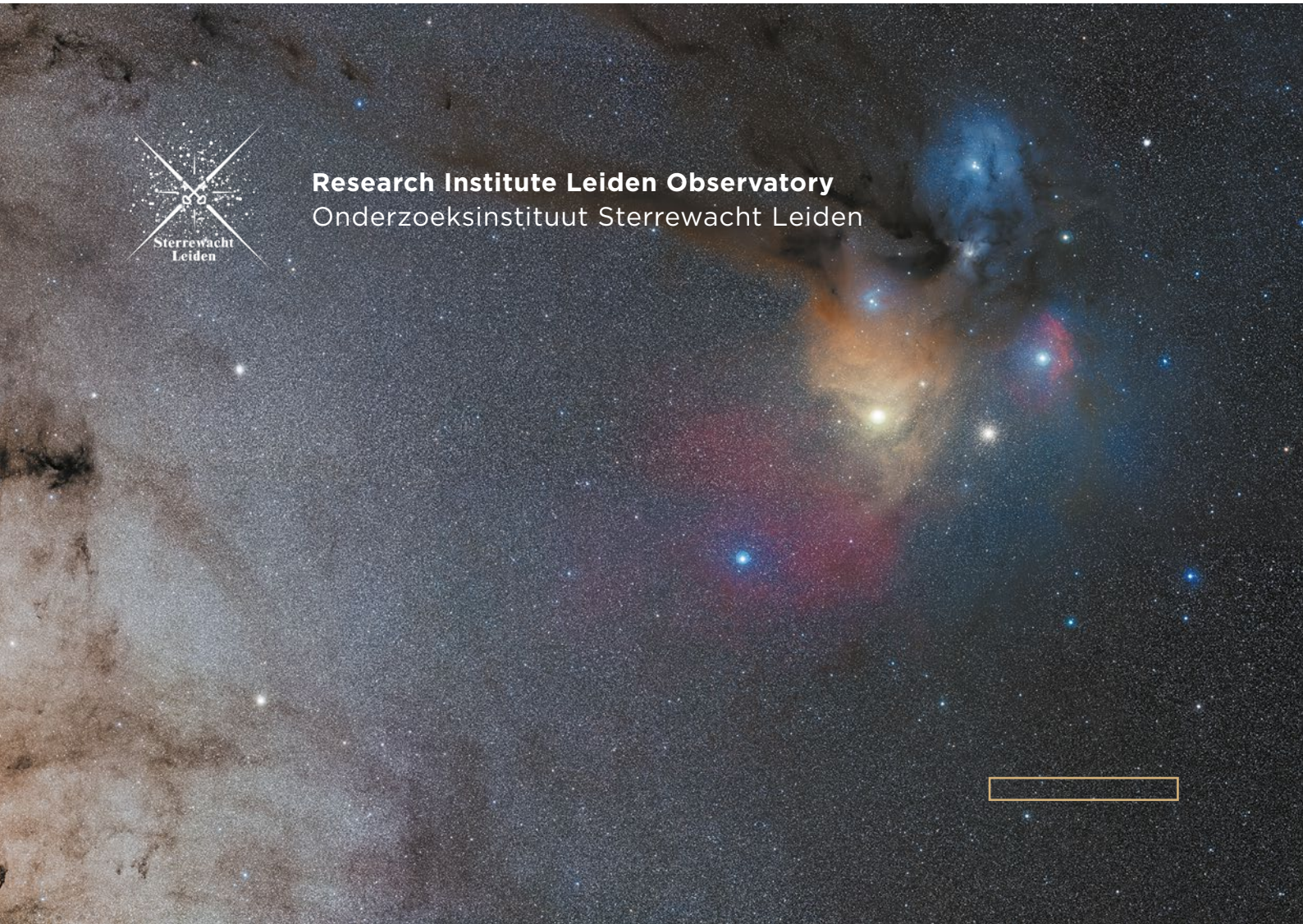
18

Annual Report

Research Institute Leiden Observatory
Onderzoeksinstituut Sterrewacht Leiden

Annual Report /18



Research Institute Leiden Observatory
Onderzoeksinstituut Sterrewacht Leiden

PUBLISHER:

Leiden Observatory, Leiden University

EDITORS:

Matthew Kenworthy, Caroline de Bruin, Evelijn Gerstel, Huub Rottgering

DESIGN:

Aneta Margraf-Druc

IMAGE CREDITS:

ESO: covers, pages: 6, 18, 40

NASA / ESA: pages: 54, 64, 68

Sterrewacht Leiden

Universiteit Leiden
The Netherlands

Index

Foreword

Dear Reader

The year 2018 was very memorable for the Observatory. It was the year that the Norwegian Academy of Science and Letters awarded the Kavli Prize in Astrophysics to Ewine van Dishoeck "for her combined contributions to observational, theoretical, and laboratory astrochemistry, elucidating the life cycle of interstellar clouds and the formation of stars and planets". On Tuesday, September 4th, his Majesty King Harald V presented the Kavli Prizes to the Laureates at the Award Ceremony. The grand ceremony, attended by some 500 people, was broadcast live on Norwegian television and featured performances by a selection of the best Norwegian musicians. In the evening there was a huge banquet in honour of the Kavli Prize Laureates in Oslo's City Hall, one of the most famous buildings in Norway which is also the venue for the Nobel Peace Prize ceremony. The banquet was attended by members of the Royal Family and the Norwegian cabinet. During the rest of the week, several other activities took place including dedicated workshops and popular science lectures. What made this event even more unforgettable was that Ewine had gracefully invited to Oslo many of our support staff, the NOVA office, former PhD students and colleagues – see the happy picture on page 17. A worthy testimony that Ewine fully appreciates that science is a team effort.

With 250 bachelor and 90 master students, student numbers reached an all-time high. In September, Harold Linnartz took over as education director, replacing Paul van der Werf. A big thanks to Paul, who skillfully managed the growth of our student numbers by a factor of more than three over the seven years that he was the director. It is already clear that Harold is very committed and working hard to ensure that every student receives an astronomy education at a level so that he/she can either start a career in research or is very welcome in the general job market – a market where many companies are eager to hire our young experts in 'big data' with a solid background in the exact sciences.

In 2018, our scientific 'production' was impressive: 19 PhD diplomas were awarded, and more than 500 refereed papers were published. However, the only thing that will really matter when future generations look back at 2018 is how our work brought us closer to the biggest questions: What is dark matter and energy? Is there other life in the Universe? To give a taste of our research several of our researchers give in this annual report a brief introduction to their field and provide some of their important results.

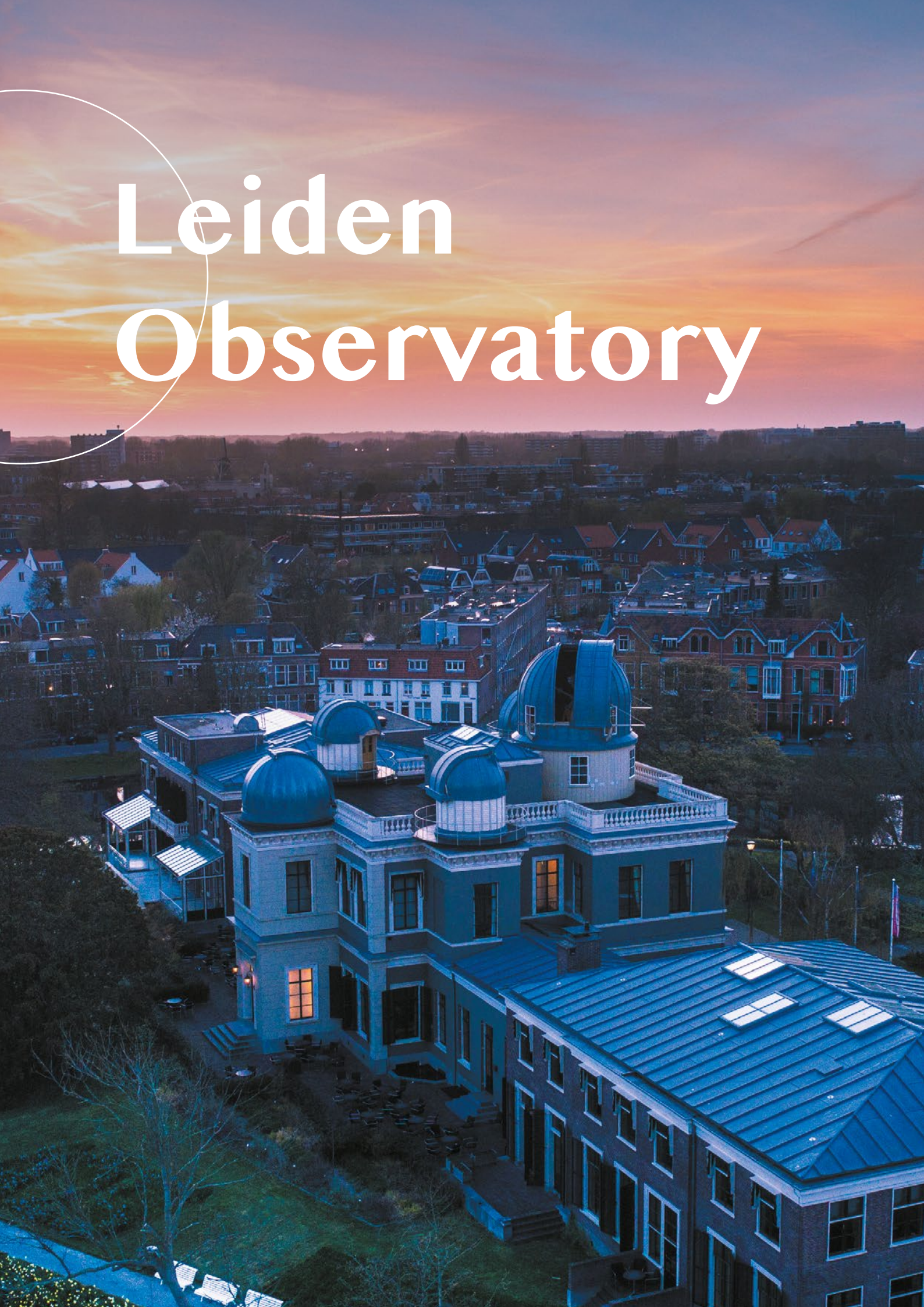
The year 2018 was also the start of the European Regional Office of Astronomy for Development (ROAD) that aims to exploit the unique aspects of astronomy to stimulate inspirational education and foster a sense of world citizenship. The signing ceremony took place on February 26th and was attended by Grace Naledi Pandor, South African Minister of Science and Technology, who was in Leiden to receive an Honorary Oort Professorship. November 19th, 2018 marked the centenary of the birth of one of our most famous astronomers, Henk van de Hulst. To commemorate Henk's unique contributions to astronomical research, not only was a large science symposium organized, but also a special event during which many aspects of Henk's life were reminisced over. Our endowed lectures were also a great success: the lectures by Oort Professor James Kasting and Prof. Julianne Dalcanton were very informative and captured the audiences.

For a number of our scientists, 2018 was also extra special. Henk Hoekstra and Michiel Hogerheijde gave inaugural lectures, Pedro Russo was awarded the K.J. Cath Award for promoting the standing of Leiden University, Adrian Hamers was awarded the Christiaan Huygens Wetenschapsprijs for his thesis 'Hierarchical Systems' and Anthony Brown featured on a list of the science journal Nature as one of the ten people who mattered in science in 2018. While we are proud that Jarle Brinchmann became Director at the Centre for Astrophysics/ Astronomy at the University of Porto in Portugal, we will miss him as a very positive force at the Observatory.

Looking back at 2018, we can all be proud of our vibrant institute, where excellent research is carried out, astronomers are trained at the highest levels, and the general public is informed about the wonders of the Universe.

***Huub Röttgering**, Scientific Director*

Leiden Observatory



*The mission of **Leiden Observatory** is to carry out world class astronomical research, provide education at the bachelors, masters, and PhD level, and inform the general public about the most exciting astronomical results and the beauty of the Universe. Our research is wide ranging, with a particular emphasis on observational and theoretical studies of galaxies and the structures in which they are embedded, on exoplanets, and on star and planet formation.*

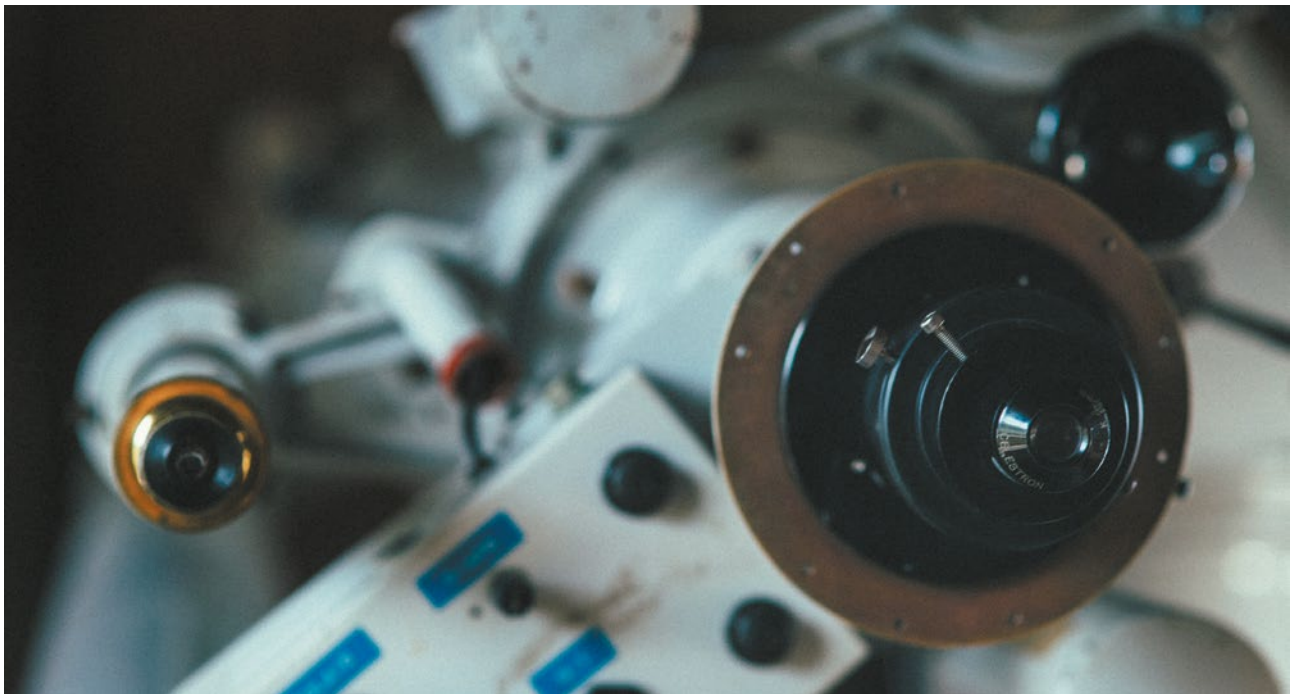
The **Observatory** and its **people**

Sterrewacht Leiden was founded by the Leiden University in 1633 to house the quadrant of Snellius, making it the oldest operating university observatory in the world. While originally located at the main Faculty Building of the university, a purpose-built observatory was constructed in the university's botanical gardens in 1860. Since the mid-1970s the institute has been located within the campus of the Faculty of Science. A long list of eminent astronomers has populated the Sterrewacht, including Profs. Willem de Sitter, Ejnar Hertzsprung, Jan Oort, Adriaan Blaauw, and Henk van de Hulst. Currently, Leiden Observatory is proud to be one of the largest and top astronomical research institutes in Europe. It has 25 scientific staff members, about 80 postdoctoral researchers, 90 PhD students, and 250 undergraduates. Among its professors are three Dutch Spinoza Prize winners: van Dishoek, Franx and Tielens. Prof. Tim de Zeeuw was the Director General of the European Southern Observatory – the largest observatory in the world, and Prof. Ewine van Dishoeck is the president of the International Astronomical Union (2018-2021).

Research & Technology

Leiden Observatory is part of the Netherlands Research School for Astronomy (NOVA). Scientific research at Leiden Observatory ranges from studying how the Earth and the Solar System have formed and how this compares to other planetary systems, to the origin and evolution of the Milky Way and the Universe as a whole. Observations play a central role in astronomical research, and the state-of-the-art instrumentation is almost exclusively built and operated through international collaborations. Optical and infrared ground-based observations are mostly conducted with telescopes from the European Southern Observatory (ESO) in Northern Chile, and from the Isaac Newton Group (ING) on La Palma (Canary Islands, Spain). Flagship telescopes at other wavelength regimes are the Atacama Large mm/sub-mm Array (ALMA) in Chile and the international Low Frequency Array (LOFAR), which has its core in the north of the Netherlands. Other observations can only be conducted from space, meaning that Leiden astronomers also frequently use the NASA Hubble Space Telescope. A second pillar of astronomical research is theoretical and astrochemistry modeling. Large-scale numerical simulations and big data are key ingredients of astronomical research. Leiden Observatory hosts the Sackler Laboratory for Astrophysics, which carries out unique experiments to simulate inter-and circumstellar conditions in a controlled environment.

Leiden Observatory is also focused on driving the development of key technologies that will enable future astronomical discoveries. Close collaborations with Dutch partners are crucial, such as the NOVA optical group at ASTRON, TNO Delft, the Netherlands Institute for Space Research (SRON), and Dutch Space. Ultimately, most instruments are built in international consortia under the umbrella of ESO or the European Space Agency (ESA). In this way, Leiden astronomers play important roles in the development and operation the ESA's GAIA and EUCLID missions. Leiden professor Bernhard Brandl is the NOVA principal investigator of METIS, one of the first light instruments of the future Extremely Large Telescope (ELT).



Bachelor & Master education

Leiden Observatory is part of the Faculty of Science and hosts both the Bachelor and Master studies in astronomy of Leiden University. The three year bachelor in astronomy is currently followed by about 200 students, and provides a broad basis in astronomy, with important components in physics, mathematics, and informatics. The two year masters in astronomy is currently followed by about 50 students. Since it is fully taught in English it is also very popular among non-Dutch students. The master not only prepares students for a scientific path, but also launches careers in business or industry.

In collaboration with ESTEC in Noordwijk, Leiden Observatory organises the year Leiden/ESA Astrophysics Program for Summer Students (LEAPS), in which talented students from all over the world conduct a summer research program at the Observatory.

Public Engagement

An important task of Leiden Observatory is to engage the general public with the wonders of the universe, and share the scientific, technological, cultural, and educational aspects of astronomy with society. It operates a modern visitor centre at the historic observatory building in the centre of town, where the astronomy student club L.A.D.F. Kaiser conducts about two hundred guided tours per year of the antique telescopes.

Leiden Observatory also hosts the international office of the Universe Awareness programme, UNAWE, which harnesses the excitement of astronomy to interest young children in science and technology and to use the perspective and enormity of the Universe to foster tolerance and a sense of world citizenship at an age when their value systems are forming. UNAWE is active in 60 countries with teacher training and production of educational materials.

Calendar of Events 2018

January

Kick-off Citizen-Science Lab [22]

February

Honorary Oort Visiting Professorship bestowed on South African Minister Naledi Pandor [26]

“Science Diplomacy and International Development” Lecture and Symposium, Campus The Hague [27]

March

Inaugural Lecture Michiel Hogerheijde at UvA [15]

Dirk van Delft appointed Officier in de Orde van Oranje-Nassau [29]

April

Oort Lecture James Kasting [26]

Ewine van Dishoeck receives the James Craig Watson Medal 2018 from the National Academy of Sciences [29]

May

Tim de Zeeuw appointed Ridder in de orde van de Nederlandse Leeuw [14]

International Day of Light celebrated at the Old Observatory [16]

Ewine van Dishoeck appointed on Board of Trustees for Advanced Study [17]

Collaboration agreement confirming move to SRON to South Holland [30]

June

Start of LEAPS Program [4]

Christiaan Huygens Wetenschapsprijs 2018 awarded to Adrian Hamers for his thesis ‘Hierarchical Systems’ [21]

Henk Hoekstra Inaugural Lecture [25]

Sterrewacht Barbeque [29]

July

August

September

October

November

December

Kavli Prize 2018 awarded to Ewine van Dishoeck

The Norwegian Academy of Science and Letters awarded ***the Kavli Prize in Astrophysics for 2018 to Ewine van Dishoeck*** *"for her combined contributions to observational, theoretical, and laboratory astrochemistry, elucidating the life cycle of interstellar clouds and the formation of stars and planets"*

Shedding light on the Origins of Stars, Planets and Life

The Kavli Prize in Astrophysics was given to Ewine van Dishoeck for her seminal work on revealing the chemical and physical processes in interstellar clouds, where stars and planets form. Her work has contributed to a breakthrough of astrochemistry, demonstrating how molecules form and evolve during the transformation of a cloud into stellar systems like our own.

Through observational studies using telescopes on Earth and in space, van Dishoeck unveiled the "water trail", measuring water vapor from dense clouds to young stars. This helps us understand the formation mechanisms of molecules crucial for life as we know it. She also discovered important structures within the rings of dust and gas surrounding young stars, the birthplace of planets and comets. Van Dishoeck has played a leading role in advancing the field of astrophysics. This includes serving on the board of the internationally-supported Atacama Large Millimeter/submillimeter Array (ALMA) in Chile—a collection of 66 dishes that can be connected to function as one telescope with a diameter of 10 km. With this exceptional instrument, van Dishoeck and colleagues have studied the formation of solar-type stellar systems within our galaxy.

"Professor Van Dishoeck's research on the chemistry of the universe has transformed virtually every aspect of the subject. She has advanced a subject that was once regarded as a small activity on the fringes of mainstream astrophysics, and brought it to the forefront of astronomy as a whole" says Robert Kennicutt, member of the astrophysics prize committee.

We live in a universe where molecules are omnipresent and play a key role in the physical processes that lead to the formation of stars, planets, and life. Observing these molecules also allows astronomers to probe cold and obscured interstellar clouds in the Milky Way and other galaxies where these processes take place.

Our understanding of cosmic chemistry has been revolutionized by a combination of measurements with new observatories on the ground and in space, laboratory experiments, and theoretical studies of the relevant processes. Among the researchers who have contributed to this revolution, Ewine van Dishoeck stands out.

Among the many advances made by van Dishoeck and her collaborators are seminal contributions to our understanding of the formation and destruction of interstellar molecules. Their pioneering work on carbon monoxide has been essential for determining the physical processes that drive the evolution of the cold components of the interstellar medium, from diffuse to dense clouds in the Milky Way, as well as the cold star-forming gas in galaxies across cosmic time.

Through laboratory experiments, van Dishoeck's group has advanced the quantitative understanding of the chemical processes governing the growth and evolution of interstellar ices. This work includes investigations of photoprocessing of ices composed of water, nitrogen, carbon monoxide and carbon dioxide. Such studies serve as the basis for modelling

the effects of photo-desorption and processing of astrophysical ices, key steps in the evolution of molecular clouds and the subsequent formation of stars, protoplanetary disks, and planets. This work also helped to elucidate the chemical evolution of our Solar System, where comets and primitive meteoritic materials preserve the composition of the original cloud of gas and dust. Recently van Dishoeck and colleagues have extended this approach in an effort to connect the chemical composition of the comet visited by the Rosetta mission with that of young Solar-type stellar systems.

Ewine van Dishoeck has masterfully applied spectroscopic tools across a broad range of wavelengths with a superb exploitation of the most capable astronomical measurement techniques. She used the Infrared Space Observatory (ISO) to study molecules previously not accessible by microwave spectroscopy, the Herschel Space Observatory to follow the trail of water throughout star formation, and more recently the Atacama Large Millimeter and sub – millimeter Array (ALMA) to provide the first view of dust traps in disks around young stars, observationally constraining planet formation theories.

These examples illustrate the remarkable breadth of her approach to these fundamental problems, encompassing cutting-edge astronomical observations, physical and chemical theory, and laboratory experiments. Ewine van Dishoeck is leading the transformation of astrochemistry into a growing, quantitative discipline.

The 2018 Kavli Prize was presented to Ewine by King Harald of Norway on September 4 in Oslo, Norway.

Research highlights

Galaxies taking shape in the EAGLE simulations

James Trayford

A striking feature of the observed galaxy population is the diversity of apparent forms that galaxies take, commonly termed their 'morphology'. This morphology encodes fundamental information about their mass assembly and kinematics, and correlates with many other fundamental properties of galaxies.

While each morphology is unique, common morphological features have long been used to classify galaxies. The Hubble sequence classification scheme endures from the early days of extragalactic astronomy, sorting galaxies sequentially from smooth spheroids (early types) to flat discs (late types), but details of how these structural features emerge remain mysterious.

While galaxy observations at different redshifts may indicate demographic changes through time, their long evolutionary timescales prohibit direct observations of individual galaxies taking shape. An observational approach also suffers from image degradation with redshift, and a shift in the frequencies of light being probed. Simulations of galaxy formation may provide key insights into these processes, allowing us to address some fundamental questions:

— Were morphological features formed in place, or the result of transformational processes?

— What fractions of stars were formed in discs?

— How is morphological change related to changes in star formation rates or other properties?

EAGLE

EAGLE (Schaye et al. 2015) is a suite of hydrodynamical cosmological simulations designed to explore these questions. The largest EAGLE volume was run ona supercomputer using 4000 computer processors simultaneously over 4 months, following the 14 billion year evolution of a 100 comoving Mpc on-a-side cubic volume from around the recombination era to the present day. By the end of the simulation run, this volume hosts around 3000 galaxies as massive as our Milky Way or larger.

The simulations demonstrate agreement with the low redshift gas content and galaxy stellar mass function, as well as galaxy size and stellar mass evolution. Radiative transfer modelling techniques are used to generate virtual data representative of the complex configurations of stars and ISM that emerge in EAGLE (Camps et al. 2016, Trayford et al. 2017). Figure 1 shows virtual images of EAGLE galaxies positioned along a Hubble 'tuning fork'.

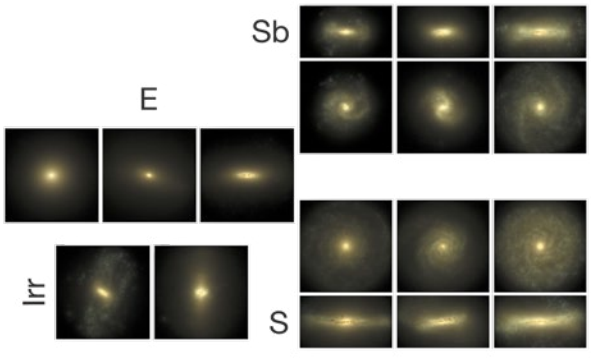


Figure 1: *A Hubble tuning-fork diagram, populated with EAGLE galaxies imaged as described by Trayford et al. (2017). Early types are positioned on the left hand side of the tuning fork, with late-type galaxies on the the right.*

An emerging Hubble Sequence

Perhaps the simplest physical picture of Hubble Sequence (or 'Hubble type') galaxies is as some combination of a spheroid supported by dynamical pressure and a disc dominated by ordered rotation. In a dichotomy of bulge and disc structures, quantifying the disc fraction gives a one-dimensional metric of morphology.

Clauwens et al. (2018) study how the spheroids build up in EAGLE galaxies through cosmic time. By defining the galaxy disc mass as the excess stellar mass in prograde rotation, a complementary spheroid mass is defined. They find an evolutionary pathway where galaxies tend to go through a disc dominated phase, peaking at a stellar mass of $10^{10.5}$ suns, and becoming more spheroid dominated with increasing mass.

On dividing the spheroidal component into an inner bulge and outer halo, they find that the bulge is predominantly formed in-situ, whereas the halo is mostly built up of accreted stars from merging systems. Ultimately, it is found that it is in-situ star formation that is responsible for the emergence of strong stellar discs in $10^{10.5}$ solar mass galaxies, and ex-situ stars subsumed from disrupted systems that contribute to the morphological transformation at higher masses.

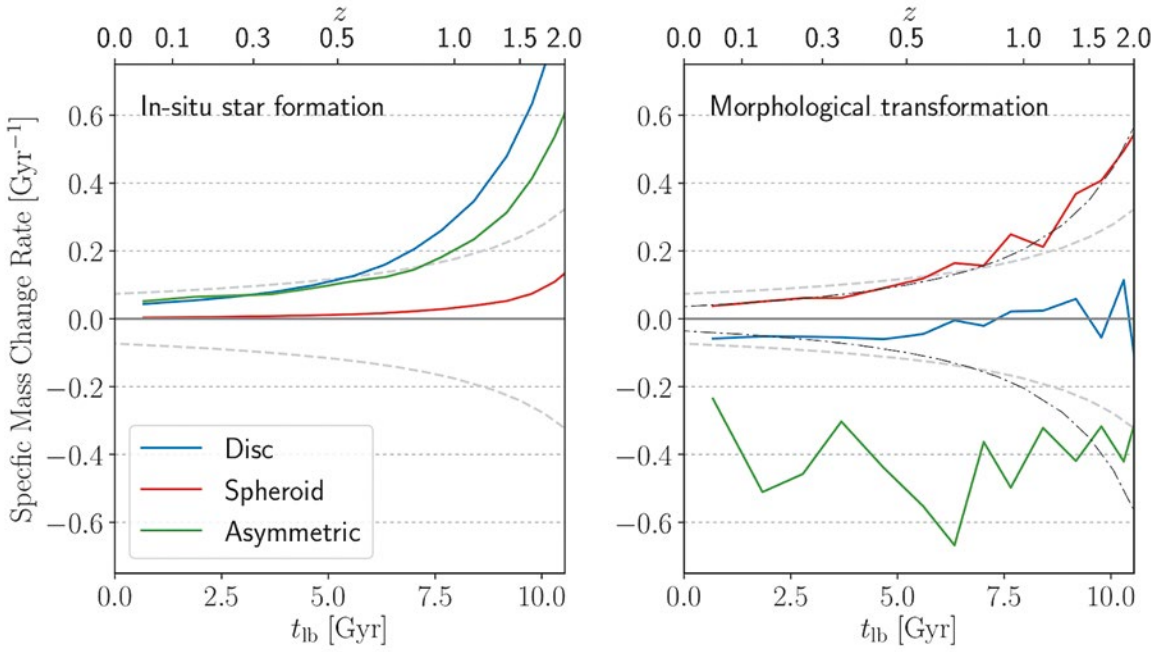


Figure 2: *The total specific growth rate of morphological components in EAGLE galaxies with stellar mass > 10^9 solar (Trayford et al. 2019a). The growth of discs, spheroids and asymmetric components due to star formation (left), showing star formation is typically most efficient in discs, and with low levels of spheroid growth. Instead, spheroids grow through morphological transformation (right) at the expense of discs and irregulars, going with the cosmic merger rate (black dash-dot line). This leads to an overall picture where spheroids grow monotonically to dominate the stellar mass, while disc mass stalls at late times.*

Trayford et al (2019a) expand on some areas of this work. In this study, they go beyond a pure disc-spheroid dichotomy and introduce a measure of asymmetry to identify disturbed systems. This is motivated as a better way to include galaxies that are not a good fit to the Hubble sequence, particularly given the more exotic morphologies observed at higher redshift.

By following the disc, spheroidal and asymmetric components of galaxies in EAGLE, we find that the majority of present day stars reside in spheroids, despite most stars historically forming in the discs of Hubble types. This implies an important role for morphological transformation in establishing morphological demographics, where the spheroids grow by the subsumption of stars born in discs and the settling of disturbed systems. The specific rates of growth or decay for morphological components by star formation and transformation are demonstrated in Figure 2.

Correa et al. (2018) go on to explore the connection between morphological and colour transformation in EAGLE galaxies, testing if the mechanisms that transform galaxy structure are associated to those that quench star formation. A weak correlation is found for galaxies dominating their local gravitational potential, where 18% of red spheroids were found to transition in colour and morphology coincidently. Satellites show no significant association between quenching and transformation events.

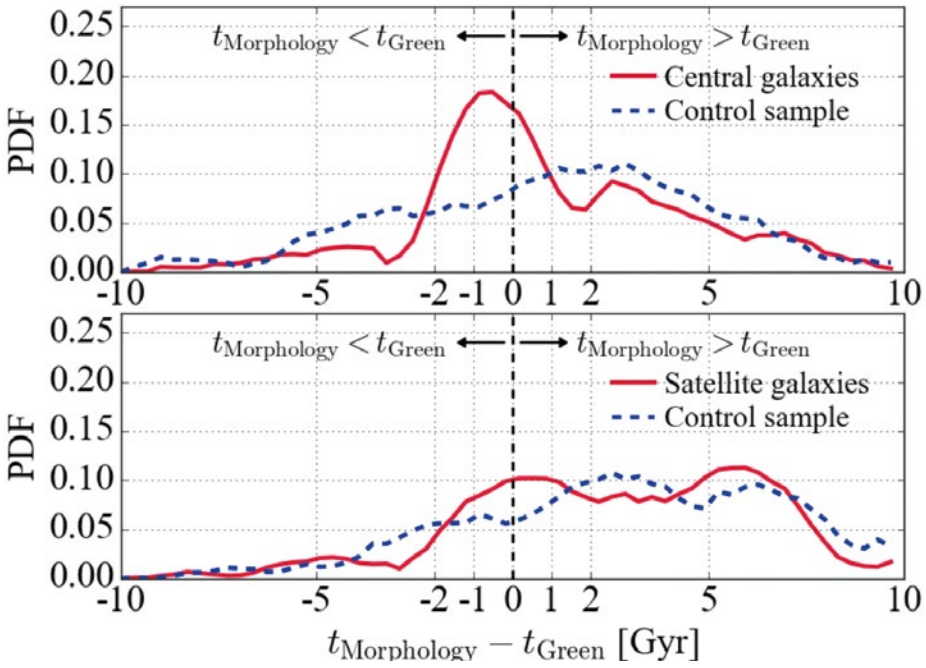


Figure 3: *Distribution of lookback time interval between the colour and morphology transformations of present-day red ellipticals in EAGLE, defined using rest-frame u-r colours and the kinetic energy fraction in corotation, respectively (Correa et al. 2017). We see a small but significant excess in colour transition 0.5±1 Gyr before morphological transition for central galaxies relative to a control sample, with no significant coincidence for satellites.*

Consolidating physical and observable morphologies

While EAGLE provides a detailed physical picture of how diverse morphologies can emerge in a cosmological context, relating the theoretical predictions back to observations is a challenge. This requires an understanding of how observed morphologies relate to physical metrics of morphology already measured for simulations. To this end, the virtual data of EAGLE galaxies can be used to obtain morphologies via observational techniques.

An ongoing project is the integration of virtual EAGLE galaxies into Galaxy Zoo, a citizen science project which allows users worldwide to classify galaxies. EAGLE galaxies are imaged as if they are SDSS targets at redshift 0.05, including matched seeing and cut-out backgrounds from SDSS fields. Despite fixing the observed redshift, galaxies are taken from simulation outputs between redshift 1.5 and the present day (Fig 4). This allows us to obtain classification statistics for an evolving population, which can be related to their physical evolution.

Integral field unit (IFU) instruments are now providing further insights into galaxy structure. Trayford et al. (2019b) explores how the structural properties of EAGLE galaxies manifest resolved scaling relations using physical property maps. Future work modelling virtual IFU data will aim to uncover further insights into structure, kinematics and the systematic uncertainties in morphology associated with these measurements.

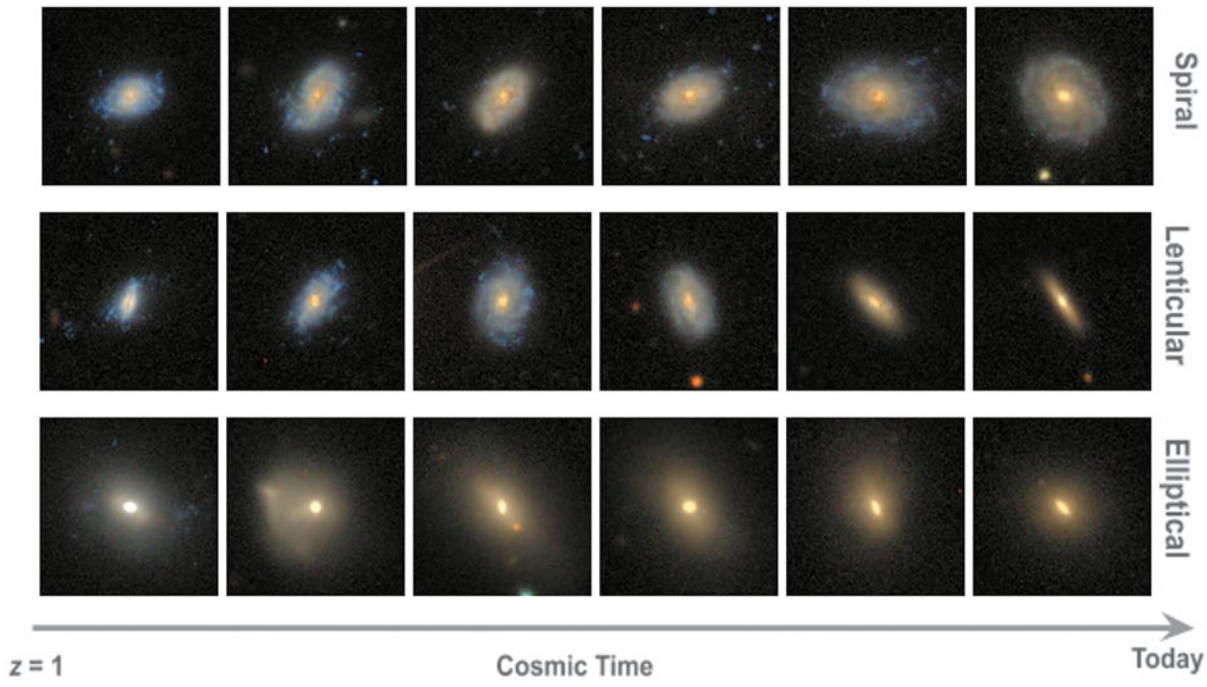


Figure 4: *Mock SDSS images of EAGLE galaxies for Galaxy Zoo, showing the ancestors of three recognisable galaxy types we see in the local universe; a spiral, a lenticular, and an elliptical.*

The interior of Jupiter revealed by the Juno mission

Yamila Miguel

The key to understanding our origins is in the interiors of the giant planets. Because Jupiter was one of the first planets to form, its primordial envelope – accreted from the primitive solar nebula – contains crucial information to understand the physics and the chemistry of the protosolar disk that gave birth to the solar system. In addition, Jupiter is the biggest planet in our system and the most influential one: its large mass shaped the architecture of the solar system, scattering smaller bodies in its migration path and delivering volatile material to the dry regions in our Solar system. Jupiter's interior and atmosphere can tell us the past of the planet, providing fundamental constraints to understand the solar system formation history.

Two of the long standing questions in planetary science have been the existence of Jupiter's core and the depth of the zones and belts observed in its atmosphere: do these zonal winds penetrate deep into the interior of the planet? These questions have important implications for the atmospheric dynamics and to have a better map of the interior structure, composition and distribution of heavy elements in Jupiter's interior.

The Juno mission

In orbit around Jupiter since July 2016, Juno mission has lead to a radical change of our knowledge of Jupiter (Figure 1). It has an unprecedented near-polar orbit with a pericenter at approximately 4000 km above Jupiter's clouds, that provides highly accurate gravity data derived from the analysis of the trajectory of the spacecraft during the flybys. Using this remarkable data of Jupiter's gravity field that improved previous measurements by 2 orders of magnitude (Bolton et al. 2017) we were able to calculate new models to understand Jupiter's interior structure and atmospheric dynamics, changing our paradigm of the interior of Jupiter.

Figure 1: *Schematic representation of the Juno spacecraft around Jupiter. Credit: NASA.*

Jupiter's interior structure

Jupiter's gravity field was mapped with higher precision with the passages of the Voyager and Pioneer spacecrafts. Later on, Cassini and New Horizons provided data, in addition to the Galileo probe, which orbited Jupiter in the 90s. Besides the gravitational (the mass of Jupiter was already derived from the orbits of the satellites), the other important constraints used in interior models are the abundances observed in Jupiter's atmosphere. In addition to the data observed from Earth, the big jump in these measurements was given by the Galileo probe, which entered into Jupiter's atmosphere and made in-situ measurements up to 20 bars (Zahn et al. 1998). These measurements show that Jupiter is enriched in heavy elements compared to the protosun by about a factor of 2 (Atreya et al. 2016), but there is a depletion of He and Ne, and a depletion of H_2O because the probe descended in a dry spot. The depletion in He and Ne is explained by the presence of a phase transition of He in the interior of Jupiter, where He forms droplets that rain down forming an He poor atmosphere and a He-rich interior.

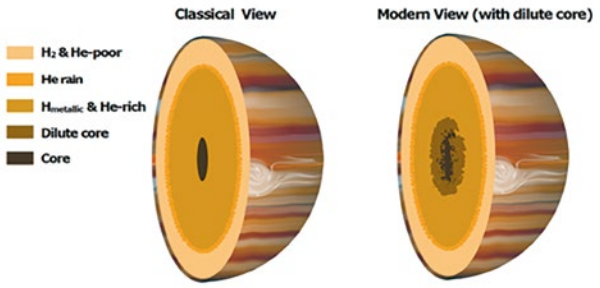


Figure 2: *Schematic representation of Jupiter's interior.*

Interior models

All these measurements help us to understand the interior structure of Jupiter and put constraints on our interior models. Before the Juno mission, our picture of Jupiter was the one shown by the classical model in Figure 2, where Jupiter was composed by an atmosphere made by H_2 and a Helium-poor environment, a deeper envelope mainly composed of metallic hydrogen and He-rich and a core, although our constraints on the core were extremely poor, with models going all the way from no core to a core made by 17 Earth masses (e.g. Saumon & Guillot 2004, Nettelmann et al. 2008, 2012, Hubbard & Militzer 2016, Miguel et al. 2016).

The new data provided by Juno allows us to get a better understanding of the distribution of heavy elements in Jupiter's interior. Our results show that only models with a large difference in the heavy elements between the atmosphere (H_2, He-poor) and the deeper envelope (H-metallic, He-rich) allows us to fit the measurements (Figure 3), showing that Jupiter's envelope is not homogeneous, which implies that mixing was not complete in the planet interior. Our results also show that a dilute core, that slowly diffuses from a central core of pure heavy elements into the H-metallic and He-rich envelope is likely to occur, being the best model to explain Juno measurements (Modern view in Figure 2, Wahl et al. 2017).

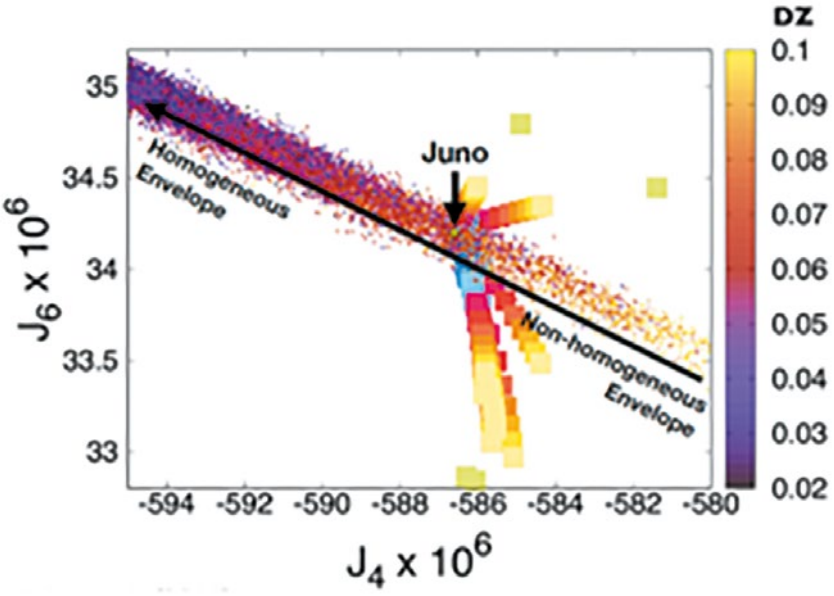


Figure 3: *Gravitational harmonics J4 and J6 for ~20000 simulations. The gradient shows the difference in heavy elements mass fraction between the atmosphere and Jupiter's deep envelope. Models with a zero Dz represent a homogeneous envelope for Jupiter. The Juno data (less et al. Nature 2018) is the yellow point indicated with the arrow. The coloured squares represent different depths for the extent of Jupiter's differential rotation (see Guillot, Miguel, et al. Nature 2018).*

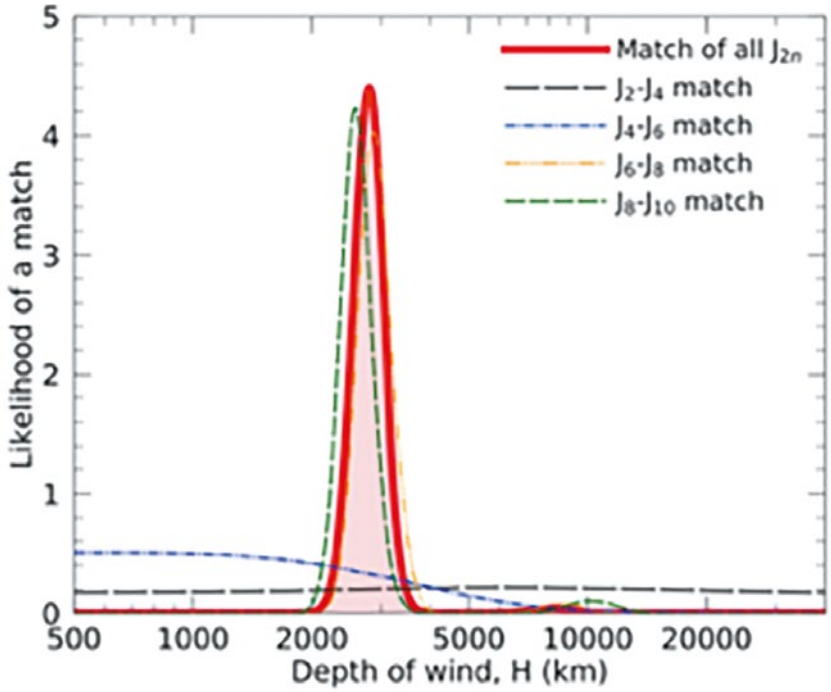


Figure 4: *Likelihood of a match between our combined models (interior+atmosphere) and the Juno data for Jupiter for different depths of the zonal winds. The best results are found for an extent of differential rotation of 3000km (extracted from Guillot et al. Nature 2018).*

Jupiter's zonal winds

Juno also provided gravity harmonics of high order (up to J_{10}), that allowed us to constrain the differential rotation in the planet's interior. A combined analysis of Jupiter's interior with atmospheric circulation models showed us the depth of Jupiter's zonal winds that explains all the observational constraints observed by Juno.

Our results show that Jupiter's zonal winds extend deep into the planet, at approximately 3000 km (Figure 4) – 4 percent of Jupiter radius – and involve approximately 3 Earth masses of gas (Kaspi et al. Nature 2018; Guillot et al. Nature 2018). This indicates that the weather layer of Jupiter is more massive and extends much deeper into the planet than expected. The new gravity measurements also show the evidence of a North-South asymmetry, that could be seen due to the large amount of mass contained in the winds, that made a non-zero signal in the gravity data (Iess et al. Nature 2018). Finally, we also show that beneath that climate layer, the planet essentially rotates as a rigid body, which has important implications for understanding the possible mechanisms driving the winds and for interior models of the planet (Guillot et al. Nature 2018). These results, besides allowing us to start seeing the planet in 3D, are highly relevant to improve our understanding of Jupiter's interior structure, its core and, eventually, its origin.

References

— Atreya, S.K., Crida, A., Guillot, T., et al., 2016, arXiv 1606.04510

— Bolton, S. J., Adriani, A., Adumitroaie, V., Allison, M., Anderson, J., Atreya, S., Bloxham, J., Brown, S., Connerney, J. E. P., DeJong, E., Folkner, W., Gautier, D., Grassi, D., Gulkis, S., Guillot, T., Hansen, C., Hubbard, W. B., Iess, L., Ingersoll, A., Janssen, M., Jorgensen, J., Kaspi, Y., Levin, S. M., Li, C., Lunine, J., Miguel, Y., et al., 2017, Science, 356 (6340), 821-825.

— Guillot, T., Miguel, Y., Militzer, B. et al. , 2018, Nature, 555, 227–230 (doi:10.1038/nature25775)

— Hubbard, W. B., & Militzer, B. 2016, ApJ, 820, 80

— Iess, L., Folkner, W.M., Durante, D., Parisi, M., Kaspi, Y., Galanti, E., Guillot, T., Hubbard, W.B., Stevenson, D.J., Anderson, J.D., Buccino, D.R., Gomez Casajus, L., Milani, A., Park, R., Racioppa, P., Serra, D., Tortora, P., Zannoni, M., Cao, H., Helled, R., Lunine, J.I., Miguel, Y., et al., 2018, Nature, 555, 220-222 (doi:10.1038/nature25776)

— Kaspi, Y. , Galanti, E., Hubbard, W.B., Stevenson, D.J., Bolton, S.J., Iess, L., Guillot., T., Bloxham J., Connerney J.E.P., Cao, H., Durante, D., Folkner, W.M., Hellede, R., Ingersoll, A.P., Levin, S.M., Lunine, J.,I., Miguel, Y., Militzer, B., Parisi, M., Wahl, S., M. , 2018, Nature, 555, 223-226 (doi:10.1038/nature25793)

— Miguel, Y., Guillot, T., & Fayon, L. 2016, A&A, 596, A114

— Nettelmann, N., Holst, B., Kietzmann, A., et al. 2008, ApJ, 683, 1217

— Nettelmann, N., Becker, A., Holst, B., & Redmer, R. 2012, ApJ, 750, 52

— Saumon, D., & Guillot, T. 2004, ApJ, 609, 1170

— von Zahn, U., Hunten, D. M., & Lehmacher, G. 1998, J. Geophys. Res., 103, 22815

— Wahl, S. M., Hubbard, W. B., Militzer, B., Guillot, T., Miguel, Y., Movshovitz, N., Kaspi, Y., Helled, R., Reese, D., Galanti, E., Levin, S., Connerney, J. E., Bolton, S. J., 2017, Geophys. Res. Lett., 44 (11), 4649-4659

Small molecules tell a tale about planet formation

Michiel Hogerheijde

Planets circle almost every star in the Galaxy, and it has been long known that planetary systems are necessary byproducts of the formation process of stars. As the interstellar cloud from which the star forms collapses, conservation of angular momentum will funnel some of the gas and dust into a disk around the young star. Such disks were first observed several decades ago, and low resolution images obtained with millimeter interferometers such as the Owens Valley Millimeter Array and the Plateau de Bure Interferometer already allowed a rough characterization of their masses, sizes, and compositions.

With the completion of construction of the Atacama Large Millimeter Array in 2012, the past few years have seen a true revolution in our understanding of disks. This concerns what we know about how the material in the disk is distributed, how the grains evolve into planetesimals, and how volatile elements like carbon, oxygen, and nitrogen are stored in the disk. This last issue is especially relevant to understand how planet Earth ended up with its ocean and atmosphere – and not least, why Earth is so relatively poor in these elements – and how rocky planets in other systems may be similarly provided with these essential elements for life.

The many ring worlds discovered by ALMA

One of the greatest surprises from ALMA, resulting from what is perhaps ALMA's most iconic image (Figure 1), is the discovery that dust particles inside the planet-forming disk around the 0.5 Myr-old star HL Tau have accumulated in a series of concentric rings separated by partially cleared out gaps. Although this was expected for evolved disks, where gas giant planets have already formed, cleared out their surroundings and shepherded the remaining dust in rings, no one had foreseen that a disk of such a young age would already show this structure. Did planets already form inside this disk, implying that planet formation is much faster than expected? Or do gas-pressure variations `trap' dust in concentric rings?

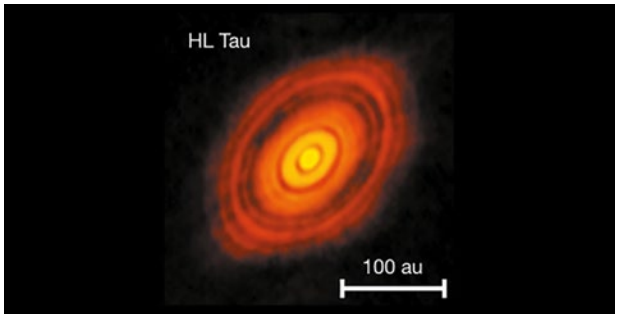


Figure 1: *The iconic image of the planet forming disk around the young star HL Tau. The dust particles are seen to have accumulated in a series of concentric rings, separated by partially cleared-out gaps. Reference: ALMA Partnership et al. (2015).*

Rings and gaps are not limited to limited to the disk around HL Tau. Virtually every disk that is imaged with ALMA at sufficiently high resolution shows that the dust has accumulated in a set of rings separated by gaps of a variety of depths and widths. As an example, Figure 2 shows two such disks, HD163296 and HD169142. Both these disks show rings in the dust emission. And when studied in gas tracers like CO or one of its isotopes like ^{13}CO or C^{18}O the gas is found to show strong radial variations, although this is often distributed over a wider region than the dust rings and often still partially fills the gaps. With dust and gas measurements together, hydrodynamical models can then be used to find the mass of planets that could clear out the necessary structures, and masses of 0.1-10 times that of Jupiter are often inferred. Interestingly, detailed studies of the gas motions have confirmed such planet masses in at least one disk (HD163296).

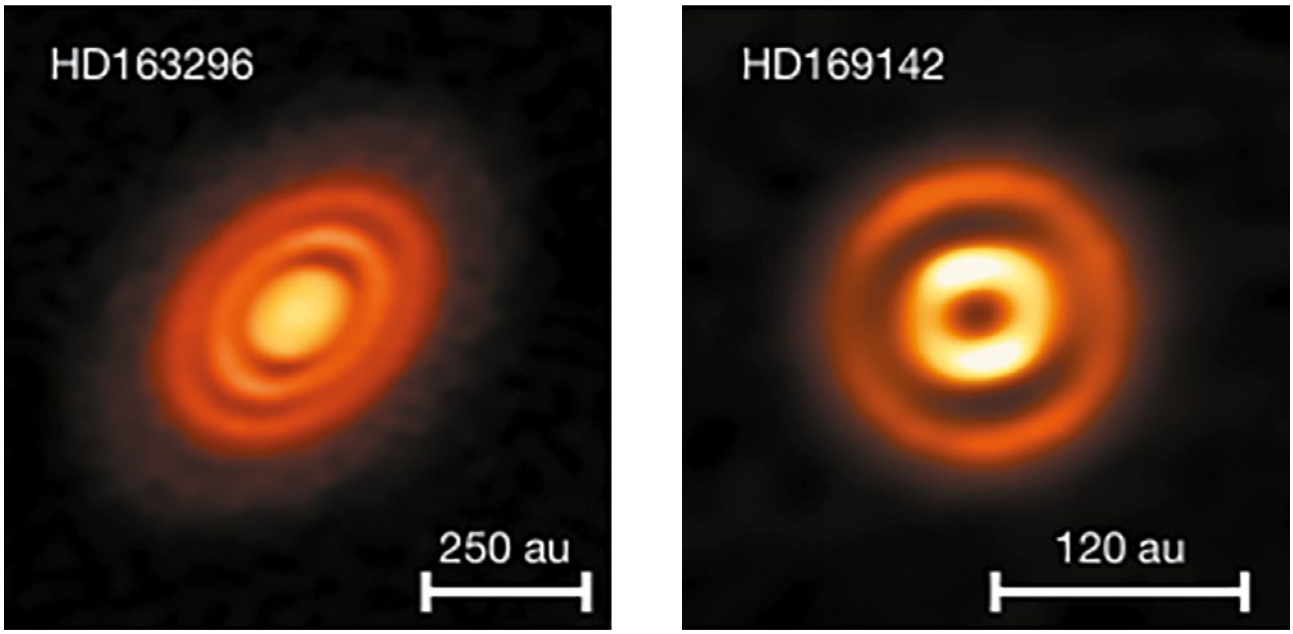


Figure 2: *Like many other disks, also the disks around HD163296 (left) and HD169142 (right) break up in rings and gaps when imaged with high resolution in thermal dust emission using ALMA. References: Isella et al. (2016) and Fedele, Carney, Hogerheijde et al. (2017).*

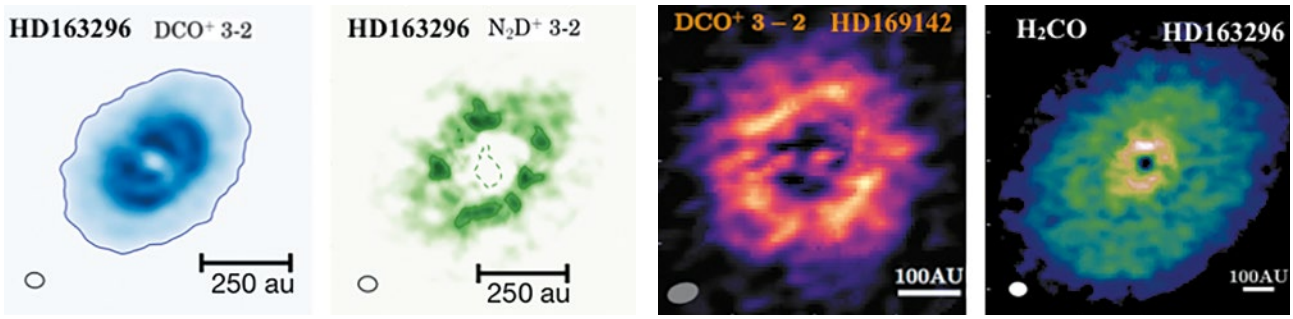


Figure 3: *N_2D^+, DCO^+ and H_2CO show clear radial structure in the disks of HD163296 and HD169142, that reflects how the evolving dust population affects the chemistry. References: Salinas, Hogerheijde et al. (2017, 2018); Carney, Hogerheijde et al. (2017); Carney, Fedele, Hogerheijde et al. (2018).*

Small molecules and grains of all sizes

Dust grains do not only play a role as the material from which planetesimals need to coalesce, they are also crucially important for the gas chemistry. Grains come in many sizes, from 0.1 microns to millimeter or centimeter in size. There is clear evidence that inside disks grains coagulate and that their size distribution evolves toward larger sizes. As grains grow, they decouple dynamically from the gas, settle to the midplane and drift inward toward the star. This radial drift stops when they reach regions where gas densities are again large enough. If the grains grow further, they start to drift in again.

As a result of grain growth and drift, ever smaller amounts of small grains remain in the outer disk regions. These small grains provide the bulk of the opacity to the ultraviolet radiation originating from the star, and as they decrease in number, the ultraviolet photons can penetrate deeper into the disk. There they heat the gas and photodissociate molecules, but they can also liberate some molecules that have frozen out onto cold grains through a process called photodesorption.

Because the gas chemistry changes in response to the increased influence of ultraviolet as the grain population evolves, the distribution of key molecules across disks can tell us much about how this dust evolution is proceeding. At the same time, these key molecules also carry an important fraction of the volatile elements C, O, and N. How much of these elements are frozen out onto icy grains, and available for future rocky planets, and how much are in gaseous molecules that can only end up in gas giant planets, is a crucial question that determines the habitability of planetary systems.

ALMA observations of e.g. CO, N_2D^+, DCO^+ and H_2CO in the disks of HD169142 and HD163296 (Figure 3) show that many of these species show radial variations that can be immediately connected to changes in the dust population in these disks. N_2D^+ can only be present when CO is frozen out by large factors, and is naturally confined radially to regions where temperatures are low enough for this. DCO^+ also requires very cold regions, but small amounts of CO do still need to be present in order for this molecule to form; when too much CO is present, HCO^+ will form instead. DCO^+ is therefore confined to an even narrower region of 'just-little-enough' CO. H_2CO, finally, forms both through gas phase reactions and inside ice layers on cold grains through hydrogenation of CO ice. The increase in abundance of this molecule in the outer regions of the disk can be explained if ultraviolet radiation can reach deeper into the disk here, and photodesorb CO and H_2CO into the gas.

As these three simple molecules show, the growth, settling and radial drift of grains leave clear imprints on the gas chemistry by the evolution of the grains as they grow, settle and drift inward, along their path toward planet(esimal) formation. This in turn determines the fate of volatile elements like C, O and N. Future ALMA observations will reveal what molecules like these can tell us about how grains evolve toward planetesimals in a wide population of disks, and how planets acquire the volatiles that are essential to life.

Hunting for Orion's Dragon with SOFIA

Cornelia Pabst

The Stratospheric Observatory for Infrared Astronomy (SOFIA, Figure 1) is a unique facility for observations in the infrared wavelengths. It is a heavily modified Boeing 747SP, the largest airborne observatory to date. Several science instruments can be mounted to its 100-inch mirror, measuring from the near-infrared to the far-infrared. The great advantage as compared to a satellite is the interchangeability of the instruments. Since the aircraft lands after each flight, the instruments can also be further improved and developed.

One of these instruments is upGREAT, the upgrade of the German Receiver for Astronomy at Terahertz Frequencies. It has been developed by groups at the University of Cologne and the Max-Planck Institute for Radioastronomy in Bonn. Its speciality is the [CII] line at 158 microns; [CII] denotes the fine-structure transition of singly-ionized carbon, a ubiquitous emission line of the interstellar medium (ISM). In fact, the [CII] line is the brightest far-infrared (FIR) cooling line of the ISM, carrying

Figure 1: *SOFIA in morning light in Palmdale, California.*

up to 5% of the total FIR luminosity. According to our current understanding, interstellar gas is heated by the photo-electric effect acting on small dust grains and large molecules. It cools through line emission of trace elements, such as carbon and oxygen. With upGREAT we can not only measure the total intensity, but also the line profile, giving us velocity information on the gas.

Our group proposed to map the Orion Nebula in the [CII] line. The illustrious Orion Nebula (M42) is one of the best-studied structures of our universe. It is the most nearby site of massive star formation, at a distance of about 400 parsec from us. Since it lies just out of the Galactic plane, it can be readily observed. Earlier, the central region of the Orion Nebula, the Huygens region hosting the most massive stars of the complex, has been mapped in [CII] using the HIFI instrument onboard Herschel (Goicoechea et al. 2015). We, however, aim for the entire Orion Nebula (the Extended Orion Nebula, EON) plus the adjacent nebulae M43 and NGC 1973, 1975 and 1977 to the north. With SOFIA/upGREAT this has become feasible due to a 50-fold increase in mapping speed.

Each 10 hour observing flight takes off at Palmdale, California. To be on board as a guest observer is an exhilarating experience. You get to see beautiful sunsets over the Pacific Ocean, San Francisco from above, or the Sierra Nevada lying still in the early morning light. Moreover, we had the opportunity to join the pilots in the cockpit for take-off or landing. During the climb leg the instrument team is setting up their systems. Our observing legs are about 3 hours of one flight, 40 hours in total. That leaves ample time for another stroll to the cockpit to chat with the pilots or for being interviewed by one of the many journalists on board. During the observation leg there is not much to do for us as guest observers, everything is perfectly prepared. Only in case of unforeseen last-minute decisions we are consulted on our preferences.

At the end of our flight series we have gathered more than 2 million [CII] spectra. The processing of this vast amount of spectra is a challenge. New tools have to be developed as we proceed. In the end the full data reduction process takes about 1.5 years.

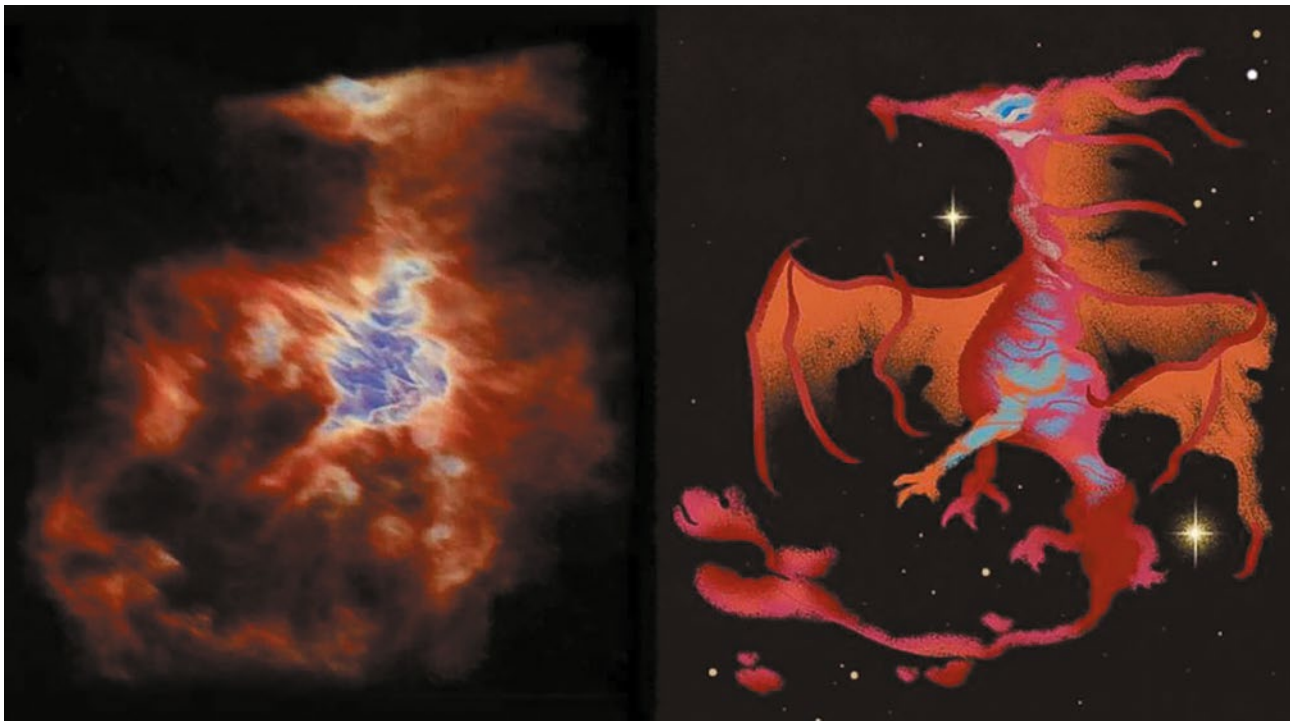


Figure 2: *Orion's dragon. Left: The real data in color scale (blue: high intensity, red: low intensity). Right: Cartoon of Orion's dragon. Image Copyright: American Institute of Physics (Inside Science/Abigail Malate)*

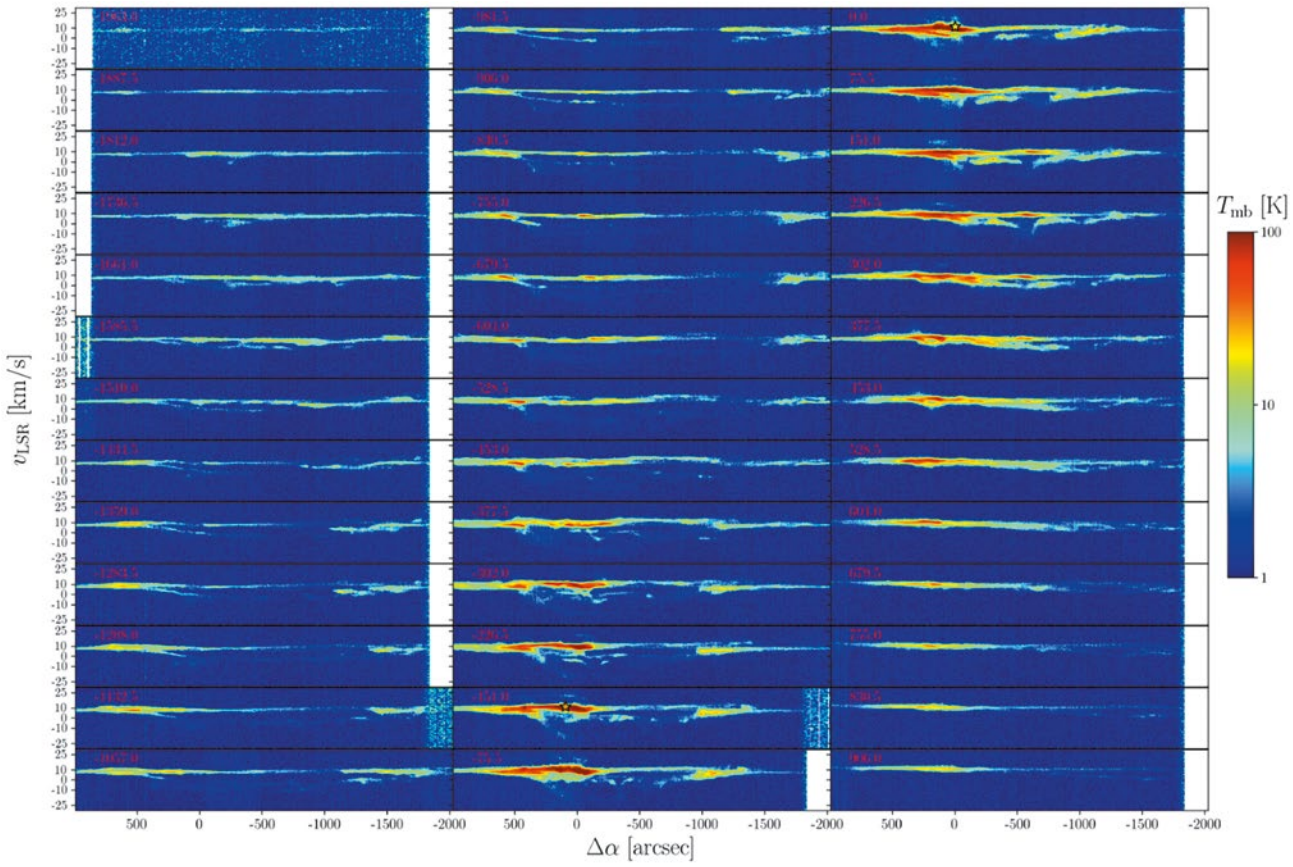


Figure 3: *Horizontal [CII] pv diagrams from the Orion Nebula. We note the persistent arc structure additionally to the [CII] emission from the background molecular cloud at 8 km/s. The yellow star indicates the position of θ¹ Ori C; the orange star is θ¹ Ori A.*

When plotting the [CII] data in 3D, with the third axis being the velocity axis, and rotating the data cube, we see Orion's dragon emerge (Figure 2). A more quantitative analysis of the data yields insight into the dynamics and energetics of the region. A useful tool are position-velocity (pv) diagrams. We slice the region of the EON into 40 strips, both horizontally and vertically, and average the pv diagrams over 75.5 arcsec each. This results in the discovery of the surprisingly spherical expansion of the EON. The arc structures, corresponding to the so-called Veil, seen in all pv diagrams are consistent with an expansion velocity of about 13 km/s (Figure 3). With a mass of the expanding gas of 2600 solar masses (estimated from the dust maps of Herschel/PACS and SPIRE), this corresponds to a kinetic energy of 4×10^{48} erg. As X-rays have been detected in the interior of the limb-brightened bubble (Güdel et al. 2008), it has been inferred that the bubble is caused by the stellar wind of the massive stars in the inside, notably θ¹ Ori C, an O7V star. We compare our observations with models of wind-blown bubbles (Castor et al. 1975). From this we compute an expansion time of about 0.2 Myr. The wind of θ¹ Ori C is powerful enough to drive the large-scale expansion of the surrounding gas (Pabst et al. 2019). Eventually the bubble will break open, releasing its content into the environing medium and rejuvenating the material in the Orion-Eridanus superbubble. While θ¹ Ori C ages, it moves rapidly away from its natal molecular cloud and will have reached a considerable distance from it by the time it goes supernova.

Not only are [CII] line observations an effective means for the study of the dynamics of the neutral ISM, the interaction between massive stars and their environment, [CII] emission has also been used as a tracer for star-formation activity in distant galaxies. With our observations of the Orion Nebula

complex we cover a rich variety of regions with different physical conditions and can determine their individual contributions to the total [CII] luminosity. Correlating [CII] observations with observations of other gas and dust tracers (e.g. 8 micron emission from polyaromatic hydrocarbons (PAHs), CO line observations, FIR photometry, see Figure 4) allows us to form a model of the specific structure and determine the origin of different tracers. For instance, [CII] seems to be well-correlated with PAH emission, stemming from the UV-illuminated surface of molecular clouds, but less so with CO emission, radiating from the cloud interior (Pabst et al. 2017). As we possess velocity information, as well, we can discern distinct structures within the gas. Plenty of smaller dynamic events show as arc structures in the pv diagrams, each deserving a study of its own.

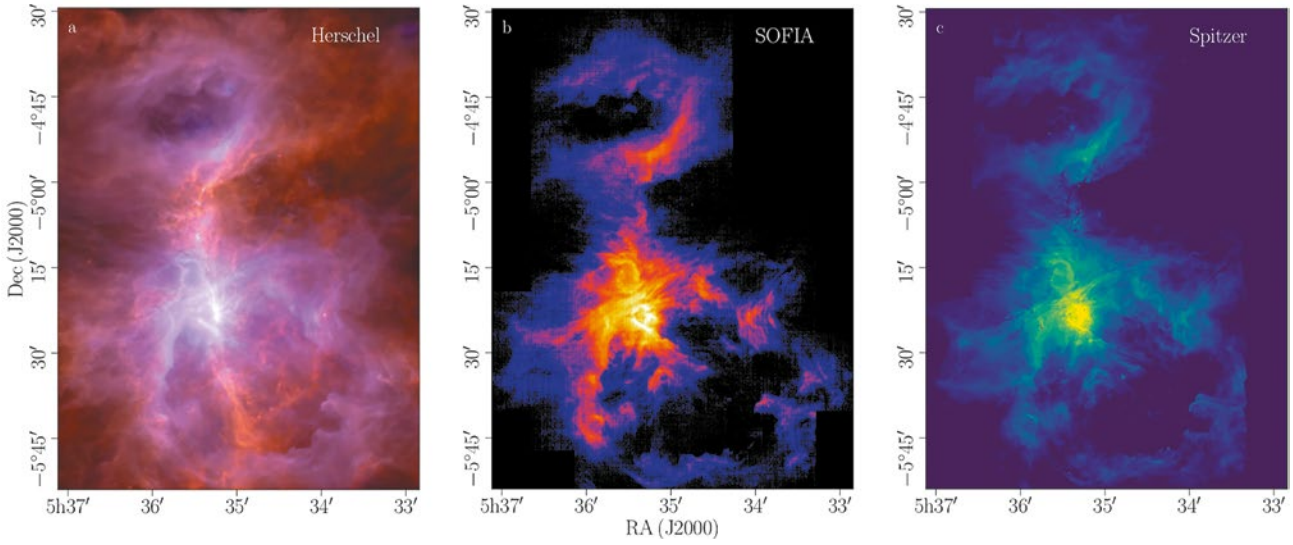


Figure 4: *Three-observatory view of the Orion Nebula with M43 and NGC 1973, 1975 and 1977. a) Herschel/PACS 70 microns (blue) and 160 microns(green) emission, tracing warm dust, and SPIRE 250 micron emission (red), tracing cold dust. b) SOFIA/upGREAT line-integrated [CII] emission. c) Spitzer/IRAC 8 micron emission tracing UV-irradiated PAHs.*

References

— Castor et al., 1975, ApJ, 200, L107

— Goicoechea et al., 2015, ApJ, 812, 75

— Güdel et al., 2008, Science, 319, 309

— Pabst et al., 2017, A&A, 606, A29

— Pabst et al., 2019, Nature, 565, 618

PhD Defences

NAME	DATE	SUPERVISOR	THESIS TITLE
G.J. Talens	19-12-2018	Snellen	Don't Blink: Detecting transiting exoplanets with MASCARA
M.T. Carney	06-12-2018	Hogerheijde/ Van Dishoeck	Protoplanetary Disk Anatomy: examining the structure and chemistry of planetary birthplaces with simple molecules
M.J. Wilby	27-11-2018	Keller/ Kenworthy	Painting with Starlight Optical techniques for the high-contrast imaging of exoplanets
Y.M. Welling	27-11-2018	Kuijken/ Achucarro	Spectroscopy of two-field inflation
A.R. Ridden-Harper	21-11-2018	Snellen/Keller	Inferno Worlds
C.R. Barber	20-11-2018	Schaye	Monsters in the Deep: Using simulations to understand the excess baryonic mass in the centres of high-mas, early type galaxies
S. Zeegers	01-11-2018	Tielens/ Costantini (SRON)	X-ray spectroscopy of interstellar dust: From the laboratory to the Galaxy
C. Eistrup	16-10-2018	Van Dishoeck	From Midplane to Planets: The Chemical Fingerprint of a Disk
J.J.A. Matthee	19-09-2018	Rottgering/ Schaye	Identifying the origins of galaxy formation

NAME	DATE	SUPERVISOR	THESIS TITLE
A.-S. Bak Nielsen	13-09-2018	Portegies Zwart/ Patruno	Spin evolution of accreting and radio pulsars in binary systems
P. Castellanos Nash	28-06-2018	Tielens	Breaking & Entering: PAH photodissociation and top-down chemistry
K. Chuang	20-06-2018	Van Dishoeck/ Linnartz	The formation of complex organic Molecules in Dense clouds – sweet Results from the Laboratory
K.D. Doney	20-06-2018	Linnartz	Infrared spectroscopy of astrophysically relevant hydrocarbons
J. Mao	07-06-2018	Kaastra	Astrophysical plasma modeling of the hot Universe: Advances and challenges in high-resolution X-ray spectroscopy
J.J.F.J. Jansen	22-05-2018	Van Lunteren	The Ornithology of the Baudin expedition (1800-1804)
A.R. Hill	18-04-2018	Franx	Some Assembly Required: The Structural Evolution and Mass Assembly of Galaxies at z<5
J.C. Mackie	29-03-2018	Tielens	The Anharmonic Infrared Spectra of Polycyclic Aromatic Hydrocarbons
A. Miotello	07-03-2018	Van Dishoeck	The puzzle of protoplanetary disk masses
J. de Boer	10-01-2018	Keller	High-contrast imaging of protoplanetary disks

Publication Overview

*Over the year 2018, scientists at Leiden Observatory have published a total of **528 articles** in international refereed journals. Astronomy and Astrophysics (178 articles), the Astrophysical Journal and Letters (88 articles), and the Monthly Notices of the Royal Astronomical Society (175 articles) published together 84% of all the papers, as reported by the Astrophysics Data System.*

The complete list can be found at: https://local.strw.leidenuniv.nl/annual-reports/annualreport.php

Anthony Brown in Nature's 10: Highlighting the importance of Gaia's second data release

By Iris Nijman

On 25 April 2018, ESA's Gaia mission revealed the most precise 3D map yet of our Galaxy. This second data release provided the richest star catalogue to date, detailing the positions and movements of more than 1.3 billion stars. Behind this incredible work is a group of more than 400 scientists and software engineers, the Data Processing and Analysis Consortium. Leiden astronomer Anthony Brown leads this consortium and is part of Nature's 10: the ten people who mattered in science in 2018.

How did it feel to be part of Nature's 10?

"It was a complete surprise. Honestly, I had never heard of Nature's 10 before. But I am very happy that Nature emphasised the importance of Gaia in this way. This release has had an enormous impact on the astronomical community. Me being part of Nature's 10 honours the whole consortium of 430 people who worked incredibly hard on this for years."

Where were you on 25 April 2018?

"I was at the ILA Berlin Air Show, where we held a press conference with ESA for the second data release. It was a very exciting day, because we released it at the same time for the whole scientific community."

Had you not seen the data before the release?

"No, I had not done any science with it before. Very early on in the mission, we decided that we would release the data at the same time for everyone, to make it public immediately. At the same time, our team published six scientific articles about the various aspects of the data, to describe the quality. It was very exciting to see how the whole community was eagerly awaiting the release and started using the data immediately. For example, the Flatiron institute New York was ready for it at 5 am in the morning."

Since the release, Gaia's data set has been cited in more than 1000 research papers. Is there one that stands out for you?

"For me the most spectacular discovery, coordinated by Teresa Antoja and Amina Helmi, is that the evolution of our Milky Way is more complicated than we expected. It is not a balanced system, but rather it is disturbed by interactions with other galaxies such as the Sagittarius dwarf galaxy. This is something we could not see before."

"Another exciting aspect about Gaia's second data release is that it contains close to half a million white dwarfs, where before only 33,000 were known. It shows us the distances to these objects and their individual brightness and colour. As a result, we can see how white dwarfs change at the end of their lifetime when they cool down and their cores crystallize. This was predicted fifty years ago, but has not been seen this clearly before."

How long have you been working for the Gaia mission?

"During my early postdoc years, I worked with data from Gaia's predecessor Hipparcos and worked out some questions related to the science case for Gaia. When I came back to the Netherlands in 2001, the first working groups in preparation of Gaia were being formed and I started to work on specific aspects of the mission, such as optimising the photometric system. We needed to know exactly how to measure the colours of the stars, to be able to characterise them. Since 2005, I have dedicated most of my time to Gaia."

What does your day-to-day work look like?

"As leader of the consortium, much of my time involves coordinating with, and meeting the teams, solving problems and making important decisions for the mission. Next to that, I supervise PhD and Master's students in Leiden, which gives me an opportunity to continue doing science."

Did you expect that this would be your job when you were a student?

"No, I did not expect that my job would involve more human resource management than science. But I still enjoy it, because of the important goal behind it: making sure the data is released successfully and on time. I love to see how colleagues all around the world work together to use the data and how much impact it has on the community. Astronomy made a huge leap forward because of all the knowledge that the mission brought with it. That motivates me."

How do you manage stressful situations?

"I try to stay calm. And sometimes I plan a day or two to play with the Gaia data myself."

Will you be involved in the next data release as well?

"Yes, I will lead the consortium until at least 2021. In 2020 we will publish a photometric and astrometric update. And in 2021 we will release much more information about the precise colours and properties of the stars. That database will also contain binary stars. For the release thereafter, we are aiming to also include a catalogue of an estimated 20,000 giant exoplanets."

Interview with Carole Jackson: “Every skill you learn is useful”

By Iris Nijman

A career in industry and several key roles in Australia’s endeavours towards the international Square Kilometre Array (SKA) have led Radio Astronomy Professor Carole Jackson to her dream job as General and Scientific Director of ASTRON, the Netherlands Institute for Radio Astronomy. Here, she continues to play a significant role in the next phase of the SKA and the Low Frequency Telescope (LOFAR), while keeping in mind what it’s all about: doing great science.

What made you decide to move to the Netherlands and to start working for ASTRON?

“During my entire career as a radio astronomer, I have always known ASTRON. When I was working in Australia as the Director of the Curtin Institute of Radio Astronomy, it was a priority for me to visit ASTRON once a year. Because of its very dedicated group of scientists and support staff, it has always been the place to be for radio astronomers. Therefore, it has been my dream to become the director of ASTRON.”

What makes ASTRON special?

“What is so great about the institute, is that it contains all parts of the operation in one building: the scientists, the engineers and the telescope operators. We also have a lot of visitors passing through. This leads to fantastic corridor conversations and interesting discussions, for exampleabout telescope calibrations.”

How has it been to move to the Netherlands?

“Wonderful. Very different than the UK and Australia, but in a good way. I like the Dutch culture of openness, honesty and respect. You can be very direct in how you express yourself and people with different ideas can work successfully side by side. This has huge advantages for the work sphere and for getting things on the table.”

What do you like most about your work for ASTRON?

“I feel very privileged to represent the institute as a whole and the full range of work that we are doing. For example, we recently published the first phase of a major new radio sky survey using LOFAR. 26 research papers describing the results were published in the journal Astronomy & Astrophysics in February 2019. That was a major achievement of which I am very proud.”

What have been the biggest achievements for ASTRON in 2018?

“In September, we celebrated the 50th anniversary of the Westerbork Synthesis Radio Telescope by officially launching the new receiver Apertif, which increases the field-of-view 37 times. This upgrade has been an institute-wide effort, where many people

from different disciplines collaborated closely. 2018 also marked the continuous success of LOFAR. One aspect is our incredible international engagement: Italy officially became a partner in April, and a new station in Ireland opened earlier in 2017. We also secured the NWO Large Grant for DUPLLO, a major upgrade for LOFAR that will greatly enhance its sensitivity. In May 2018, the Netherlands Chinese Low-Frequency Explorer (NCLE) was successfully launched on the relay satellite Chang'e 4 to an orbit behind the Moon. With this radio antenna, we want to measure radio waves originating from the period directly after the Big Bang, when the first stars and galaxies were formed. Last, but not least, we have delivered a number of important parts for the SKA pre-construction design."

What are you working towards with ASTRON?

"I just came back from Italy (March 2019), where the Netherlands along with six other countries signed the treaty for the Square Kilometre Array Observatory (SKAO), the intergovernmental organisation (IGO) tasked with delivering and operating SKA. The Dutch Ministry of Education, Culture and Science allocated 30 million Euros for the Dutch participation in SKA. ASTRON hosts the SKA office for the Netherlands and will be working with our international partners to deliver the full success of this new global telescope."

"Additionally, the LOFAR 2.0 design is now fully underway. All LOFAR stations will be upgraded in the coming years, which will increase LOFAR's sensitivity, particularly in the low frequencies. Currently, we can only observe with either the low-band or the high-band antennas at any one time. But with the upgrade we will be able to use both types of antennas at the same time. This will allow us to study very old emission from radio galaxies—a field of research that I am particularly interested in."

What is your connection to Leiden Observatory?

"After I started working for ASTRON, I was also appointed Radio Astronomy Professor at Leiden University. The research into radio continuum survey science at Leiden is personally a huge bonus for me—here is a frontline group with great students and postdocs publishing in the subject I know and love."

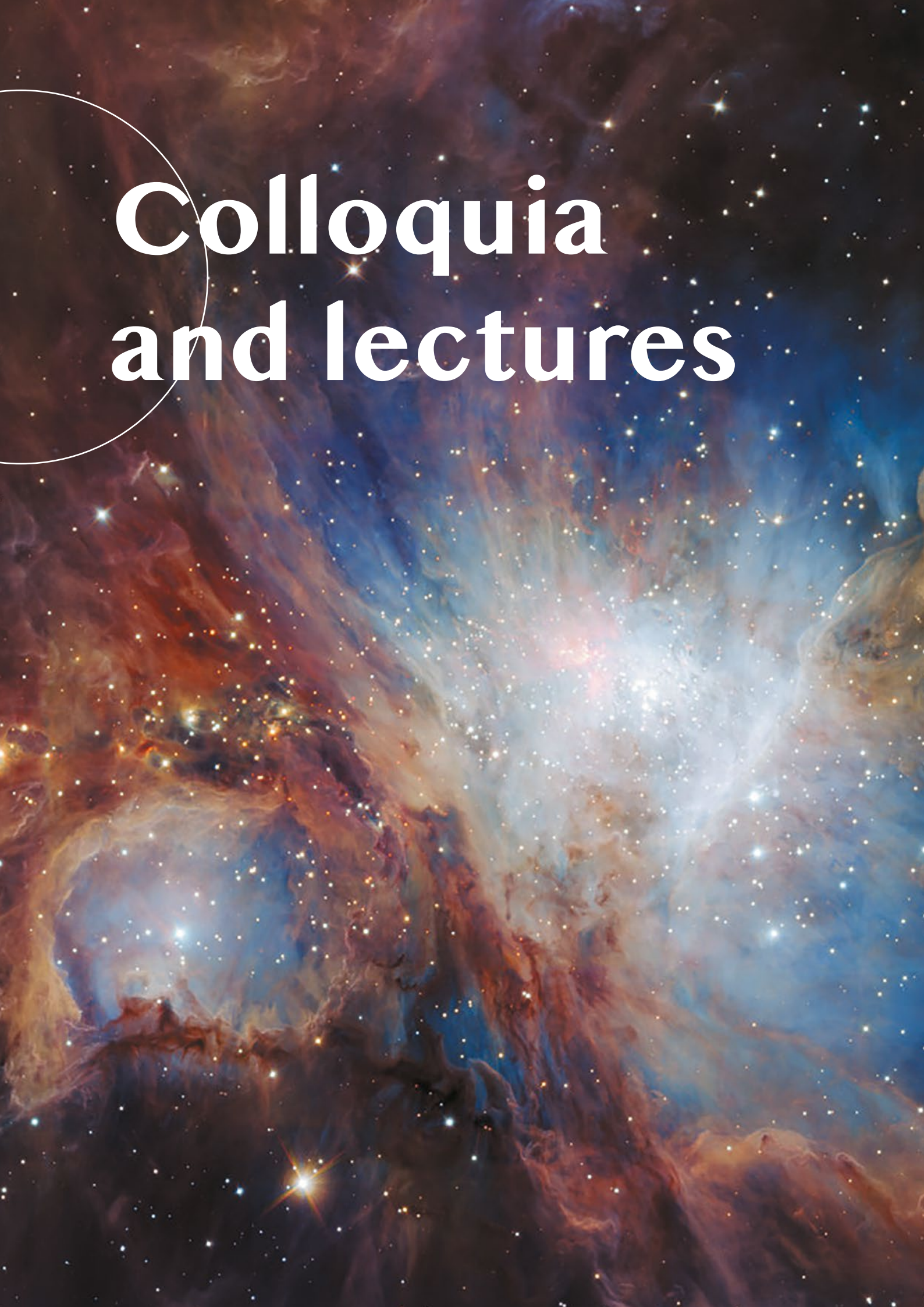
What is your view on the collaborations between ASTRON and Leiden Observatory?

"The linkages between ASTRON and Leiden are very strong. Both entities have a clear, and quite deliberate overlap of expertise built from the exploitation of LOFAR, particularly for survey-based science research. I see this as hugely successful symbiosis, evidenced through the A&A special issue. This also points to a long and impactful future where this expertise, shared and distributed between ASTRON and groups like that in Leiden, is fully transferable to the SKA."

What made you decide to get a degree in astronomy after working in industry?

"I was always good in physics and math and I loved astronomy—and I am old enough to have seen Neil Armstrong walking on the Moon. But after high school, I chose not to go to university but to start working in industry, because I wanted to know how the world of business functioned. After 10 years, I decided I it was time to try to be a professional astronomer. So, I went to Cambridge University where I got my physics degree and PhD, and then relocated to Australia. My industry experience has turned out to be very valuable in all of my roles, and particularly at ASTRON. A sizable part of my role is in leadership, organisational development and of course working with individuals to build the best teams and successes. In my experience, every skill you learn is useful."

Colloquia and lectures



Scientific colloquia

25 January 2018

Neutron star dynamics

Mehmet Ali Alpar, Sabanci University

01 February 2018

Multi-Messenger GW-EM Astronomy: A Radio View

Dale Frail, National Radio Astronomy Observatory

15 February 2018

Hunting for Cool Brown Dwarfs with WISE

Michael Cushing, University of Toledo

08 March 2018

Hunting for Exomoons and Other Cool Worlds

David Kipping, Columbia University

29 March 2018

New Views of Debris Disks with Millimeter Interferometry (NOVA colloquium)

David Wilner, Harvard-Smithsonian Center of Astrophysics

12 April 2018

Inside-Out Planet Formation

Jonathan Tan, Chalmers University of Technology and University of Virginia

26 April 2018

The search for life on planets around other stars (Oort Lecture)

James Kasting, Penn State University

03 May 2018

The Plurality of Worlds

Amaury Triaud, University of Cambridge

17 May 2018

Black hole demography in the era of gravitational-wave astronomy

Michela Mapelli, University of Innsbruck and Astronomical Observatory of Padova

24 May 2018

Gas stripping and star formation in galaxies: the GASP survey

Bianca Poggianti, Padova Observatory

07 June 2018

The interstellar medium at high redshift

Roberto Decarli, MPIA Heidelberg

20 September 2018

Models of Circumstellar Chemistry in AGB Stars

Tom Millar, Queen's University Belfast

27 September 2018

Gravitational waves, BlackGEM and new old problems in astronomy

Paul Groot, Radboud University

04 October 2018

Testing General Relativity using a pulsar in a triple system

Anne Archibald, University of Amsterdam

11 October 2018

Dissecting the Nearest Spiral Galaxies with the Hubble Space Telescope (Sackler Lecture)

Julianne Dalcanton, University of Washington

18 October 2018

The heaviest Stars and Black Holes in the Universe

Jorick Vink, Armagh Observatory

25 October 2018

Visualisation and exploration of the Gaia archive and other very large data sets

Andre Moitinho de Almeida, University of Lissabon

01 November 2018

Chemistry of Planet Formation

Karin Öberg, Harvard-Smithsonian Center for Astrophysics

08 November 2018

Radiation feedback and the dispersal of cluster-forming molecular clouds

Eve Ostriker, Princeton University

15 November 2018

Uncovering the nature of dark matter with stellar streams in the Milky Way (NOVA colloquium)

Ana Bonaca, Harvard-Smithsonian Center for Astrophysics

22 November 2018

New simulations and observations of highly-complex molecules in star-forming regions (NOVA colloquium)

Robin Garrod, University of Virginia

29 November 2018

Embedding Gender Equality in Universities – The QUB Experience

Tom Millar, Queen's University Belfast

Endowed lectures

The Oort Lecture

The Oort Lecture is an annual event, in memory of the famous Dutch astronomer, organized by the Jan Hendrik Oort Foundation and Leiden Observatory. The lecture covers an astronomical subject of current interest and is intended for a general audience with an interest in astronomy. This year's lecture was presented by ***Prof. James Kasting*** *and took place in the Academy Building in Leiden on April 26.*

Prof. James Kasting

Prof. James Kasting is one of the leading researchers in the field of planetary habitability. He joined Penn State University in Pennsylvania in 1988, he is a Distinguished Professor in Geosciences and has worked extensively with NASA in several capacities and places including the Ames Research Center. He has written extensively about planetary habitability in books that include "The Earth System", "How to Find a Habitable Planet" and "Atmospheric Evolution on Inhabited and Lifeless Worlds".

Kasting constructs numerical models of early atmospheric composition and climate. He is particularly interested in the rise of atmospheric O_2 and long-term climate evolution and is involved in research on atmospheric evolution, planetary atmospheres and paleo climates.

According to Kasting's calculations, the Earth's oceans will evaporate in about a billion years, while the Sun is still a main sequence star. This date is much earlier than previously thought. He has also considered the habitability criteria of other stellar systems and planets.

In his lecture "The Search for Life on Planets Around Other Stars", Kasting talked about the ways in which he searches for "simple life" outside our galaxy, referring to any life that is not intelligent but has a detectable impact on the planet's atmosphere. He began by pointing out the large number of planets that we have discovered orbiting stars other than the Sun, and how a fraction of these appear to be rocky planets orbiting within the liquid water habitable zone of their star. He then discussed the factors that make a planet habitable, along with the techniques that may be used over the next several decades to find and characterize such planets and to look for evidence of life.

Sackler Lecture

Prof. Julianne Dalcanton

The Raymond and Beverley Sackler lecture 2018 was held on on October 11 and was given by Prof. Julianne Dalcanton. Julianne Dalcanton works on galaxy formation and evolution, focusing primarily on what can be learned in the nearby universe. Her group works on several large projects studying the resolved stellar populations of nearby galaxies using the Hubble Space Telescope, their neutral gas distribution with the Very Large Array, and their stellar mass, dust, and star formation properties with the Spitzer Space Telescope. She also works closely with the N-body shop on the interface between observation and numerical theory.

Prof. Dalcanton's lecture was titled "Dissecting the Nearest Spiral Galaxies with the Hubble Space Telescope". The lecture presented the Panchromatic Hubble Andromeda Treasury, an HST multicycle program to image the north east quadrant of M31 to deep limits in the UV, optical, and near-IR. This project has imaged and resolved the galaxy into over 150 million stars, all with common distances and foreground extinctions. Prof. Dalcantion then presented the recently completed comparable imaging for the high-intensity star forming disk of M33 adding to M31, the Milky Way and Magellanic Clouds as fundamental calibrators of stellar evolution and star-formation processes. She described the survey strategy, data reduction, and key data products, and then highlighted work using the NIR stellar populations to constrain the large scale properties of the cold ISM, with 25 pc resolution. These new maps offer the highest resolution available in M31, and point to surprising challenges facing models of dust emission and new possibilities for the study of pressure as a driver of star formation efficiency.

PhD Colloquia

08 February 2018

The Anharmonic Infrared Spectra of Polycyclic Aromatic Hydrocarbons

Cameron Mackie

19 February 2018

Some Assembly Required: The Structural Evolution and Mass Assembly of Galaxies at z<5

Allison Hill

22 February 2018

The X-ray View of Interstellar Dust

Sascha Zeegers

05 March 2018

The puzzle of protoplanetary disk masses

Anna Miotello

19 April 2018

Astrophysical plasma modeling of the hot Universe: Advances and challenges in high-resolution X-ray spectroscopy

Junjie Mao

22 May 2018

Infrared spectroscopy of astrophysically relevant hydrocarbons

Kirstin Doney

29 May 2018

The formation of complex organics in dense clouds - sweet results from the laboratory

Ko-Ju Chuang

05 June 2018

Breaking & entering: PAH photodissociation and top-down chemistry

Pablo Castellanos Nash

12 June 2018

Monsters in the Deep: Using simulations to understand the unexpected mass in the centres of high--mass, early-type galaxies

Chris Barber

14 June 2018

Spin evolution of accreting and radio pulsars in binary systems

Ann-Sofie Bak Nielsen

19 June 2018

Painting with Starlight: Developing optical techniques for the high-contrast imaging of exoplanets

Mike Wilby

26 June 2018

Identifying the origins of galaxy formation

Jorryt Matthee

11 September 2018

Inferno Worlds

Andrew Ridden-Harper

18 September 2018

Don't Blink: Detecting transiting exoplanets with MASCARA

Geert-Jan Talens

2 October 2018

From Midplane to Planets: The Chemical Fingerprint of a Disk

Christian Eistrup

23 October 2018

Protoplanetary Disk Anatomy: examining the structure and chemistry of planetary birthplaces with simple molecules

Mason Carney

Education


Toelichting nodig?
Vraag assistentie van één van de vrijwilligers van de
Werkgroep Leidse Sterrewacht
Wij zijn graag bereid om uitleg te geven.

Bachelor and Master in Astronomy

Teaching and training of students is a major priority of Leiden Observatory, which offers both a university bachelor (BSc) and master (MSc) programme in astronomy.

The BSc programme is 3 years and is partly taught in Dutch, with combinations of lectures, problem classes, and practicals. In addition to astronomy courses, the programme consists in the first year of a significant fraction of courses in mathematics, physics, and informatics. First year students conduct their first astronomical observations with the modern LUF/Gratama telescope on the roof of the historic observatory building in the center of Leiden, and learn about coordinate systems during a lecture at the planetarium in Artis, Amsterdam. In years two and three the emphasis is increasingly on astronomy. Highlights include observations at the 2.4m Isaac Newton Telescope on La Palma (Canary islands) carried out and analysed by the students, and the 6-months research project at the end of their BSc. The MSc programme is 2 years and taught fully in English, attracting also many foreign students. Education and research focus on three major themes: (i) the formation and evolution of galaxies, (ii) the birth of stars and planets, and (iii) cutting-edge instrumentation. The astrochemistry and optics laboratories, and high performance computing facilities also function as training grounds for students, and are used for student's research projects. Students graduate with a broad knowledge of astronomy and astrophysics, but may specialise in various fields.

The MSc programme in Astronomy offered seven specialisations:

1. Astronomy Research
2. Astronomy and Cosmology
3. Astronomy and Instrumentation
4. Astronomy and Data Science
5. Astronomy and Education
6. Astronomy and Science-Based Business
7. Astronomy and Science Communication and Society

Student **Numbers**

Student numbers, which have been increasing since several years, continue to rise. In 2018, 105 freshmen started their studies in the Astronomy BSc. Of this number, 41 (39%) were women, and 43 (41%) pursued a combined astronomy/physics or astronomy/mathematics/computer science degree. The Observatory registered a total number of 248 BSc students at the end of the year, of which 95 (39%) aimed at a combined astronomy/physics degree or astronomy/mathematics degree; 36% of all BSc students is female. In 2018, the inflow of master students has grown with 24% (47 students). In total there were 90 MSc students, including 28 (32%) women and 40 (44%) of foreign nationality.

Organisation

The entire teaching program is organized and supported by the Education Office Astronomy (EOA), which deals with all aspects of the curriculum, including organization, student support, outreach and internationalisation.

The EAO team currently consists of a Director of Education, Head of Education Office Astronomy & Programme Coordinator, Study Advisor, PR Education Coordinator, Internationalisation PR Officer, Education & Student Affairs Officer and a Secretary.

In addition to counseling by the student adviser, incoming students were assigned to small groups meeting at regular intervals with a staff mentor and a senior student mentor. In the tutor programme, physics and astronomy freshman students were provided on a voluntary but regular basis with coaching by senior students.

In the BSc programme, students in the 2nd and 3rd year write a Study Plan, which must be approved by the Study Advisor. The astronomy curriculum is monitored by the 'Programme committee' (Opleidingscommissie), which advises the Director of Education on all relevant matters, and which was chaired by Hogerheijde. Under the authority of the Education Committee, the lecture course monitoring system was continued. In this system, students provide feedback to lecturers during and after the course.

Quality control of all aspects of the exams is the responsibility of the Board of Examiners (Examencommissie) chaired by Snellen. Admission to the master-curriculum for students without a BSc in astronomy from a Netherlands university requires a recommendation by the 'Admissions committee' (Toelatingscommissie) chaired by Schrier.

Academic courses and pre-university Programmes

BSc courses

TITTLE	LECTURER
Planetenstelsels	Franx
Inleiding Astrofysica	Hoekstra
Praktische Sterrenkunde	Van Langevelde
Modern Astronomy Research	Russo
Astronomical Lab & Observing Project	Van Weeren
Keerpunten in de Geschiedenis van de Natuurwetenschappen	Van Lunteren
On Being a Scientist	van Lunteren/ Haring/Smeets
Astronomical Observing Techniques	Rottgering
Galaxies & Cosmology	Hodge
Stars	Snellen
Astronomical Relativity	Van der Werf
Radiative Processes	Van Daalen
Bachelor Research Project	Linnartz

BSc courses

MSc courses

TITTLE	LECTURER
Astronomical Telescopes and Instruments	Keller/Kenworthy
Computational Astrophysics	Portegies Zwart
Origin and Evolution of the Universe	Bouwens
Deep Learning Course	Portegies Zwart
Detection of Light	Keller/Kenworthy
Large Scale Structure and Galaxy Formation	Kuijken
Stellar Structure and Evolution	Miguel
Radio Astronomy	Brentjens/Shimwell
Astronomical Spectroscopy	Bouwens
High-energy Astrophysics	Kaastra
Modern Astrostatistics	Sellentin
Numerical Recipes in Astrophysics	Van Daalen
Science and the Public: contemporary and historical perspectives	Van Lunteren

MSc courses

Degrees awarded in 2018

A total of 21 students obtained their Bachelor's Degree.

NAME	DATE	PRESENT POSITION
Ward Chaifa	31-01-18	MSc ICLON
Stefanie Brackenhoff	28-02-18	Finishing second BSc
Sebastiaan van Mulken	28-02-18	Unknown
Mike Slootweg	29-03-18	MSc Industrial Ecology, Leiden
Luther Algra	31-07-18	MSc Astronomy, Leiden
Remi Claessen	31-07-18	MSc Physics, Leiden
Okke van der Haak	31-07-18	MSc Astronomy, Leiden
Joost 't Hart	31-07-18	MSc Astronomy, Leiden
Rico Landman	31-07-18	MSc Astronomy, Leiden
David de Lange	31-07-18	Job searching
Amy Louca	31-07-18	MSc Astronomy, Leiden
Matthijs Mars	31-07-18	MSc Astronomy, Leiden
Luuk Oudshoorn	31-07-18	MSc Astronomy, Leiden
Thijs Stockmans	31-07-18	MSc Astronomy, Leiden
Ardjan Sturm	31-07-18	MSc Astronomy, Leiden
Tjerk Venema	31-07-18	MSc Physics, Leiden
Alex van Vorstenbosch	31-07-18	MSc Astronomy, Leiden
Orlin Koop	31-07-18	MSc Astronomy, Leiden
Christian Groeneveld	30-08-18	MSc Astronomy, Leiden
Jurrian Meijerhof	30-08-18	MSc Astronomy, Leiden
Josias van der Spek	30-08-18	Finishing BSc Mathematics

The following 20 students were awarded Master's degrees

NAME	DATE	PRESENT POSITION
Eero Vaher	31-01-18	Unknown
Max Wijsman	31-01-18	IT and Data Science
Rafael Mostert	31-01-18	PhD Leiden Observatory
Joris Hanse	28-02-18	University of Amsterdam
Paula Ortiz Oltalvaro	28-02-18	Unknown
Lieke van Son	29-06-18	PhD Amsterdam
Andres Felipe Ramos Padilla	31-07-18	PhD Rijksuniversiteit Groningen
Charlotte Brand	31-07-18	Unknown
Dirk van Dam	31-07-18	PhD Leiden Observatory
Jorge Andres Villa Velez	31-07-18	PhD LAM, Marseille
Louis Martin	31-07-18	Unknown
Marco Trueba van den Boom	31-07-18	Travelling
Michail Dagtzis	31-07-18	PhD abroad
Niloofar Khorshid	31-07-18	PhD University of Amsterdam
Pranav Mohanty	31-07-18	Industry
Juan Manuel Espejo Salcedo	20-08-18	PhD abroad
Dominique Petit dit de la Roche	30-08-18	PhD abroad
Hasan Albanna	30-08-18	Unknown
Jianfei Liang	30-08-18	Quantitative Research Analyst at Ostrica Vermogensbeheer
Job van der Wardt	30-08-18	Graduate Teaching Assistant, Introduction in Modern Physics, Leiden University

Outreach and Popularisation

Astronomy & Society Group

*The aim of the **Astronomy & Society Group** is to foster Leiden Observatory's mission to engage the Dutch, European and global audiences with the wonders of the Universe and share the scientific, technological, cultural and educational aspects of astronomy with society. Find below the most important highlights of the group activities in 2018:*

Leiden Observatory – Visitor Centre

The visitors center of the Old Observatory Leiden is open 3 days a week: Wednesdays, Saturdays and Sundays. Over the course of 2018 we welcomed over 11,000 people, 2011 of which joined a walk-in tour of the domes.

Private tours remained a popular activity at the Old Observatory. 2711 people visited in 2018, a 20% increase compared to 2017. Revenue increased by 53% to €14,259.50 despite an average increase of 23.5% on ticket prices.

The visitors center, along with the historic telescopes available in the building, were also opened during several nights in 2018 for special events such as Museumnacht, Midzomernacht, and De Nacht van Kunst & Kennis. These events drew large crowds, averaging one thousand visitors per night.

During the open day on October 28th, approximately 1600 people came to the Old Observatory to enjoy talks, tours and workshops, as well as the launch of Jos van den Broek's book "Wandelen tussen de sterren in Leiden".

Another high point of the year was our contribution to the worldwide event "100 Hours of Astronomy", for which we had a diverse, three day long program.

The historic building has also maintained a strong presence on the social media platform Facebook, reaching a total of 1727 likes, a 14% increase compared to 2017.

Moreover, just before the end of the year, we finalised the plan to create a new exhibition for 2019, based on the "Above and Beyond" exhibition for the 100 year anniversary of the IAU.

spaceEU

Launched in december 2018, spaceEU will implement an exciting Space Outreach and Education programme to capture the interest of young people in STEAM fields and encourage them to choose space-related careers. The project inspires and broadens young people's minds, develops a sense of European and global citizenship and builds long-term partnerships between people from different cultural backgrounds and countries. spaceEU also aims to lay the groundwork for the possible future establishment of a Knowledge Innovation Community (KIC) in the field of Space.

MORE-PE

Launched in 2016, the MORE-PE project investigates the culture of public engagement (PE) of research institutes. While a great deal of research has been conducted on how individual scientists do public engagement, less attention has been devoted to find out more about how this is done at the institute level.

In 2018 a comprehensive survey was distributed across 8 countries: US, UK, Germany, Portugal, the Netherlands, Japan and Brazil. Over 3000 research institutes were surveyed. The survey asked a series of questions about the institutes' resources for PE such as staff, budget, policies and motivations for doing PE.

The Dutch case had a target sample was 821 RIs, with 142 responses that translate into a response rate of 17%. While data analysis is still ongoing we are able to present some results that allow us to make some interpretations regarding budget, media outreach and barriers for PE. 33% of Dutch research institutes spend 1 – 5% of the budget on PE. One of the goals of the Dutch Research Agenda is to allocate 10% of research funding to Societal Impact activities, which includes PE. Furthermore, 53% of the survey participants thinks more of the funding should go towards PE. We also detect quite a high percentage of engagement from media and journalists in the Netherlands, with 85% of the RIs reporting 10 or more inquiries from the media/journalists per year.

Parallel to the international project, the research team in the Netherlands has also been working in implementing the survey at the project level. This is a collaboration with the NWO to find out more about the PE culture of NWO-TTW funded projects, with the aim of coming up with recommendations to the NWO for how it can better facilitate future projects with regards to PE and science communication. This survey is currently set to be implemented at the end of April 2019.

Open Science Hub

Open Science Hub (OSHub) is an international network with several european partners aimed at establishing collaborative co-creation spaces (OSHubs), based on Open Standards, near social and/or geographical borders borders throughout Europe, to engage and support communities to tackle locally relevant STEAM-related challenges.

OSHub-Portugal (OSHub-PT), inaugurated in July 2017, is the first hub of the OSHub network, in a partnership between Leiden University (the Netherlands) and the Municipality of Figueira de Castelo Rodrigo), aimed at bringing together science, technology and innovation to the daily life of local and regional communities, and ultimately promoting school performance and boosting social innovation. As such, OSHub-PT has been working closely with the school community towards the establishment of an Open Schooling strategy, where schools are positioned as collaboration hubs for community development, innovation and well being, by addressing issues of local relevance with global impact, in collaboration with multiple stakeholders.

Throughout the last year, this strategy has been implemented both in non-formal and formal educational settings, in collaboration with the EU-funded project Open Schools for Open Societies.

In particular, in the non-formal setting, OSHub-PT provides a transdisciplinary educational program targeted at the school public (3-18 years-old) and families, focused on locally relevant issues and linked to the Sustainable Development Goals (SDGs), and grounded on inquiry-based science education (IBSE) and citizen-science projects (1400 participants since July 2017); and national school exchange programs (400 participants). In addition, we have been co-developing with teachers a STEAM-club at school to take action on local challenges identified by teachers at school or in the region, e.g. waste management at school and preservation of the biodiversity of indigenous flora (pilot year 2018/19: 50 students from middle school).

On the other hand, in the formal setting, OSHub-PT has been collaborating with teachers and school heads in the development, implementation and evaluation of curricula for the “Citizenship and Development” subject (pilot year 2018/19: 74 students from 5th and 7th grades). Following the design-thinking methodology, students and teachers create collaborative projects, from the identification of relevant problems and discussion of possible solutions, to the implementation of a plan of action, in collaboration with several stakeholders, and sharing with the local community. In this pilot year, the challenges identified by students, which are the focus of their projects, are “Animal Welfare” and “Pregnancy in Adolescence”.

Finally, with the aim of involving families and citizens in the Open Schooling projects being developed at school, we recently started a monthly cycle of events entitled “Open School to the Community”, organized in collaboration with students, teachers, researchers, youtubers, activists, families and policy makers.

IAU astroEDU

In 2018, the open-access educational platform IAU astroEDU became one of the most innovative programmes in Education Worldwide. For the 2018 list, HundrED has recognized IAU astroEDU among the top 100 innovations.

HundrED's mission is to help schools evolve by seeking and sharing inspiring innovations in K12 education. IAU astroEDU is an open-access platform that uses the familiar peer-review workflow of scientific publications, to improve the standards of quality, visibility and accessibility of educational activities.

In addition, IAU astroEDU also released a set of educational videos to explain the unknown universe, spanning concepts of black holes, dark matter and dark energy, featuring two Leiden Observatory astronomers, Henk Hoekstra (professor at Leiden University) and Maria Cristina Fortuna (PhD candidate at Leiden University). The videos provide incisive explanations supporting primary and secondary school activities on the topic.

The platform had 81,526 views, while 80 experts scientists and educators joined as volunteers to support the peer review process.

IAU100

In 2019, the International Astronomical Union (IAU) is celebrating its 100th anniversary (IAU100) and the astronomical breakthroughs that have shaped science, technology and culture throughout the last century. The year-long celebrations also aim to highlight the importance of astronomy as a tool for education, development and diplomacy.

The IAU100 Secretariat is located at Leiden Observatory and during 2018 their main task was setting up the networks that will carry the main projects implemented in 2019.

The first plans for the celebration were announced at the opening session of the Communicating Astronomy with the Public 2018 Conference in Fukuoka, Japan, the world's largest gathering of astronomy communicators. However, the official opening of the celebrations was held at the IAU General Assembly in Vienna (Austria) on 20-31 August

2018. During the IAU General Assembly, the IAU100 activities were kicked-off during a special ceremony as well as with the opening of the Above and Beyond open-source exhibition. The exhibition — commissioned within the framework of the IAU 100th anniversary celebrations — showcases some of the most significant and surprising astronomical breakthroughs that have shaped science, technology and culture over the last century. Designed in the spirit of open science, it is available as a travelling exhibition and since then have been in Bratislava (Slovakia), Brno (Czech Republic) and Brussels (Belgium). Furthermore it also have been reproduced in local versions for Leiden Old Observatory (the Netherlands) or the TeNQ museum in Tokyo, Japan.

The activities set in train for 2019 comprise a diverse collection of events that will inspire everyone with their celebrations and will help implement the IAU100 Themes. Global Projects, such as IAU100 Name ExoWorlds will allow countries around the world to provide names to planetary systems. On the projects Einstein Schools (under the IAU Theme 100 Years of General Relativity: Eclipse) or Open Astronomy Schools (under Astronomy for Education), teachers will find creative supportive structures to bring their students to the next level of engagement. Other programs, such as Inspiring Stars (Inclusive Astronomy) or Dark Skies for All (Astronomy Natural and Cultural Heritage), will encourage audiences around the world to participate in a wide range of initiatives that in 2019 will bring the international astronomy community together “Under One Sky”.

Citizen Science Lab

The Citizen Science Lab brings together residents, scientists and societal organizations to gain new insights for science and society. In January 2018 the Lab kicked off during their first highly interactive workshop on air pollution, which was hosted by the Citizen Science Lab, the Dutch Institute for Public Health and the Environment (RIVM), DesignLab at the University Twente and Waag Society.

Air pollution is an urgent scientific and societal issues in which citizen science can potentially lead to significant breakthroughs, for instance by providing measurements on a scale that cannot realistically be achieved by professional measurement equipment. One important aspect of this workshop was the aim to connect the "top-down" approach of many projects initiated by scientists, and the "bottom-up" grass-roots activities that are emerging throughout society all over the world now. The Lab brought together an international and heterogeneous group of people active in citizen science. Participants came from all over Europe. Together they addressed many aspects of citizen science projects related to air pollution, resulting in eight pitches on plans and projects to pursue in the near future, delivered to a jury on the final day of the workshop.

After this successful first workshop, a workshop on Language and Culture was organized in April and one on Archaeology in July at the Lorentz Center.

Astronomy on Tap in Leiden

By Lizette Guzmán

Astronomy on Tap was created in New York city in 2013, by Dr. Meg Schwamb. Since then it has grown exponentially with more than 30 events per month! There are "satellite" locations all over the US, Europe, Central and South-America, and Asia.

Astronomy on Tap (AoT) Leiden (www.astronomyontap.nl) is an event that happens the last Monday of every month at the Grand Cafe de Burcht, in Leiden from 8 to 10 pm. The event features games, talks, and quizzes in the informal setting of a local bar. The topics are mainly astronomy-related topics, from how do planets and stars form, all the way to how the Universe was formed and what can we learn from that. All our talks

are in simple English and our quizzes are in two languages (Dutch and English).

AoT is organised by professional astronomers from Leiden Observatory. We are a group of 12 people, 7 postdocs (Dr. Liz Guzman-Ramirez, Dr. Yanett Contreras, Dr. M. Carmen Toribio, Dr. Vincent Van Eylen, Dr. Arun Kannawadi, Dr. Mohammad Javad, and Dr. Themiya Nanayakkara), and 5 PhD students (Fran Concha Ramirez, Merel van't Hoff, Alex Mechev, Maaike Van Kooten, and Roohi Dalal), all working in the astronomy department of Leiden University.

We started on the 27th of March 2017 (we were the first ones to bring Astronomy on Tap to Europe), with a great kick-off event that brought more than 180 people together to learn about exoplanets.

Since then we have had 22 very successful events that have attracted people of all ages, from 6 to 75 years old. For all these events we gathered speakers from Leiden Observatory, the European Space Agency, the University of Amsterdam, and the University of Nijmegen.

At every event, we have two talks and two quizzes. After each talk, the audience asks questions to the speakers. Our audience is very curious and on average, we have 15 questions per event. We make our own games/quizzes, that for most of the events are related to the talks. On two occasions, we have organised an audience survey, which showed a high level of satisfaction with our events. Over 85% of the audience indicated they are likely or very likely to attend future events. So our audience is very happy and we

now have a stable crowd with an average of 150 people per event.

In addition to “physical events”, we actively manage several social media accounts. We are working on growing our YouTube channel, which is used to spread recordings of the event talks to a much wider audience. We have currently received about 2000 views. We are also active on Twitter and Facebook page which currently has more than 1000 ’likes’. On these media, we engage with our audience and spread astronomy-related information and news.

We also have events that we call Astronomy on Tap on Tour, where we go to other locations. We have participated in the Museum Night (2017 and 2018), the Open Day at the observatory (2017, 2018, and 2019), the Science Faculty day (2018), the music festival Werfpop (2018), Leiden + (2018), and we joined the celebrations of the 444 anniversary of Leiden University by having an extra event where we presented the 4 most recent discoveries of Leiden Observatory (2019).

In Astronomy on Tap, we look to deliver astronomy knowledge to the public in a way that is simple and easy for everybody to understand. We also deliver insights on the life of astronomers, and on how science is done. We do not want to just bring astronomy education, we want to bring people closer to the academic world and show that anybody curious and dedicated can become a scientist.

We especially look to motivate our young audience. We like to think that we do not spread just education, but also incentivise curiosity, a sense of wonder, and responsibility towards the world around us.

Pre-university programme

The Pre-University programme is aimed at enthusiastic and ambitious high school students from the 5th and 6th grade. Candidates are selected on the basis of their high school grades and their enthusiasm to participate, as shown by a letter of motivation. Students that are selected then take part in 6 to 8 meetings from January till March. The programme in 2018 consisted of the following meetings:

meetings

TITTLE	LECTURER
Kosmologie	Hoekstra
Planeten buiten ons zonnestelsel	Snellen
Astrofysica	Icke
Zwarte gaten	Van der Werf
De hemel in 3D	Brown
Bouwen van moleculen en planeten in het heelal	Van Dishoeck
Radiosterrenkunde	Van Weeren

meetings

Excursion to the radio telescopes of Westerbork and Dwingeloo

In 2018, there were 20 participants, all 5th grade students. They all attended several lectures and went on a field trip to the ASTRON radio telescopes in Westerbork. Each student completed the programme by writing a short article on a subject of their choice. The article written by astronomy participant Marieke den Dungen was selected by the head editorial office of NEMO Kennislink as the best from the almost 400 submissions from all over the university. She wrote an article on black holes after attending Paul van der Werf's lecture. The programme was concluded with a joint meeting with all participants in the Pieterskerk.

Contact VWO

Contact.VWO (Contact-punt-VWO) is the liaison between pre-university education and the Departments of Astronomy and Physics at the University of Leiden. It supports both teachers and their students with various activities. Since the start in 2008, Contact.VWO has built a significant network of more than 500 teachers over the entire country, through which a multitude of high school students is reached. Various activities are defined through which this network is fed, including teacher meetings, celebration of Einstein's birthday, profielwerkstuk support, school class visits and experiments that demonstrate quantum mechanical effects to high school children.

Astronomy and Society Activities

The European Regional Office of Astronomy for Development (E-ROAD) was officially established on 26 February 2018 at a signing ceremony at Leiden University. The event was attended by the South African Minister of Science and Technology and marked the formation of the tenth Regional Office of Astronomy for Development and an honorary professorship for Minister Pandor.

Grace Naledi Mandisa Pandor was South Africa's Minister of Science and Technology from 2009 until 2012 and again from 2014 until 2018. Minister Pandor is an inspirational and charismatic ambassador of science as a tool for development, particularly in the field of astronomy. She has received several awards for her accomplishments, including the Grand Cross of Merit by the German government, the Science Diplomacy Award from the American Association for the Advancement of Science, and honorary doctorates from Stellenbosch University, Nova University Lisbon and University College Dublin.

The E-ROAD is the IAU's tenth Regional Office, coordinated by the IAU's global Office of Astronomy for Development (OAD) in Cape Town, South Africa. The IAU Astronomy for Development network and its coordinating office was created in 2010 according to a blueprint in

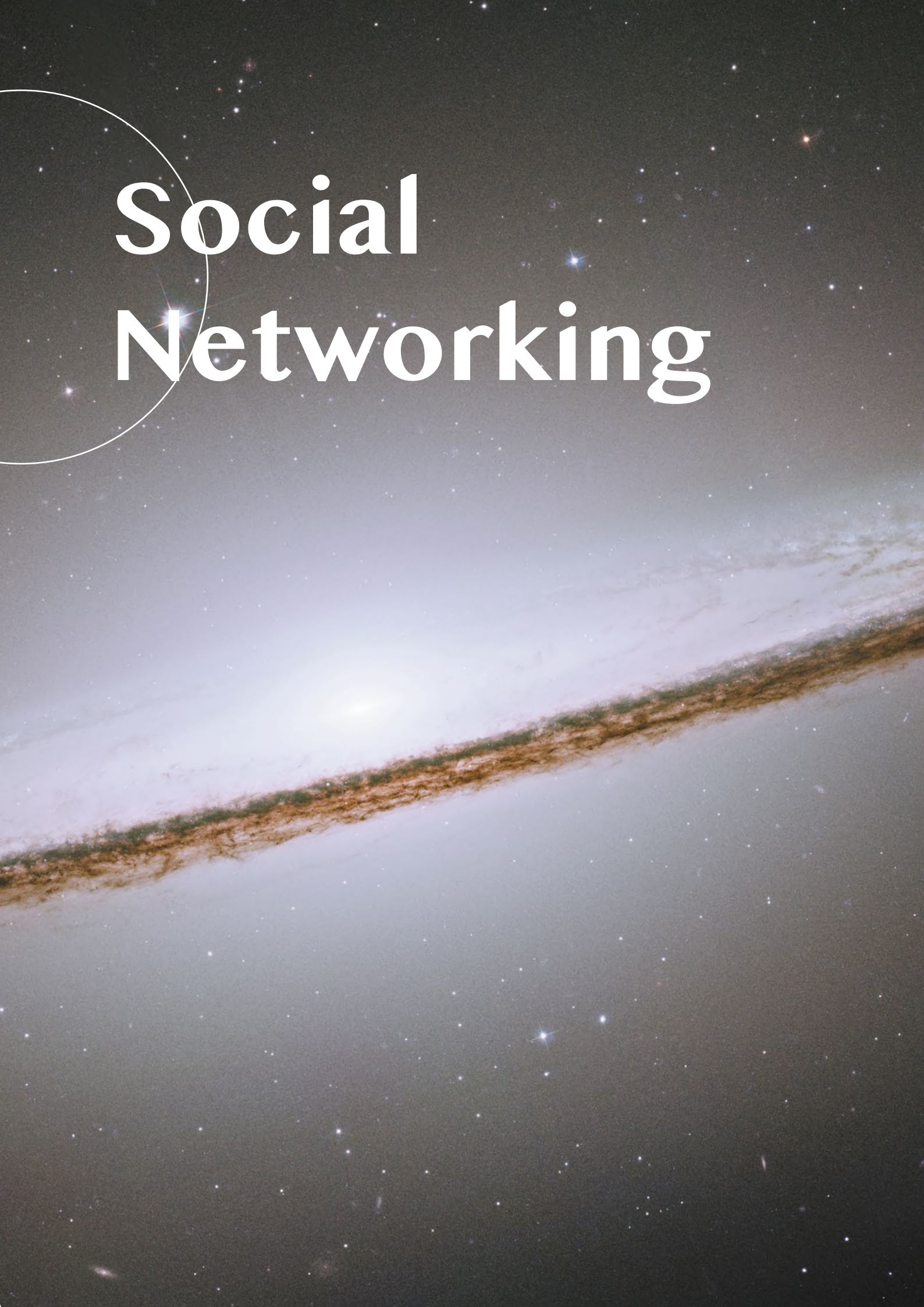
an IAU strategic plan under the leadership of Leiden astronomy professor George Miley, who was then an IAU Vice President and member of its Executive Committee. The aim of the Astronomy for Development (AfD) network is to exploit unique aspects of astronomy to further the United Nations Sustainable Development Goals, build technological capacity, stimulate inspirational education and foster a sense of world citizenship. The new European ROAD is located at Leiden Observatory and operated jointly by the European Astronomical Society and Leiden University.

The 10 regional IAU AfD offices work closely with the OAD to execute the vision of Astronomy for a better world, with a focus on a geographic or cultural region. The other regional offices are located in: Colombia, Jordan, Ethiopia, China, Portugal, Thailand, Armenia, Zambia and Nigeria. The newest regional office in Europe will carry out and coordinate relevant astronomy-for-development activities in all three Task Force areas defined in the IAU Strategic Plan — Universities and Research, Children and Schools and Public Outreach, focusing on furthering the UN SDGs in Europe. These E-ROAD tasks will be carried out in cooperation with existing activities of pan-European and national astronomical organisations.

On the day following the signing of the E-ROAD agreement, an interdisciplinary symposium on "Science Diplomacy and International Development" was held in honour of Minister Pandor at the Leiden University College Campus in the Hague. The symposium was organised jointly by the European Commission Space Awareness project, Leiden Observatory, the Leiden African Studies Centre, the Leiden University Faculty of Governance and Global Affairs and the Leiden University Hague Campus. Minister Pandor gave a lecture at the symposium on "Science Diplomacy and the Square Kilometre Array".

IAU European Regional Office of Astronomy for Development Signing ceremony at Leiden University, the Netherlands. *From left to right: Prof. Dr. Huub Röttgering (Director, Leiden Observatory), Dr. Vanessa McBride (Acting Director, IAU Office of Astronomy for Development), Prof. Dr. Piero Benvenuti (IAU General Secretary), Hon. Prof. Dr. Naledi Pandor (South African Minister of Science and Technology), Prof. Dr. Geert de Snoo, (Dean, Leiden University Faculty of Science), Prof. Dr. George Miley (Author of IAU Astronomy for Development Strategic Plan, Leiden University), Prof. Dr. Roger Davies (President European Astronomical Society), Dr. P. Russo (Head of Astronomy & Society Group, Leiden Observatory).*

Social Networking



LAD F Kaiser

The Leidsch Astronomisch Dispuut "Frederik Kaiser" is the society for Leiden astronomy students, named after the founder of the historic observatory building in the centre of Leiden. It is part of De Leidsche Flesch, the student association for Physics, Astronomy, Mathematics, and Computer Science. Kaiser strives to promote integration between students and staff at the Leiden Sterrewacht by organising social activities. In addition, Kaiser facilitates practical observing sessions using the historic telescopes of the old observatory, and is active with outreach events.

The 2018/2019 board: *Willem Kroese (chair), Ivana van Leeuwen (secretary/assessor Old Observatory), Silvan Toet (assessor Old Observatory) and Delia Zhang (assessor Outreach/treasurer).*

Very popular are the annual football tournament, which includes teams from both observatory staff and students, and the Lasergame Night, where students get the unique chance to Lasergame in the Snellius building.

Kaiser also organizes student dinners, movie nights, excursions, pub quizzes and a series of talks like a lecture by VO-S to get closer ties between students and alumni and to give students an opportunity to think about what they want to do after their studies. Kaiser also organises very successful observing events at the Old Observatory with the historic telescopes. This is done by the Observing Committee, who organises as many observing nights as the weather will allow.

L.A.D. "F. Kaiser" trains the students that perform tours through the historic observatory. In order to keep the tours up to date and find new material, Kaiser also has a Historical Committee, who studies the institute archives and interviews older Astronomers to find more information about the history of the observatory. The tour guides, along with the porters of the visitor centre and other volunteers, also form the backbone of the organisation of major public events at the observatory, such as the annual Nationale Sterrenkijkdagen (National Stargazing Nights), the Museumnacht (Museum Night) and the Nacht van Ontdekkingen (Night of Discoveries).

VO-S the Leiden Observatory Alumni Association

The Vereniging van Oud-Sterrewachters ("VO-S") is the Leiden Observatory alumni association. In 2018 several events have been organised, including the celebration of our 4th lustrum, together with the Kaiser student association.

Studying or working at Leiden Observatory is an unforgettable experience to many. The exciting discoveries of astronomy on one side, the strong social aspects on the other. Fuelled by the early participation of students in astronomical research and the lively social interaction in this relatively small, international community. Then it should come as no surprise that when (under) graduates or staff leave Leiden Observatory to pursue (career) life elsewhere, good memories often remain of this special period in life. The alumni association VO-S aims at bringing our alumni together and keeping these ties alive, both on the social level as well as feeding the general interest in scientific research. As such it serves as a network between alumni and the institute. Activities comprise of the both social and science-related events. The association has nearly 150 members, with membership open to all Leiden Observatory alumni and staff.

Celebrating our 4th lustrum

2018 has been a special year as our association was formally established 20 years earlier. And not only for us, also for the Kaiser student association, who had their 5th lustrum. A great opportunity to celebrate our lustra together! On June 23, some 50 Sterrewacht alumni and student convened at the Old Observatory, where they enjoyed a varied program. Both committees looked backed on their rich history with some joyful anecdotes. Lectures followed by top researchers followed: Henk Hoekstra on mapping dark matter and energy in the universe and Anthony Brown the first exciting results of the GAIA survey. The Kaiser Price was awarded by the VOS chair to Dominique Petit for her outstanding contribution in organising the public outreach activities at the Old Observatory. The official program concluded with a grand tour through the beautifully renovated Observatory, where many alumni have memories of their studies.

Social activities

In April, some 20 alumni joined for drinks at café Barrera, prior to the Oort lecture by prof. James Kasting. At the Academy building, he shared the latest developments in the searc for habitable exoplanets.

Our annual meeting was held in November at the Kamerlingh Onnes Building, a place most of them knew so well from lectures in physics a long while ago. In our formal annual meeting we thanked Yuen Ng for his contributions over many years, when he stepped down as the VO-S treasurer. We welcomed Maaike Damen as our new secretary, where Gerben Zwart will proceed as our treasurer.

The VO-S was delighted to have prof. Dirk van Delft speak on the history of the Kamerlingh Onnes lab. In his amusing lecture, he focused on the special relation of the institute with Albert Einstein. An exciting tour followed through the new library and the basement of the restored building, concluded by chats over drinks at a nearby pub.

Other activities

We proceeded with our mentoring of individual students. The sizeable VO-S network serves here as a source of inspiration for those who consider a career outside astronomy.

Communication with our members on the latest research in astronomy and our upcoming activities took place via www.vo-s.nl, our newsletter and by e-mail. We thank the Marcom team of the Faculty of Science for their ongoing support in updating our website and preparing our newsletters.

Join the **VO-S**!

For contact and membership of our alumni association visit our website/ send an email to:

www.vo-s.nl
vo-s@strw.leidenuniv.nl

VO-S Committee:
— Niels van Weeren (chair)
— Maaike Damen (secretary)
— Gerben Zwart (treasurer)
— Anthony Brown (liaison)

Organisation

Observatory Staff

FULL PROFESSORS

- Prof.dr. B.R. Brandl
- Prof.dr. E.F. van Dishoeck
- Prof.dr. M. Franx
- Prof.dr. H. Hoekstra
- Prof.dr. M.R. Hogerheijde
- Prof.dr. C.U. Keller
- Prof.dr. K.H. Kuijken
- Prof.dr. H.V.J. Linnartz
- Prof.dr. F.H. van Lunteren
- Prof.dr. S.F. Portegies Zwart
- Prof.dr. H.J.A. Rottgering
- Prof.dr. J. Schaye
- Prof.dr. I.A.G. Snellen
- Prof.dr. A.G.G.M. Tielens
- Prof.dr. P.P. v.d. Werf
- Prof.dr. P.T. de Zeeuw

EMERITI

- Dr. A.M. van Genderen
- Prof.dr. H.J. Habing
- Prof.dr. V. Icke
- Prof.dr. F.P. Israel
- Prof.dr. W.J. Jaffe
- Dr. J. Lub
- Prof.dr. G.K. Miley
- Drs. R.S. le Poole

AFFILIATE PROFESSORS

- Prof.dr. D. van Delft
  Stichting tot beheer Museum Boerhaave,
  Directeur Museum Boerhaave
- Prof.dr. N.J. Doelman
  J.H. Oortfonds, TNO
- Prof.dr. P. Ehrenfreund
  CEO, German Aerospace Center
- Prof.dr. M. Fridlund
  J.H. Oortfonds, staff scientist ESTEC/ESA
- Prof.dr. M.A. Garrett
  Jodrell Bank Centre for Astrophysics
- Prof.dr. C.A. Jackson
  ASTRON
- Prof.dr. J.S. Kaastra
  Senior scientist SRON
- Prof.dr. H.J. van Langevelde
  JIVE Dwingeloo

ASSOCIATE /ASSISTANT PROFESSORS AND SENIOR RESEARCHERS

- Dr. R.J. Bouwens
- Dr. J. Brinchmann
- Dr. A.G.A. Brown
- Dr. L.H. Burtscher
- Dr. J.A. Hodge
- Dr. M.A. Kenworthy
- Dr. P. Russo
- Dr. E.M. Rossi
- Dr.ir. F. Snik
- Dr. R. Stuik
- Dr. R.P.J. Tilanus
- Dr. R.J. van Weeren

TEMPORARY STAFF, POSTDOCS, PROJECT PERSONNEL, LONGTERM VISITING SCIENTISTS

Dr. F.J. Alonso Floriano	
Dr. Y.M. Bahé	
Dr. J.I. Bailey III	
Dr. J. Bedorf	
Dr. M.A. Bilicki	
Dr. J. Bouwman	(Assistant professor)
Dr. M.A. Brentjens	
Dr. J. Brinchmann	(Guest)
Dr. H. Buddelmeijer	
Dr. X. Cai	
Dr. A. Candian	
Dr. S.M. Cazaux	(Guest)
Dr. T. Chen	
Dr. Y.A. Contreras Morales	
Dr. C.A. Correa	
Dr. E. Costantini	(Guest)
Dr. A.J. Cridland	
Dr. M.P. van Daalen	(Assistant professor)
Dr. J. de Boer	
Dr. F. de Gasperin	
Dr. J.M.F. Donnert	
Dr. K.J. Duncan	
Dr. C. Eistrup	
Dr. S. Facchini	(Guest)
Dr. T.A. Fernandes Gomes Da Costa	
Dr. C.J. Garcia Vergara	
Dr. C. Ginski	(Guest)
Dr. C. Goddi	(Guest)
Dr. M.L.P. Gunawardhana	
Dr. L. Guzman Ramirez	
Dr. A. Hacar Gonzalez	
Dr. R.H. Hammerschlag	
Prof.dr. L.O. Hanlon	(Guest)
Dr. D.S. Harsono	
Dr. J. He	
Dr. H.J. Hoeijmakers	
P.W. Hoogendoorn	(Guest)
Dr.ing. H.T. Intema	
Dr. A. Kannawadi Jayaraman	
Dr. J.K. Katgert-Merkelijn	(Guest)
Dr. M. Kazandjian	
Dr. R.D. Köhler	
Dr. B.R. Leite Ribeiro	
Dr. P. Liebing	
Dr. N.F.W. Ligterink	
Dr. J.A. Lynn	(Guest)

Dr. J.C. Mackie	
Dr. M.V. Maseda	
Dr. L.T. Maud	
Dr. Y. Miguel	(Assistant professor)
Prof.dr. T.J. Millar	(Guest)
Dr. P.D. Mitchell	
Dr. P.M. Molliere	
Dr. E.P. Monaghan	
Dr. N.M. Murillo Mejias	
Dr. A. Mushtukov	
Dr. S. Muzahid	
Dr. W.T.T. Nanayakkara	
Dr. J.B.R. Oonk	
Dr. A. Patruno	(Assistant professor)
Dr. F.I. Pelupessy	(Guest)
Dr. S. Plöckinger	
Dr. S.M. Pompea	(Guest)
Dr. A. Riedo	
Dr. M. Rybák	
Dr. V.N. Salinas Poblete	
Dr. M. Schaller	
Dr. C. Schreiber	
Dr. M.C. Segers	

Dr. E. Sellentin	(Assistant professor)
Dr. D.R. Serrano Goncalves Sobral	(Guest)
Dr. T.W. Shimwell	
Dr. A. Simionescu	(Guest)
A.B. Seli	(Guest)
Dr. A. Sonnenfeld	
Dr. M. Stefanon	
Dr. I.M. Stewart	
Dr. L.A. Straka	
Dr. B.X.J.A. Tabone	
Dr. G.J.J. Talens	
Dr. J.J. Tobin	(Guest)
Dr. M.C. Toribio Perez	
Dr. J.W. Trayford	
Dr. M. Vakili	
Dr. L. Vallini	
Dr. V. Van Eylen	(Oort Fellow)
Dr. C. Walsh	
Dr. T.P.G. Wijnen	
Dr. W.L. Williams	
Dr. P.A. Wilson	
Dr. S.G. Wolff	(Oort Fellow)
Dr. A. Wyttenbach	

PROMOVENDI

A.S. Abdullah MSc	(Guest)
S.L. Ahad MSc	
J. Albert MSc	
H.S.B. Algera MSc	
X. Bacalla MSc	
C.R. Barber MSc	
A.G. Barr MSc	
R.E. v.d. Berg	(Guest)
E.G. Bogelund MSc	
A.J. Bohn MSc	
L.A. Boogaard MSc	
S.P. Bos MSc	
A.D. Bosman MSc	
S. v.d. Broek MSc	
M. Bulak MSc	
O. Burggraaff MSc	
K.M. Butler MSc	
T. Caglar MSc	
G.E. Calistro Rivera MSc	
D. Campisi MSc	
M.T. Carney MSc	
D.J. Carton MSc	
P. Castellanos Nash MSc	
P. Cazzoletti MSc	
Y.N. Cendes MSc	(Guest)
K. Chuang MSc	
F.A. Concha Ramirez MSc	
O. Contigiani MSc	
A.G. de Graaff MSc	
S.N.B. Debackere MSc	
G. Di Gennaro MSc	
D.S. Doelman MSc	
K.D. Doney MSc	
P. Dorval MSc	
G.C. Dufour MSc	(Guest)
A. Dvornik MSc	
C. Eistrup MSc	
K.L. Emig MSc	
F.A.F. Evans MSc	
M.C. Fortuna MSc	
V. Gamez Rosas MSc	
M. Gasso Miracle MSc	(Guest)
C. Georgiou MSc	
C.C. Giese MSc	
M. Gomes Rachid MSc	
S.Y. Haffert MSc	
S. Heikamp MSc	(Guest)
E. v.d. Helm MSc	(Guest)
A.R. Hill MSc	
N.D. Hoang MSc	
J.J.F.J. Jansen	(Guest)
V. Kofman MSc	
V. Korol MSc	
C.C. Lam MSc	
J. Lorenzo Álvarez MSc	(Guest, ESTEC)
Z. Lu MSc	

J.C. Mackie MSc
S. Mandal MSc
J. Mao MSc
T. Marchetti MSc
M. Marinello Assis de Oliveira MSc (Guest)
J.J.A. Matthee MSc
A.P. Mechev MSc
R.I.J. Mostert MSc
A.B. Nielsen MSc
F.S.J. Nobels MSc
M.S.S.L. Oei MSc
M. Paalvast MSc
C.H.M. Pabst MSc
S. Panchagnula MSc
E.H. Por MSc
D.N. Qasim MSc
L.H. Quiroga Nunez MSc
V.M. Radhakrishnan MSc
S. Reino MSc
E.F. Retana Montenegro MSc
A.R. Ridden-Harper MSc
P.A. Salas Munoz MSc
V. Sarkovic MSc
A. Saxena MSc
S.T.M. Schouws MSc
D.B. Serindag MSc
Drs. D.M. Smit (Guest)
L. Stofanová MSc
Y. Sun MSc
F. Sweijen MSc
G.J.J. Talens MSc
T. Tax MSc (Guest, ESO)
Ing. J. Terwisscha van Scheltinga
S. Torres Rodriguez MSc
L. Trapman MSc
L. Tychoniec MSc
I. Urdampilleta Aldama MSc
D.M. van Dam MSc
M.L. van Gelder MSc
R.G. van Holstein MSc
M.A.M. van Kooten MSc
M.L.R. van 't Hoff MSc
S.E. van Terwisga MSc
V. Vardanyan MSc
D. v.d. Vlugt MSc
D. Wang MSc
Y.M. Welling MSc
N.A. Wijers MSc
M.J. Wilby MSc
E.M. Zari MSc
S.T. Zeegers MSc
M. Zhang MSc
X. Zhang MSc
X. Zheng MSc
M. Zilinskas MSc
S.L. Zoutendijk MSc

SUPPORT STAFF

Drs. M. Balkestein
Secretary

Drs. C.J. de Bruin
Secretary

Drs. E. Gerstel
Institute Manager

P. Heijsman
Project Support

M. Lamers
Secretary

H. Olgun
Administrator

Drs. A. Schouten-Voskamp
Secretary

G.A. v.d. Tang
Secretary

A. Zaidenberg
Secretary

EDUCATION OFFICE

S. Blok
Education Assistant & Student Affairs

Dr.ir. S. Commandeur
Coordinator PR & Education

Drs. M. van Driel
Internationalisation & PR officer

Drs. A.N.G. Pen-Oosthoek
Education Coordinator

W.C. Schrier MSc
Study Advisor

L. v.d. Veld
Education Assistant

Prof.dr. P.P. van der Werf
Education Director

Prof.dr. H.V.J. Linnartz
Education Director (from September)

COMPUTER STAFF

Dr. E.R. Deul Manager
Computer Group

Dr. D.J. Jansen
Scientific Programmer

E.J. v.d. Kraan
ICT Support

A. Vos
Programmer

Ir. A.K. van Elteren
Software Engineer

Dr. J.M.F. Donnert
Scientific Programmer

NOVA

Ir. F.C.M. Bettonvil
ASTRON

Dr. W.H.W.M. Boland
Managing Director

Prof.dr. E.F. van Dishoeck
Scientific Director

C.W.M. Groen
Financial Controller

J.T. Quist
Management Assistant

Dr.ir. M. Rodenhuis
Instrumentation Coordinator

ASTRONOMY & SOCIETY

M. Ahmadi
UNAWE Discovery Club Coordinator

G. Azenha
Business Development Trainee

Dr. B.J.F. Clauwens
Old Observatory Coordinator

B.R. Downer
Science Writer

S. Edrisy
Science Communication Intern

A.H. Kerkhoven
Research Assistant

M. de Korte
Science Educator

Dr. J.G. Rivero Gonzalez
Space Awareness Project Manager and IAU100 Coordinator

Dr. P.M. Russo
Group Leader

A. Savre
Space Awareness Project Manager

N. Scheinowitz
Old Observatory Student Coordinator

W. Schrier
Space Awareness and NWA Event Horizon Project Manager

D.T.H. Tran
Science Communication Intern

I. van Vledder
Old Observatory Tour Coordinator

Observatory Management

DIRECTORATE

Drs. E. Gerstel
Institute manager

Prof.dr. H.J.A. Röttgering
Scientific director

Prof.dr. P.P. van der Werf
Education director

Prof.dr. H.V.J. Linnartz
Education director (from September)

ADVISORY BOARD

Prof.dr. C. van Bochove
Dr. F. Eulderink
Prof.dr. K. Gaemers
Prof.dr. I.M. de Pater
Prof.dr. S.M. Verduyn Lunel (Chair)

INSTITUTE COUNCIL

Dr. E.R. Deul (Chair)
Prof.dr. H. Hoekstra
L. van der Veld
A. Vos

SCIENTIFIC COUNCIL

Dr. R.J. Bouwens
Prof.dr. B.R. Brandl
Dr. J. Brinchmann
Prof.dr. E.F. van Dishoeck
Prof.dr. M. Franx (Chair)
Dr. J.A. Hodge
Prof.dr. H. Hoekstra
Prof.dr. M.R. Hogerheijde
Prof.dr. C.U. Keller
Dr. M.A. Kenworthy
Prof.dr. K.H. Kuijken
Prof.dr. H.V.J. Linnartz
Prof.dr. S.F. Portegies Zwart
Dr. E.M. Rossi
Prof.dr. H.J.A. Röttgering
Dr. P.M. Russo
Prof.dr. J. Schaye
Prof.dr. I.A.G. Snellen
Prof.dr. A.G.G.M. Tielens
Dr. R.J. van Weeren
Prof.dr. P.P. van der Werf
Prof.dr. P.T. de Zeeuw

Observatory Committees

MSc ADMISSION COMMITTEE

Dr. M. van Daalen	
Dr. J. Hodge	
Dr. M.A. Kenworthy	
Prof.dr. K.H. Kuijken	
drs. A.N.G. Pen	
Prof.dr. S.F. Portegies Zwart	
Dr. E.M. Rossi	
W.C. Schrier MSc	(Chair)

BOARD OF EXAMINERS

Prof.dr. B.R. Brandl	
Dr. J. Brinchmann	
Dr. H. Hoekstra	
Prof.dr. A. de Koter UvA	(UvA – external)
Prof.dr. I.A.G. Snellen	(Chair)

EDUCATION COMMITTEE BSc

Prof. dr. M. Hogerheijde	(Chair)
Dr. J. Bouwman	
Dr. R.J. Van Weeren	
A. van Vorstenbosch	
B. van Ommen	
M. Tollenaar	

PhD ADMISSION ADVISORY COMMITTEE

Dr. E.M. Rossi	
Prof.dr. I.A.G. Snellen	

EDUCATION COMMITTEE MSc

Prof.dr. M. Hogerheijde	(Chair)
Prof.dr. C.U Keller	
L. Martin	(International EU)
L. Trapman	
J. Villa Velez	(International non-EU)
E. van Weenen	(National)

OORT SCHOLARSHIP COMMITTEE

Dr. M. van Daalen	
Dr. J. Hodge	
Dr. M.A. Kenworthy	
Prof.dr. K. Kuijken	
Prof.dr. S.F. Portegies Zwart	(Chair)
Dr. E.M. Rossi	

COLLOQUIUM COMMITTEE

Prof.dr. M. Hogerheijde	
Prof.dr. S.F. Portegies Zwart	

PhD GUIDANCE COMMITTEE

Dr. J. Brinchmann
Dr. A. Brown
Prof.dr. M. Franx
Prof.dr. J. Schaye
Dr. F. Snik
Prof.dr. A.G.G.M. Tielens

COMPUTER COMMITTEE

Dhr Dr. R. J. Bouwens	(Chair)
Prof. dr. M. Hogerheijde	
Dr. M. Kazandjian	
Prof.dr. S.F. Portegies Zwart	
Dr. T.W. Shimwell	
Dr. R. Stuik	

MAYO GREENBERG PRIZE COMMITTEE

Prof.dr. E.F. van Dishoeck	
Drs. E. Gerstel	
Prof.dr. H.V.J. Linnartz	
Dr. J. Lub	
Prof.dr. G.K. Miley	(Chair)

PUBLIC OUTREACH COMMITTEE

H.S.B. Algera MSc	
L.A. Boogaard MSc	
Prof.dr. H. Hoekstra	(Chair)
M.L.R. van 't Hoff MSc	
N.A. Wijers MSc	

SOCIAL COMMITTEE

S. Bos MSc	(Chair)
K. Butler MSc	
M.C. Fortuna MSc	
Dr. M. Kenworthy	
M.A.M. van Kooten MSc	
M. Lamers	
S. Mandal MSc	
Dr. M. Schaller	
Drs. W. Schrier	

BORREL COMMITTEE

F.A. Concha Ramirez MSc
K.L Emig MSc
M.C. Fortuna MSc
E.M. Zari MSc

LEAPS ORGANIZERS

Dr. A. Cridland
Dr. N.M. Murillo Mejias
Dr. S.G. Wolff

Science policy functions and University Committee Memberships

DR. R.J. BOUWENS

- Member, BUFFALO team
- Member, Dutch time allocation panel for the telescopes on La Palma
- Deputy Coordinator, "Euclid Science Ground Segment, OU-NIR"
- Member, MUSE GTO team
- Member, SOC for the “Rise and Shine Meeting”, Strasbourg, France
- Member, XDF team

PROF.DR. B.R. BRANDL

- Member, ESO Contactcommissie
- Member, ESO ELT Project Science Team
- Member, Evaluation Board
- PI, METIS (mid-IR instrument for the E-ELT)
- Deputy co-PI, MIRI (mid-IR instrument for the JWST)
- Member, NOVA Instrument Steering Committee (ISC)
- Member, Review committee
- Chair, SOC for "Science Enabled by Novel Infrared Instrumentation”

DR. J. BRINCHMANN

- Member, Leiden University Funds International Student Grant board
- Secretary/treasurer, Leids Sterrewacht Fonds
- Secretary/treasurer, Leids Kerkhoven--Bosscha Fonds
- Secretary/treasurer, Jan Hendrik Oort Fonds
- Member, Leids Universiteits Fonds International Study Fund
- Member, ATLAS spectroscopic survey telescope project (proposed to NASA)
- Member, Euclid Archive User Group
- Member, Euclid Calibration Working Group
- Member, Euclid COMS Group
- Co-chair, Euclid Consortium: Legacy science
- Member, Euclid Diversity Committee
- Member, Euclid Editorial Board
- Co-chair, Euclid Galaxy & AGN Evolution Science Working Group
- Legacy Science Coordinator, Euclid mission
- Coordinator, Galaxy and AGN evolution science working group
- Member, JWST Data Processing Working Group
- Chair, MUSE Data management group
- Member, MUSE Science Team

DR. A.G.A. BROWN

- Member, Faculteitsraad
- Member, Executive Board GENIUS FP7-Space Collaborative Project
- Chair, Gaia Data Processing and Analysis Consortium
- Member, Gaia Science Team
- PI, Gaia/Netherlands
- President, IAU Commission A1
- Associate Member, International Earth Rotation and Reference Systems Service
- Member, NOVA Instrument Steering Committee
- Member, Steering Committee IAU Division A

PROF.DR. E.F. VAN DISHOECK

- Coordinator, Fundamentals of Science profile area Leiden University
- Chair, A-ERC PE9 panel
- Co-Editor, Annual Reviews of Astronomy & Astrophysics
- Co-PI, European JWST-MIRI consortium
- Member, Gebiedsbestuur Exacte Weten-schappen (GB-E)Science policy functions
- President-elect, IAU
- President-elect, International Astronomical Union (IAU)
- Member, National Committee on Astronomy (NCA)
- Scientific Director, Netherlands Research School for Astronomy (NOVA)
- Member, Steering committee NCCR PlanetS Switzerland

DR. L. BURTSCHER

- Organiser, AGN meeting
- Co-initiator and co-organiser, Galaxy Coffee
- Member, GATOS collaboration
- Member, LLAMA collaboration
- Member, MATISSE commissioning team
- Lead, METIS calibration working group
- Theme lead AGN, METIS science team
- Chair, SOC on "The Next Generation of Thermal-IR Astronomy"

PROF.DR. M. FRANX

- Member, Board of Directors, Leids Kerkhoven Bosscha Fonds
- Chair board of directors, Leids Sterrewacht Fonds
- Chair board of directors, Oort Fonds
- Member, Promotie Begeleidings Commissie
- Chair, Wetenschappelijke Raad
- Member, 3DHST team
- Member, KNAW
- Member, Lega-C team
- Member, MUSE Science Team
- Member, NIRSPEC Instrument Science Team
- Member, NIRSPEC/JWST Instrument Science Team
- Member, NWO M exacte wetenschappen commissie
- Member, NWO Middelgroot beoordelings-commissie Exacte Wetenschappen
- Co-PI, Ultravista Survey
- Member, NOVA Research Committee

PROF.DR M. FRIDLUND

- Member, CHEOPS Science Team representing ESA

PROF.DR. M.R. HOGERHEIJDE

- Program Director, Allegro, European ALMA Regional Center node in the Netherlands
- Member, ALMA Regional Center Coordinating Committee
- Member, Board of Directors Leids Kerhoven – Bosscha and Leids Sterrewacht Foundations
- Member, Board of Directors, Jan Hendrik Oort Fonds
- Member, Board of Directors, Leids Kerkhoven-Bosscha Fonds
- Member, Board of Directors, Leids Sterrewacht Fonds
- Member, European ALMA Regional Center Coordinating Committee
- Member, European Science Team Origins Space Telescope
- Member, German SOFIA Time Allocation Committee
- Member, MATISSE Science Group
- Program director, Netherlands node ALMA Regional Center
- Member, SOC for CA, USA, 20-23 September 2016

DR. J.A. HODGE

- Member, Diversity committee Science policy functions and University Committee Memberships
- Member, ESO OPC
- Referee, JCMT Large Proposal
- Chair, Licentiate seminar of Judit Fogasy
- Member, Next Generation Very Large Array (ngVLA) High-redshift Universe working group
- Member, NL-LAC
- Member, Origins Space telescope Galaxy Evolution Science Working Group
- Member, SKA Extragalactic Spectral line working group
- Member, SOC for SMG20 conference
- Member, SOC Lorentz Workshop 'Physical characteristics of normal galaxies at z>2'
- Member, SOC Oort Workshop 'Feedback in galaxy formation'

PROF.DR. H. HOEKSTRA

- Member, Athena Mission
- Vice-chair, ESO Observing Program Committee
- Member, Euclid Consortium Coordination Group
- Member, Euclid Consortium Editorial Board
- Coordinator, Euclid Cosmology Science
- Chair, Lorentz Center Astronomy Advisory Board
- Deputy coordinator, NOVA NW1
- Member, NWO Vidi grant selection committee
- Chair, SOC for "A century of gravitational lensing"
- Member, SOC 2019 Texas Symposium
- Member, SOC CosmoGold IAP 2019

PROF.DR. V. ICKE

- Member, Advisory Board of CAMRAS (Dwingeloo)
- Member, Advisory Board of the Institute for Interdisciplinary Studies (University of Amsterdam)
- Member, Advisory Council
- Member, Board of Editors of the Nederlands Tijdschrift voor Natuurkunde
- Member, Board of Regents of the Gerrit Rietveld Academie (Amsterdam)

PROF.DR. F.P. ISRAEL

- Member, mid-term review-commissie onderwijs Natuur – en Sterrenkunde
- Vice-chair, Editorial Board Mare
- Lid, kamer Middel, Nationale Wetenschaps Agena (NWA-ORC)
- Chair, NWO Top-1 Panel
- Chair, Skepsis Foundation

PROF.DR. W.J. JAFFE

- Dutch Member, European Interferometry Initiative
- Member, IAU FITS working group
- Scientist, MATISSE Project
- Member, Various IAU scientific committees
- Chair, Veni Selection Committee

PROF.DR. J.S. KAASTRA

- Lead, AGN Science team Arcus
- Chair, Athena science working group WHIM
- Member, Athena XSAT team
- Principal Investigator, Chandra Low Energy Transmission Grating Spectrometer (NASA)
- Member, Editorial board, Astrophysics & Space Science
- Member, Hitomi Science Advisory Committee (On behalf of ESA)
- Member, KRISM Science team
- Member, SOC “ICAMDATA 2018”
- Principal Investigator, XMM-Newton Reflection Grating Spectrometer (ESA)
- Vice-chair, XRISM Atomic data team
- Member, XRISM Science team

PROF.DR. C.U. KELLER

- Member, Board, Isaac Newton Group of Telescopes
- Member, Editorial Advisory Board of Europhysics News
- Member, Editorial board of the journal Astronomische Nachrichten
- Member, ELT Project Science Team, ESO
- Member, EPA Network Task Group on Citizen Science
- Co-Coordinator, NWO program on Planetary and Exoplanetary Science (PEPSci)
- Member, NWO VIDI grant selection committee

DR. M.A. KENWORTHY

- PI, bRing Project
- Member, China FWN Committee
- Lead, Coronagraph design for ERIS
- Manager, High Contrast Imaging for METIS
- Reviewer, NASA and NSF
- Member, Veni Review Panel

PROF.DR. K.H. KUIJKEN

- Member, Leiden Latin America /Caribbean Committee
- Chair, ESO contact committee
- PI, ESO KiDS Survey
- Co-investigator, ESO VIKING Public Survey
- Lead, "Euclid Consortium: Complementary Observations Group"
- Board Member, Kapteyn Fonds (Groningen)
- Member, KNAW Council voor Natural and Technical Sciences
- Scientific Delegate, Netherlands
- Member and Vice-chair, Netherlands Committee for Astronomy
- Chair, NWO Exact/Natural Sciences advisory committee for astronomy
- Principal Investigator, OmegaCAM project
- Board Member, Physics Society Diligentia (the Hague)
- Co-investigator, Planetary Nebulae Spectrograph project
- Member, "Search committee, ESO KiDS Survey"
- Board member, SRON
- Scientific Delegate, the Netherlands, ESO Council
- Member, Steering committee National Science Agenda, Route "Building Blocks of Space, time and matter"

PROF.DR. H.J. VAN LANGEVELDE

- Chair, Board of directors Leids Kerkhoven Bosscha Fonds
- Member, Board of directors Leids Sterrewacht Fonds
- Member, Board of directors Jan Hendrik Oort Fonds
- Member, AENEAS consortium board
- Member, ALMA European Scientific Advisory Committee (ESAC)
- Member, ALMA Scientific Advisory Committee (ASAC)
- Member, ASTERICS consortium board
- Member, Board of Directors Jan Hendrik Oort Fonds
- Chair, Board of Directors Leids Kerkhoven Bosscha Fonds
- Member, Board of Directors Leids Sterrewacht Fonds
- Member, Consortium Board of Directors European VLBI Network
- Member, Dutch URSI committee
- Member, EC project AENEAS Board
- Member, EC project ASTERICS Board
- Coordinator, EC project JUMPING JIVE
- Member, EC project RadioNet Board
- Member, Event Horizon Telescope Publication Working Group
- Coordinator, JUMPING JIVE project
- Member, RadioNet consortium board
- Chair, SKA Consortium Board for Signal and Data Transport (SaDT)

- Member, SKA klankbordgroep NL
- Member, SKA Science Focus Group on VLBI
- Member, SKA Science Working Group "Cradle of Life"
- Member, SKA Science Working Group "The Galaxy"

PROF.DR. H. LINNARTZ

- Member, FMD/ELD user committee
- Chair, OC Astronomy (Leiden)
- Member, Biomarker theme coordinator within the Planetary and Exo Planetary
- Member, Board of IAU subdivision Laboratory Astrophysics
- Coordinator, Detection of Extraterrestrial Biosignatures and Organics (PEPSci)
- Vice chair, Division XII / IAU commission 14 / working group solids and their surfaces
- Board member, ECLA2019
- Member, Editorial board "Journal of Molecular Spectroscopy"
- Workgroup leader, FOM group FOM-L-027
- Group leader, Holland Research School for Molecular Chemistry
- Board member, IAU division "Laboratory Astrophysics"
- Co-PI, Ice Age – JWST ERS DD program
- Member, International advisory committee ECOSS 2018
- Chair, Lorentz Center workshop "ICE AGE – the era of JWST"
- Chair, Lorentz Center workshop "SWEDIBLES"
- Reviewer, numerous Journals and Science Organizations
- Member, NWO-CW "Spectroscopy and Theory"
- Member, Science Network (PEPSCI)
- Member, SOC on "ECLA2016" (European Conference on Laboratory Astrophysics)
- Member, SOC on "IR Plasma Spectroscopy Meetings"
- Board member, SOC on "Molecular high resolution spectroscopy symposium"
- Member, SOC astrochemistry within CHAINS
- Member, SOC of international "Molecular High Resolution Spectroscopy Symposium"
- Member, Solid state astrochemistry theme coordinator within the Dutch Astrochemistry Network (DAN)
- Workgroup leader, within the H2020 ITN EUROPAH

DR J. LUB

- Member, Faculty Library Committee
- Chair, Astronomy & Astrophysics Board
- Treasurer, Dutch Astronomical Society (NAC)

PROF.DR. F.H. VAN LUNTEREN

- Member, Koninklijk Nederlands Historisch Genootschap
- Member, History of Science Society
- Member, Historisch Genootschap Amsterdam
- Member, Woensdagavond Gezelschap Utrecht
- Member, Teylers Tweede Genootschap
- Member, Koninklijke Hollandse Maatschappij van Wetenschappen

- Member, Descartes Centre Utrecht
- Member, Redactie Nederlands Tijdschrift voor Natuurkunde
- Member, Advisory editor Isis
- Member, Bestuur Stichting Vrienden van de Leidse Universiteitsbibliotheken
- Member, Studium Generale-commissie Universiteit Leiden
- Member, Gastschrijvercommissie Universiteit Leiden
- Member, Wetenschapscommissie Teylers Museum
- Member, Wetenschappelijke Raad Museum Boerhaave
- Member, Wetenschappelijke Raad Scaliger Instituut
- Vertrouwenspersoon, Wetenschappelijke Integriteit BŠtafaculteit VU
- Member, Committee on Meetings and Programs van de Amerikaanse History of Science Society
- Voorzitter, Stevin Centre for the History of Science and the Humanities, Amsterdam
- Voorzitter, Bestuur Octavie Siegenbeek van Heukelom Stichting, Leiden
- Voorzitter, Bestuur Stichting Historische Commissie voor de Leidse Universiteit

PROF.DR. G.K. MILEY

- Chair, Greenberg Foundation
- Member, "University and Oort Professorship for South African Minister of Science and Technology, H.E. Naledi Pandor"
- Member, Advisory Committee, Dublin Institute for Advanced Studies
- Trustee, Associated Universities Inc. (AUI – managing body of US National Radio Astronomy Observatory)
- Trustee, Associated Universities Inc. (Governing body of US NRAO)
- Member, Board of Governors of the LOFAR Foundation
- Member, ERC Synergy Proposals Panel
- Member, European Research Commission Advisory Panel
- Co-Chair, IAU European Regional Office of Astronomy for Development
- Chair, LOFAR Survey Science Group
- Member, Raad van Toezicht Stichting LOFAR
- Member, South African Astronomy Advisory Council

PROF.DR. S.F. PORTEGIES ZWART

- Chair, AMUSE development team
- Member, Computational Science board
- Member, Hubble Fellow selection committee
- President, IAU commission C.B1 Computational Astrophysics
- Member, IAU Division VII Commission 37 Star Clusters & Associations
- Member, IAU Division VII Galactic System
- Member, KHMW
- European Ambassador, Meta Institute for Computational Astrophysics
- Beta Ambassador, Netherlands
- Representative, NOVA ISC
- Member, PRACE
- External advisor, Qatar NSF
- Visiting professor, RIKEN, Japan
- Editor, Springer Journal of Computational Astrophysics and Cosmology
- Member, VPRO Noorderlicht

DR. E.M. ROSSI

- Member, Advisory board Delft University Space Institute
- Member, Board Holland Space Cluster
- Member, Board LOFAR International Telescope
- Chair, Board of the Netherlands Research School for Astronomy
- Member, Committee for Astroparticle Physics in the Netherlands
- Chair, Euclid (ESA's dark energy satellite mission) consortium board
- Member, European leader of the LISA consortium's work package “multimessenger astrophysics”
- Member, Leiden university wide committee on policies related to top-researchers
- PI, LOFAR surveys: Opening up a new window on the Universe
- Member, Netherlands Committee for Astronomy
- Member, NL-SKA contact committee
- Member, Science Advisory Committee ASTRON
- Member, SKA Science working group on radio continuum surveys
- Co-leader, XIPE's "tidal disruption event” working group

PROF.DR H.J.A. ROTTGERING

- Member, Board of directors of the faculty of Science
- Member, Leiden University wide committee on policies related to top-researcher
- Member, Science Advisory Committee ASTRON
- Member, Steering Group relocation SRON to Zuid-Holland
- Member, advisory board Delft University Space Institute
- Member, ALMA Proposal Review panel for Cosmology
- Member, Board Holland Space Cluster
- Member, Board LOFAR International Telescope
- Chair, Board of the Netherlands Research School for Astronomy
- Member, Curatorium of the professorship at Leiden University “Experimental Astroparticle physics”
- Chair, Euclid (ESA's dark energy satellite mission) consortium board
- PI, LOFAR surveys: Opening up a new window on the Universe
- Member, LOFAR's NL-LAC, national LOFAR steering committee
- Member, Netherlands Committee for Astronomy
- Member, NL-SKA contact committee
- Member, Leiden University wide committee on the promotion of scientific excellence and talent policy
- Member, SKA Science working group on radio continuum surveys

DR. P. RUSSO

- Expert, European Commission's H2020
- President, IAU Commission C2: Communicating Astronomy with the Public
- Member, IAU Division C Education, Outreach and Heritage
- Member, IAU Working Group: IAU 100
- Member, SOC Communicating Astronomy with the Public Conference
- Advisor, Nederlands Space Office about European Commission's Space Programme Committee

- Vice-President, Portuguese Science Communication Association
- Advisor, Regional Directorate Science & Technology, Azores Regional Government, Portugal

PROF.DR. J. SCHAYE

- Member, WeCo (Permanent Committee for Academic Practice)
- PI, MUSE QuBES (Quasar Blind Emitter Survey)
- Member, Athena X-IFU science advisory team
- Member, Athena X-IFU science team
- Member of the Board, "Stichting Studiefonds J.C. Kapteyn"
- Member of the Board, "Pastoor Schmeits prize"
- PI, EAGLE collaboration (Evolution and Assembly of GaLaxies and their Environments)
- Member, EUCLID cosmological simulations working group
- Member, Executive board
- Chair, LOC of "Computational Cosmology"
- Core member, LOFAR Epoch of Reionization science team
- Scientific Editor, Monthly Notices of the Royal Astronomical Society
- Member of the executive board, MUSE (Multi Unit Spectroscopic Explorer)
- Builder, MUSE GTO team
- PI, MUSE QuBES (Quasar Blind Emitter Survey)
- Member of the executive board, MUSE (Multi Unit Spectroscopic Explorer)
- Member, Virgo Consortium for cosmological supercomputer simulations
- Member of the board, Pastoor Schmeits prize
- Scientific Editor, Scientific Reports
- Member, SOC "European week of astronomy and space science"
- Member, SOC "Intergalactic Interconnections"
- Member, SOC "Warm and Hot Baryonic Matter in the Cosmos"
- Member, SOC "What matter(s) between galaxies"
- Member, SOC, "A Decade of the Star-Forming Main Sequence"
- Member, SOC, "European Week of Astronomy and Space Science"
- Member, SOC, "Frontiers of astrophysical modeling"
- Member, SOC, "IAU Focus Meeting #2: Warm and Hot Baryonic Matter in the Cosmos"
- Member, SOC, "Intergalactic Interconnections"
- Member, SOC, "What matter(s) around galaxies"
- Member, Stichting Studiefonds J.C. Kapteyn
- Member, Virgo Consortium for cosmological supercomputer simulations
- Member, WEAVE QSO science team

PROF.DR I.A.G. SNELLEN

- Member, Student travel fund of Leiden University Fund (LISF)
- Member, Board of Dutch Astronomy Society (NAC)
- Member, Editorial Board, Zenit
- Panel Chair, ESO Observation Program Committee (OPC)
- Referee, EU ERC grant proposal
- Reviewer, EU FP7 Network progress
- Dutch Co-PI, HARPS3 at the INT

- Member, HIRES/E-ELT consortium
- Member, METIS Science Team
- Principal Investigator, Multi-site All-Sky CAmeRA (MASCARA)
- Member, NWA, Route 4 committee

DR.IR. F. SNIK

- Member, De Jonge Akademie
- Member, Isaac Newton Group of Telescopes Time Allocation Committee
- Editor, Nederlands Tijdschrift voor Natuurkunde
- Member, NOVA Instrument Steering Committee
- Member, Time Allocation Committee Isaac Newton Group

DR. R. STUIK

- Secretary, Leids Kerkhoven Bosscha Fonds
- Secretary, JHOF
- Secretary, Leids Sterrewacht Fonds

PROF.DR. A.G.G.M. TIELENS

- Editor in Chief, AstroPAH
- Member, European Space Sciences Committee
- Member, KNAW
- Editor in Chief, Molecular Astrophysics
- Chair, Science Advisory Committee of SRON

DR. R.J. VAN WEEREN

- Member, Opleidingscommissie (Astronomy bachelor)
- Member, LOFAR 2.0 Science Advisory Panel
- Member, Lorentz Center science board

PROF.DR. P.P. V.D. WERF

- Organist, Academy Auditorium
- Member, Task Force Strengthening Master Programmes
- Member, ALMA Spectroscopic Survey consortium
- Member, ALMA-LABOCA ECFS Survey consortium
- Project Scientist, AMKID Sub-mm camera
- Principal Investigator, DESHIMA spectrograph
- Member, Herschel Astrophysical Terahertz Large Area Survey consortium
- Principal Investigator, JCMT Cosmology Legacy Survey
- Member, METIS Science Team
- Co-investigator, MIRI
- Member, SOC on “20 Years of Submillimetre Galaxies”, Durham (UK)
- Member, STFC Herschel Oversight Committee

PROF.DR P.T. DE ZEEUW

- Member, Raad van Advies, NWO
- Member, Prize Selection Committee, Franqui Foundation, Brussels, Belgium
- Chair, International Advisory Board, ASTRO3D Consortium, Australian Research Council, Canberra

Grants

P.I.	FUNDER	PROPOSAL TITLE	GRANT (K€)
Rottgering / Schaye	NWO	Nationale Roadmap Wetenschappelijke Infrastructuur (Athena): SRON	622
Mushtukov	NWO VENI	VENI: Pulsating ULXs: highly magnetised neutron stars at extreme mass accretion rates	250
Rosotti	NWO VENI	VENI: Studying planet formation in the ALMA era	250
Sonnenfeld	EU H2020	Marie Curie Individual Fellowship: Accurate halo masses in the precision cosmology era	166
Cautun	EU H2020	Marie Curie Individual Fellowship: Dancing with giants: dynamics of dwarf satellite galaxies	166
van Weeren	EU ERC	ClusterWeb: Unravelling the physics of particle acceleration and feedback in galaxy clusters and the cosmic web	1488
Russo		Citizen Science-ION	21
Portegies Zwart		Machine Learning-SURFSara	50
Russo, Snik	EU H2020	SwafS-Citizen Science: The Platform for Sharing, Initiating, and Learning Citizen Science in Europe	57
Russo, Miley	EU H2020	spaceEU: Fostering a young, creative and inclusive European Space Community	282
Russo		Open Science Hub	65
Hogerheijde / Tilanus	ALLEGRO	The ALMA Regional Center Node in the Netherland	2500

19

Research Institute Leiden Observatory
Onderzoeksinstituut Sterrewacht Leiden

Sterrewacht Leiden

Universiteit Leiden
The Netherlands