15)

Simis

Astrophysikalisches Institut Potsdam (Potsdam, Germany; September 25–29)

Tschager

JIVE (Dwingeloo, The Netherlands; June 5–9)
JIVE (Dwingeloo, The Netherlands; December 11–22)

Vlemmings

NRAO (Socorro, New Mexica, USA; January 12–24)
NRAL (Jodrell Bank, UK; August 29–September 1)

van der Werf

European Southern Observatory (Garching, Germany; January 13–14)
European Southern Observatory (Garching, Germany; February 10–11)
European Southern Observatory (Garching, Germany; March 23–24)
European Southern Observatory (Garching, Germany; May 8–9)
Max-Planck-Institut für extraterrestrische Physik (Garching, Germany; May 10)
Imperial College of Science, Technology and Medicin (London, UK; June 14–15)
Max-Planck-Institut für extraterrestrische Physik (Garching, Germany; June 29–30)
University of Edinburgh (Edinburgh, Scotland; August 1–5)
Oxford University (Oxford, UK; October 30–31)
Institute of Astronomy (Cambridge, UK; November 1–3)
Cardiff University (Cardiff, Wales; November 6–7)
European Southern Observatory (Garching, Germany; November 20–21)
Max-Planck-Institut für extraterrestrische Physik (Garching, Germany; November 22)
European Southern Observatory (Garching, Germany; December 7–8)

van Zadelhoff

MPI (Garching, Germany; January 17–21)

de Zeeuw

Dept. of Theor. Physics (Oxford, England; January 10–11)
ESA Headquarters (Paris, France; February 2–3)
Space Telescope Science Institute (Baltimore, MD, USA; February 13–17)
Columbia University (New York, NY, USA; February 17–19)
Max-Planck-Institut für Astronomie (Heidelberg, Germany; March 22)
Astron. Dept. Univ. of Washington (Seattle, WA, USA; April 6–7)
National Maritime Museum (London, England; April 18)
Space Telescope Science Institute (Baltimore, MD, USA; May 7–12)
Observatoire de Lyon (Lyon, France; May 14–17)
London (England; May 23)
ESA Headquarters (Paris, France; June 22–23)
Max-Planck-Institut für extraterrestrische Physik (Garching, Germany June 29–30)
ESA Headquarters (Paris, France; September 12–13)
Royal Observatory (Edinburgh, Scotland; September 25–26)
CDS (Strasbourg, France; October 13)
Dept. of Physics and Astronomy (Durham, England; October 16–18)
Obs. Roque de los Muchachos (La Palma, Spain; October 26–29)
Columbia University (New York, NY, USA; November 5–11)
Penn State University (State College, PA, USA; November 13–14)
Space Telescope Science Institute (Baltimore, MD, USA; November 15–17)
Astron. Dept., Univ. of California (Berkeley, CA, USA; November 18–30)
Mt. Stromlo Observatory (Canberra, Australia; December 1–14)

Appendix IX

Colloquia given outside Leiden

Colloquia given outside Leiden

Appendix IX

Boonman

"H_2O, CO_2 and HCN toward massive young stars"	Joint Astronomy Centre, Hilo, Hawaii, USA; October 23

de Bruijne

"Astrometry from space: a Hipparcos study of young stellar groups"	Sterrenkundig Instituut Anton Pannekoek, UvA, Amsterdam, The Netherlands; April 28

Bureau

"The Nature of Boxy/Peanut-Shaped Bulges in Spiral Galaxies"	Instituto Astrofisica de Canarias (IAC), La Laguna, Spain; February 25
"The Nature of Boxy/Peanut-Shaped Bulges in Spiral Galaxies"	Kapteyn Laboratorium, Groningen, The Netherlands; March 8
"SAURON: Project and First Results"	NFRA, Dwingeloo, The Netherlands; October 20
"SAURON: Overview and First Results"	Pontificia Universidad Catolica de Chile, Santiago, Chile; October 27
"SAURON: Overview and First Results"	La Plata Observatory, La Plata, Argentina; November 3

"SAURON: Instrument and First Results"	Space Telescope Science Institute, Baltimore, USA; December 15
"The Dark Halo of NGC 2915"	Columbia University, New York, USA; December 19
"SAURON: Instrument and First Results"	Harvard-Smithsonian Center for Astrophysics, Boston, USA; December 20

Cioni

"Stellar Content and Structure of the Magellanic Clouds from DENIS Data"	European Southern Observatory, Munich, Germany; November 23
"Stellar Content and Structure of the Magellanic Clouds from DENIS Data"	Univeristy of Arizona, Tucson, USA; December 1
"Stellar Content and Structure of the Magellanic Clouds from DENIS Data"	University of Washington, Seattle, USA; December 4
"Stellar Content and Structure of the Magellanic Clouds from DENIS Data"	Infrared Processing & Analysis Center (IPAC), Pasadena, USA; December 5
"Stellar Content and Structure of the Magellanic Clouds from DENIS Data"	Harvard–Smithsonian Center for Astrophysics (CfA), Boston, USA; December 7
"Stellar Content and Structure of the Magellanic Clouds from DENIS Data"	Univeristy of Princeton, Princeton, USA; December 13

d'Arcio

"Instrumental issues of wide-field stellar interferometry"	Osservatorio Astronomico di Arcetri, Italy; December 15

van Dishoeck

"Unravelling the Chemical Structure of Star-Forming Regions with ALMA and FIRST"	Royal Astronomical Society discussion meeting, London, UK; February 11

"What can Astronomers Learn from Observations at THz Frequencies?"	DIMES, TU, Delft, The Netherlands; March 22
"ISO's View of Star-Forming Regions"	Herzberg Institute for Astrophysics, Victoria, Canada; May 23
"Gas and Dust in Protoplanetary Disks"	University of California, Berkeley, USA; November 9
"ISO's View on Star- and Planet Formation"	IGPP, Lawrence Livermore, USA; November 10
"Ices in Space and in the Laboratory"	Miller Institute, University of California, Berkeley, USA; November 14
"Astrochemistry: Basic Principles and Recent Results (6 seminars)"	University of California, Berkeley, USA; November 3–30

Ehrenfreund

"Ices and Organic Molecules in Space: A Voyage from dark clouds to the early Earth"	ESTEC, Noordwijk, The Netherlands; January 14
"Ices and organics: From dark clouds to the early Earth"	MPI for Aeronomy, Lindau, Germany; January 27
"Ices and organic molecules in the Interstellar Medium, Comets and Meteorites"	Univ. Basel, Basel, Switzerland; May 10
"Organic molecules in the Interstellar Medium, Comets and Meteorites: A voyage from dark clouds to the early Earth"	MPI Mainz, Mainz, Germany; May 30
"Ices and organic molecules in the Interstellar Medium, Comets and Meteorites"	TU Berlin, Berlin, Germany; November 2

Fraser

"Surface Chemistry and Reactions of Molecular Ices in an 'Interstellar' Environment"	Department of Theoretical Chemistry, Hebrew University of Jerusalem, Israel; September 18
"Surface Chemistry and Reactions of Molecular Ices in an 'Interstellar' Environment"	Department of Space Sciences and Engineering, University of Virginia, USA; October 10

Greenberg

"Comets: the key to our origins"	Geol. Soc. Miolnir, Utrecht, The Netherlands; March 21
"Comets: the key to our origins"	PAC foundation, Leiden; March 3
"Possibilities of life elsewhere"	LBC Dies symposium, Leiden; November 23

Habing

"Incidence and decay of dusty disks around very young stars"	Astronomisches Institut, Potsdam; February 23
"The Nature of Boxy/Peanut-Shaped Bulges in Spiral Galaxies"	Kapteyn Laboratorium, Groningen, The Netherlands; March 8

Helmi

"The formation of the Galactic halo"	Kapteyn Laboratorium, Groningen, The Netherlands; March 10
"The formation of the Galactic halo"	Case Western Reserve University, Cleveland, USA; September 2

Hoogerwerf

"The origin of runaway stars"	Kapteyn Astronomical Institute, Groningen, The Netherlands; May 29

Icke

"The death of Sun-like stars"	NNV Annual Meeting Invited Discourse, Eindhoven, The Netherlands; March 17
"The unpredictability of science"	Science Indicators, Leiden, The Netherlands; May 24
"The hydrodynamics of planetary nebulae"	Dept. of Theoretical Physics, Utrecht, The Netherlands

Mellema

"Cometary Knots in the Helix Nebula"	Kapteyn Laboratorium, Groningen, The Netherlands; October 27

Papadopoulos

"CO at high redshift, fuelling early starbursts"	National Observatory, Athens, Greece; October 5
"A massive reservoir of molecular gas at $z \sim 4$"	University College, London, UK; October 17

Perryman

"Galactic Stereoscopy: from Milli- to Micro-Arcseconds, Lecture Series, 1/4"	Institute of Physics, Cork, Ireland; February 7
"The Optical STJ Development Programme at ESTEC, Lecture Series, 2/4"	Institute of Physics, Galway, Ireland; February 8
"Galactic Stereoscopy: from Milli- to Micro-Arcseconds, Lecture Series, 3/4"	Institute of Physics, Dublin, Ireland; February 10
"The Optical STJ Development Programme at ESTEC, Lecture Series, 4/4"	Institute of Physics, Dublin, Ireland; February 11
"Superconducting Optical Detectors: Instrument, Results and Plans"	Radio Astronomy group, Cavendish Laboratory; Scotland; February 22
"Results from Hipparcos and Ambitious Plans for the Future"	Edinburgh, UK; February 23
"Galactic Stereoscopy: from Milli- to Micro-Arcseconds"	Birmingham, UK; March 22

Le Poole

"The fascination of Adaptive Optics"	Bosscha Observatory, Lembang, Indonesia, November 4

"GAIA"	ITB, Bandung, Indonesia, November 11
"Optical/IR Interferometry"	Bosscha Observatory, Lembang, Indonesia, November 18
"Modern Developments in Astronomical Instrumentation"	Bosscha Observatory, Lembang, Indonesia, November 25

Röttgering

"The most distant radio galaxies: probing the formation of massive galaxies and clusters"	Max Planck Institute, Heidelberg (Germany), November 27

Schöier

"Winds from Red Giant Stars: Observations and Modelling of Molecular Line Emission"	Department of Astronomy and Space Physics, Uppsala University, Sweden; September 28

Simis

"Simulations of dust driven winds on the AGB"	Astrophysikalisches Institut Potsdam (AIP), Potsdam, Germany; September 26
"Simulations of dust driven winds on the AGB"	Technische Universität Berlin, Institut für Astronomie und Astrophysik, Berlin, Germany; September 28
"Simulations of dust driven winds on the AGB"	Sterrenkundig Instituut, Universiteit Utrecht, the Netherlands; October 4

van der Werf

"Probing the cosmic star formation history"	Kapteyn Institute, Groningen, The Netherlands; February 25

"Probing the cosmic star formation history longwards of 1 micron"	Oxford University, Oxford, UK; October 31
"Probing the cosmic star formation history longwards of 1 micron"	Institute of Astronomy, Cambridge, UK; November 2

de Zeeuw

"Grubb Parsons Lecture; Giant Black Holes and Cosmic Collisions"	Durham University, Durham, England; October 18
"Integral Field Spectroscopy of Galaxies: First Results with SAURON"	Dept. of Astronomy, Univ. of Washington, Seattle, WA, USA; April 6
"ESA Cornerstone Presentations; The Scientific Case for the GAIA Mission"	ESA HQ, Paris, France; September 13
"Evidence for Massive Black Holes in Nearby Galactic Nuclei"	Dept. of Physics and Astronomy, Durham University, Durham, England; October 16
"Integral Field Spectroscopy of Galaxies: First Results with SAURON"	Dept. of Astronomy, Columbia University, New York, NY; November 8
"Runaway Stars and Pulsars Ejected from Young Stellar Groups"	Dept. of Astronomy, Columbia University, New York, NY; November 9
"Integral Field Spectroscopy of Galaxies: First Results with SAURON"	Astronomy Dept., Univ. of California, Berkeley, CA; November 29
"Runaway stars and pulsars"	Astronomy Department, UC Berkeley, CA, USA; November 27
"Integral Field Spectroscopy of Galaxies: First Results with SAURON"	Mount Stromlo Observatory, Canberra, Australia; December 12

Appendix X

Scientific publications

Sterrewacht Leiden

Scientific publications

Appendix X

X.1 Ph.D. theses, books and catalogues

R. Brown, S. Baum, J. Beletic, P. T. de Zeeuw, L. Esposito, S. M. Fall, R. Fosbury, R. Green, T. Heckman, G. D. Illingworth, S. Kulkarni, H. Lamers, M. Mateo, J. Mather, C. Max, D. McCarthy, R. McCray, K. Noll, E. Schreier, C. Steidel, and J. Stocke, The Hubble Treasury Program & The Hubble Data Archive, 2000.

C. de Breuck, Very distant radio galaxies. Search techniques and emission line properties, Ph.D. thesis, Leiden University, November 2000.

J. de Bruyne, Astrometry from space. A Hipparcos study of young stellar groups, Ph.D. thesis, Leiden University, May 2000.

A. Helmi, The formation of the Galactic halo, Ph.D. thesis, Leiden University, June 2000.

R. Hoogerwerf, Hipparcos and the nearby OB associations. Space astrometry and high-mass star formation, Ph.D. thesis, Leiden University, May 2000.

M. A. C. Perryman, K. de Boer, F. Favata, G. Gilmore, E. Hoeg, M. G. Lattanzi, L. Lindegren, X. Luri, F. Mignard, O. Pace, and P. T. de Zeeuw, GAIA: Composition, Formation and Evolution of the Galaxy. Concept and Technology Study Report and Executive Summary of the Concept and Technology Study, ESA-SCI(2000)4, 2000.

F. van der Tak, The embedded phase of massive star formation, Ph.D. thesis, Leiden University, September 2000.

P. M. Veen, Intriguing variability of WR 46 and "dusty" Wolf-Rayet stars, Ph.D. thesis, Leiden University, September 2000.

X.2 Papers in refereed journals

M. E. van den Ancker, J. Bouwman, P. R. Wesselius, L. B. F. M. Waters, S. M. Dougherty, and E. F. van Dishoeck, ISO spectroscopy of circumstellar dust in the Herbig Ae systems AB Aur and HD 163296, *Astron. Astrophys.* **357**, 325–329.

P. Andreani, A. Cimatti, L. Loinard, and H. Röttgering, CO detection of the extremely red galaxy HR10, *Astron. Astrophys.* **354**, L1–L5.

S. F. Beaulieu, K. C. Freeman, A. J. Kalnajs, P. Saha, and H. Zhao, Dynamics of the Galactic Bulge Using Planetary Nebulae, *Astron. J.* **120**, 855–871.

P. N. Best, The cluster environments of the $z \sim 1$ 3CR radio galaxies, *Monthly Notices Roy. Astr. Soc.* **317**, 720–736.

P. N. Best, H. J. A. Röttgering, and M. D. Lehnert, More redshifts of powerful equatorial radio sources from the Best, Röttgering & Lehnert sample, *Monthly Notices Roy. Astr. Soc.* **315**, 21–23.

P. N. Best, H. J. A. Röttgering, and M. S. Longair, Deep spectroscopy of distant 3CR radio galaxies: the data, *Monthly Notices Roy. Astr. Soc.* **311**, 1–22.

P. N. Best, H. J. A. Röttgering, and M. S. Longair, Ionization, shocks and evolution of the emission-line gas of distant 3CR radio galaxies, *Monthly Notices Roy. Astr. Soc.* **311**, 23–36.

G. V. Bicknell, R. S. Sutherland, W. J. M. van Breugel, M. A. Dopita, A. Dey, and G. K. Miley, Jet-induced Emission-Line Nebulosity and Star Formation in the High-Redshift Radio Galaxy 4C 41.17, *Astrophys. J.* **540**, 678–686.

L. Binette, J. D. Kurk, M. Villar-Martìn, and H. J. A. Röttgering, A vestige low metallicity gas shell surrounding the radio galaxy 0943-242 at z=2.92, *Astron. Astrophys.* **356**, 23–32.

F. Bocchino, J. Vink, F. Favata, A. Maggio, and S. Sciortino, A BeppoSAX and ROSAT view of the RCW86 supernova remnant, *Astron. Astrophys.* **360**, 671–682.

A. D. Bolatto, J. M. Jackson, F. P. Israel, X. Zhang, and S. Kim, Carbon in the N159/N160 Complex of the Large Magellanic Cloud, *Astrophys. J.* **545**, 234–250.

A. C. A. Boogert, P. Ehrenfreund, P. A. Gerakines, A. G. G. M. Tielens, D. C. B. Whittet, W. A. Schutte, E. F. van Dishoeck, T. de Graauw, L. Decin, and T. Prusti, ISO-SWS observations of interstellar solid $^{13}CO_2$: heated ice and the Galactic $^{12}C/^{13}C$ abundance ratio, *Astron. Astrophys.* **353**, 349–362.

A. C. A. Boogert, A. G. G. M. Tielens, C. Ceccarelli, A. M. S. Boonman, E. F. van Dishoeck, J. V. Keane, D. C. B. Whittet, and T. de Graauw, Infrared observations of hot gas and cold ice toward the low mass protostar Elias 29, *Astron. Astrophys.* **360**, 683–698.

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X.5 Awards

E. van Dishoeck was awarded the Spinoza prize from the Netherlands Organization for Scientific Research (NWO).

Appendix XI

Phone-, room numbers and e-mail addresses

Phone-, room numbers and e-mail addresses

Appendix XI

Fax and Phone numbers: only the internal extensions are given. To call or send a fax from outside the institute the numbers have to be preceeded by (+31+71) 527.

E-mail addresses: Usernames are given. The complete e-mail addresses with the domain name are `user@strw.LeidenUniv.nl`

Office	Fax number	E-mail address `user`
Observatory	5819	`strw`
A&A	5803	`aanda`
NOVA	5743	`nova`

Name	Phone number	Room number	E-mail address `user`
d'Arcio,	5826	561	`darcio`
Arts	5866	567	`arts`
Bakker	5811	532	`bakker`
Bloemen	5891	570	`bloemen`
Boland	5873	464	`boland`
Boonman	5815	504	`boonman`
Bot	5591	508	`bot`

Name	Phone number	Room number	E-mail address user
Broekhuizen, van	5815	504	fvb
Bureau	5882	455	bureau
Cappelari	5875	463	mcappell
Copin	5880	462	ycopin
Dam, van	5845	436	bdam
Deul	5827	509a	deul
Dirksen	5597	542	dirksen
Dishoeck, van	5814	505	ewine
Drost	5833	456	drost
Ehrenfreund	5842	507	pascale
Faas	5596	540	faas
Förster-Schreiber	5861	551	forster
Franx	5870	553	franx
Fraser	5818	537	fraser
Genderen, van	5863	568	genderen
Greenberg	5804	501	greenber
Habing	5916	525	habing
Habing	5853	539	habing
Haverkorn	5831	506	haverkrn
Heij, de	5866	567	deheij
Heijden, van der	5818	537	heijden
Heijligers	5866	567	heyliger
Houten, van	5876	432	
Houten-Groeneveld, van	5881	435	vhouten
Icke	5843	470	icke
Israel	5891	570	israel
Jaffe	5862	563	jaffe
Jansen	5810	509c	jansen
Janssen	5813	437	olaf
Jarvis	5847	453	jarvis
Jong, de	5848	535	jdejong
Jørgensen	5831	506	joergens
Kamp	5841	569	kamp
Kanter, de	5801	521	
Katgert	5817	502	katgert
Katgert-Merkelijn	5916	525	merkelijn

Name	Phone number	Room number	E-mail address user
Katgert-Merkelijn	5845	464	merkelijn
Keulen	5829	440	kueln
Kloppenburg	5848	535	klop
Knudsen	5861	551	kraiberg
Kol-Groen	5837	560	kol
Kouwenhoven	5875	451	kouwenho
Krajnovic	5847	453	davor
Kurk	5838	571	kurk
Kwee	5881	435	kwee
Labbé	5805	558	ivo
Lacerda	5738	467	lacerda
Lindhout	5916	525	lindhout
Lub	5840	564	lub
Luu	5846	441	luu
Meisner	5572	528	meisner
Mellema	5738	467	mellema
Mengel	5838	571	mengel
Messineo	5594	527	messineo
Meyerink	5836	438	meijerin
Mil, van	5860	458	mil
Miley	5849	469	miely
MunozCaro	5809	503	munoz
Overzier	5594	527	overzier
Paardekooper	5813	437	paardeko
Papadopoulos	5850	457	papadop
Pelupessy	5850	457	pelupes
Percheron	5826	561	percheri
Pontoppidan	5812	507	pontoppi
Le Poole	5871	541	lepoole
Reeven, van	5813	437	reeven
Rengelink	5595	538	rengelin
Roland	5818	537	roland
Röttgering	5851	465	rottgeri
Ruiterkamp	5594	527	ruiterka
Sammar	5825	468	fsammar
Schilizzi	5839	439	rts
Schnitzeler	5594	527	schnitze

Name	Phone number	Room number	E-mail address user
Schöir-Larsen	5812	507	fredrik
Schutte	5801	521	schutte
Shen	5804	501	shen
Simis	5841	569	simis
Smit, B.	5916	525	smit
Smit, M.	5825	468	msmit
Starkenburg	5877	562	vstarken
Thi	5809	503	thi
Thomas	5860	458	thomas
Tschager	5839	439	tschager
Veijgen	5836	438	veijgen
Venemans	5813	437	venemans
Verdoes-Kleijn	5875	463	verdoes
Verhoeff	5597	542	verhoef
Verolme	5882	455	verolme
Visser	5891	570	rvisser
Vlemmings	5831	506	vlemming
Vos	5828	509b	avos
Weerstra	5572	528	klaasw
Wel, van der	5850	457	vdwel
Werf, van der	5883	565	pvdwerf
Wilman	5839	439	wilman
Zaal	5852	459	zaal
Zadelhoff, van	5809	503	zadelhof
Zeeuw, de	5879	461	dezeeuw

Name	Phone number	E-mail address user@domain
Baas (Joint Astronomy Center, Hawaii)	1-808-935-4332	baas@jac.hawaii.edu
Perryman (Estec, Noordwijk, The Netherlands)	+31 +71 527 5891	mperryman@estsa2.estec.esa.nl

An electronic version of this annual report will be made available on the web at `http://www.strw.LeidenUniv.nl/research/annrep.php`.

Editors

Huub Röttgering
Yoke Slegtenhorst
Kirsten Kol
Rowin Meijerink

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Wolfgang Tschager

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