Leiden Science

Our Talents & Discoveries in 2016

Faculty of Science

Universiteit Leiden

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Leiden Science, Our Talents and Discoveries in 2016

Foreword

The year 2016 marked the second half of our lustrum year, in which we celebrated the 200th anniversary of our Faculty of Science. Many students, staff members and scientists came together at our grand Science Gala in the Leiden Stadsgehoorzaal for a memorable night of dancing and music. Our faculty-wide lustrum symposium 'Science Matters' highlighted the importance of fundamental research.

Our statisticians and computer scientists have taken the initiative to enrich our research portfolio, currently comprising the research domains Fundamentals of Science and Bioscience: the Science Basis of Health. Data Science is the third focus area of the faculty. In the Leiden University Data Science research programme, launched this year, our scientists are teaming up with colleagues from all other faculties, not only to improve health care, develop better risk assessments, and make energy more sustainable, but also to develop new tools for research in Archaeology, the Social Sciences, Humanities, and Law.
Our education is thriving. The number of students that enrolled in our faculty has grown for the fifth consecutive year. In September, we started the new Master's Programme Pharmacy, together with Leiden University Medical Center. It combines the strong scientific basis of Leiden Bio-Pharmaceutical Sciences with the patient-focused elements of the Master's Programme Medicine. In the same month, the new Master's Programme Statistical Science for the Life and Behavioural Sciences was launched. This programme is a cooperation between our Mathematical Institute, the Faculty of Social Sciences and the Leiden University Medical Center.
We believe working and studying in an international community generates new insights, inspiring contacts and resulting in more robust research and teaching. This year, faculty-wide delegations visited Indonesia, Brazil and China to forge new collaborations and connect with prospective students.
We actively reach out to society. More than 3000 high school pupils visited our Junior Science Lab. The Universe Awareness programme is active in more than 60 countries worldwide. Our famous Hortus botanicus attracted 145,000 visitors in 2016.
Not only students and scientists make up our science community. Without the work of our support staff we would not be able to perform our research and education. Therefore, this year we have included the stories of several of our colleagues in this book.
Altogether, we are very proud of all achievements our entire community has made last year. We hope you will enjoy reading about them.

The Board of the Faculty of Science,

Geert de Snoo
Dean

Han de Winde
Vice Dean

Dirkje Schinkelshoek
Executive Director

Maxim Allaart
Assessor

Our Lustrum

On 2 August 2015, our Faculty celebrated her 200th anniversary - a milestone that we celebrated throughout the academic year 2015-2016 with a variety of events.

To mark the celebration of our lustrum year, the history of the faculty is included in a special lustrum book *Van cabinet naar science park*. Prof. Willem Otterspeer, Prof. Dirk van Delft and Prof. Frans van Lunteren were the main contributors. Together they drew up the history of our faculty, containing the most important events in the past 200 years and a series of 40 portraits of prominent professors. Furthermore, the book comprises an overview of all professors and faculty boards appointed at the faculty in the past 200 years.
The motto of this lustrum year was 'We Are Science'. The slogan is about science and education, about celebrating our staff and students and the joined capacity of our community, and about the impact of science on society.
Our Lustrum Magazine is online available for you to look back with its photos, impressions and videos of the lustrum year.

leidenscience-lustrummagazine.nl

Events:

- Opening Ceremony (1 September 2015)
- Science Run (10 October 2015)
- Pub Quiz (11 December 2015)
- New Year's Reception (5 January 2016)
- Science Gala (12 February 2016)
- Lustrum Symposium (18 March 2016)

Lustrum Symposium

Opening Ceremony

Science Gala


New Year's Reception


Opening Ceremony

We are
SCIENCE SINCE 1815

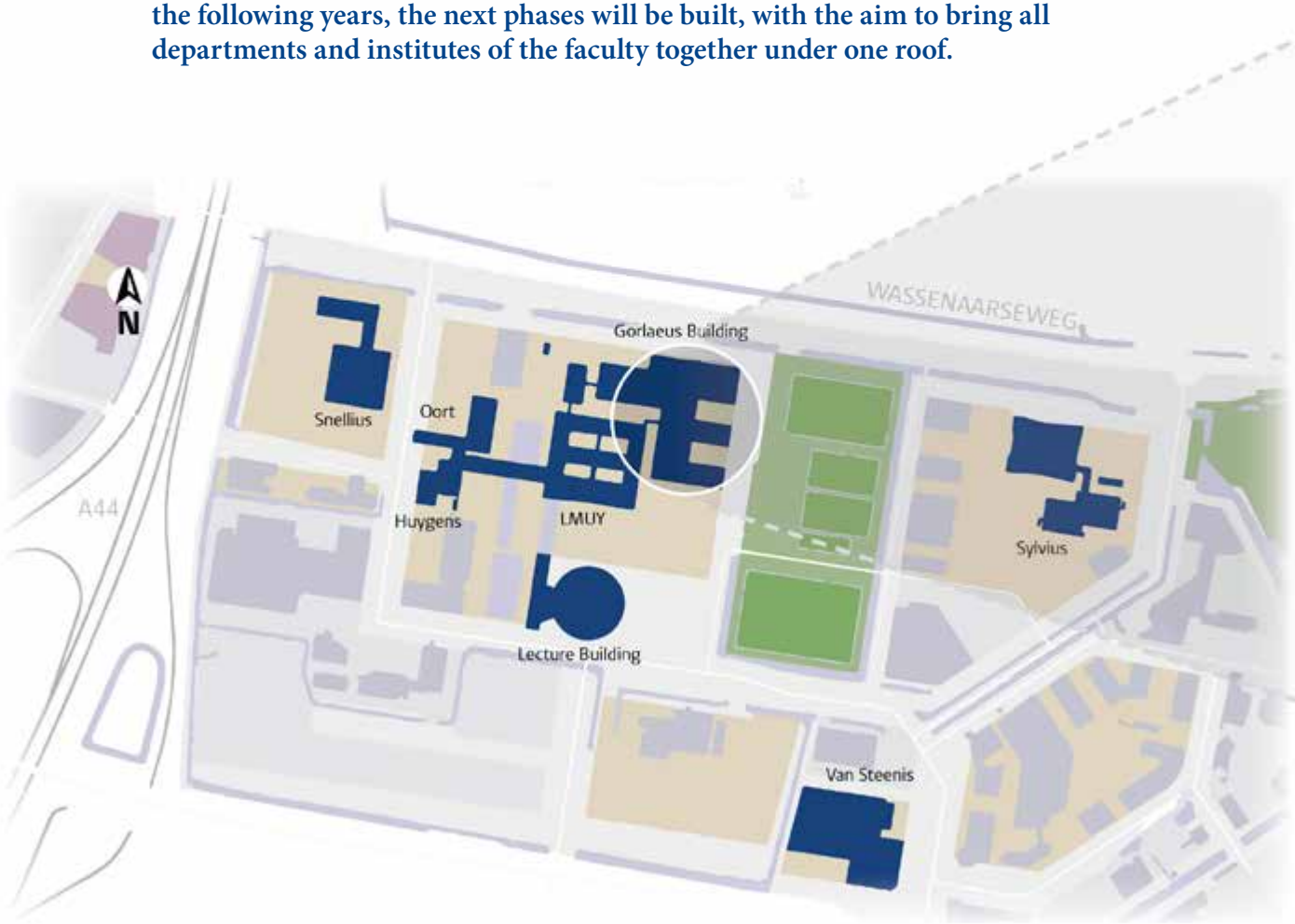

Pub Quiz

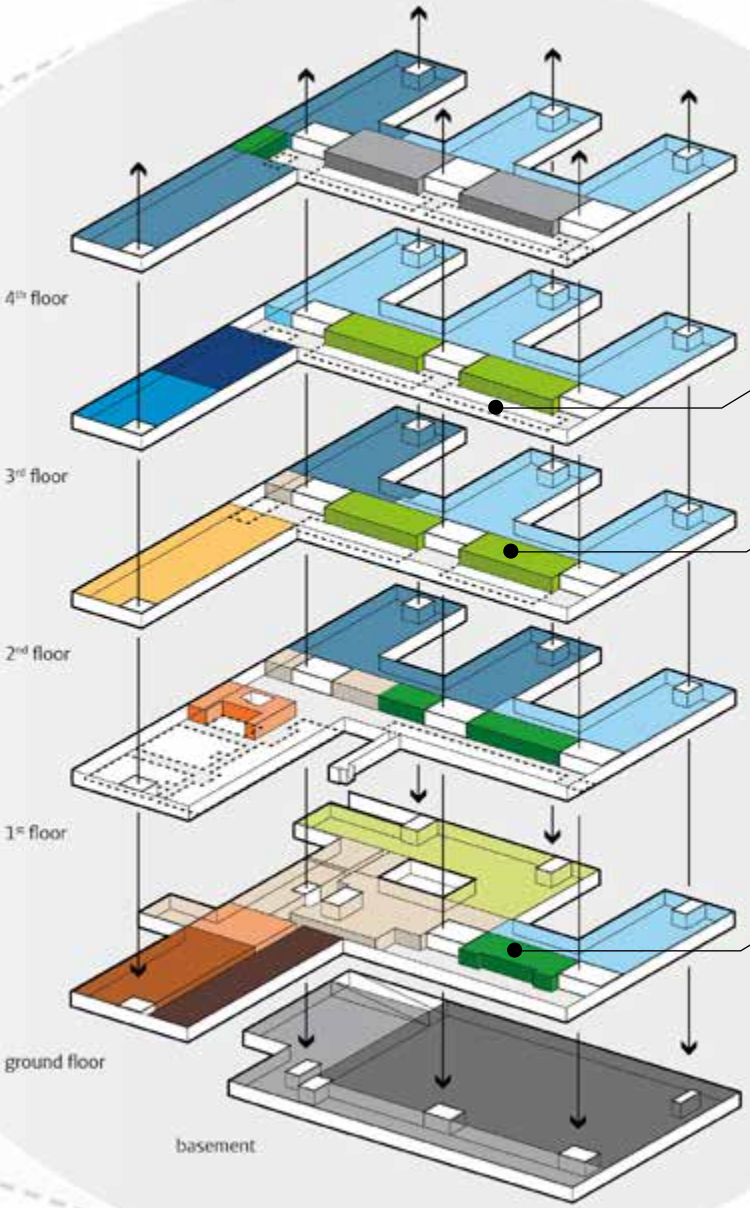

Science Gala


Science Run

Our Campus

Our institutes and facilities are spread out over a number of buildings, located at the heart of the Bio Science Park – one of Europe's top rated science parks. Since 2016, students and staff from several institutes occupy the first phase of the new Gorlaeus Building. This new energy efficient building offers a high-tech environment with state-of-the-art research and education facilities. In the following years, the next phases will be built, with the aim to bring all departments and institutes of the faculty together under one roof.

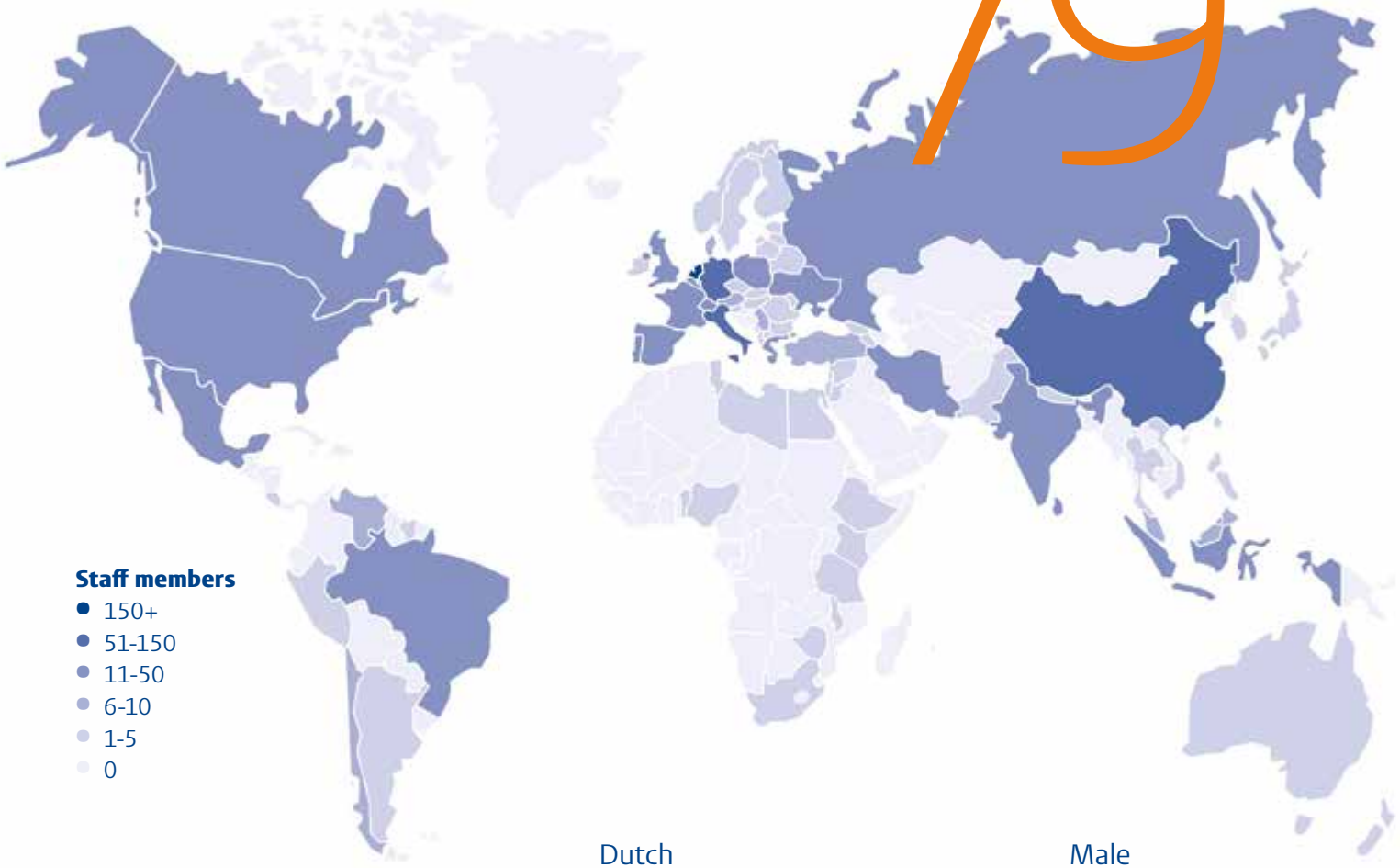




- Leiden Institute of Chemistry
- Leiden Academic Centre for Drug Research
- Institute for Biology Leiden
- Leiden Institute of Physics
- Fine Mechanics and Electronics Department
- Practical Laboratory
- Lecture room
- General
- Cell Observatory
- NeCEN
- Ultramicroscopy Hall
- NMR
- Parking
- Technical

Our Staff

79 Nationalities



Staff members Faculty of Science*

Total
2190

Dutch
1355 62%

Other nationalities
835 38%

Male
1429 65%

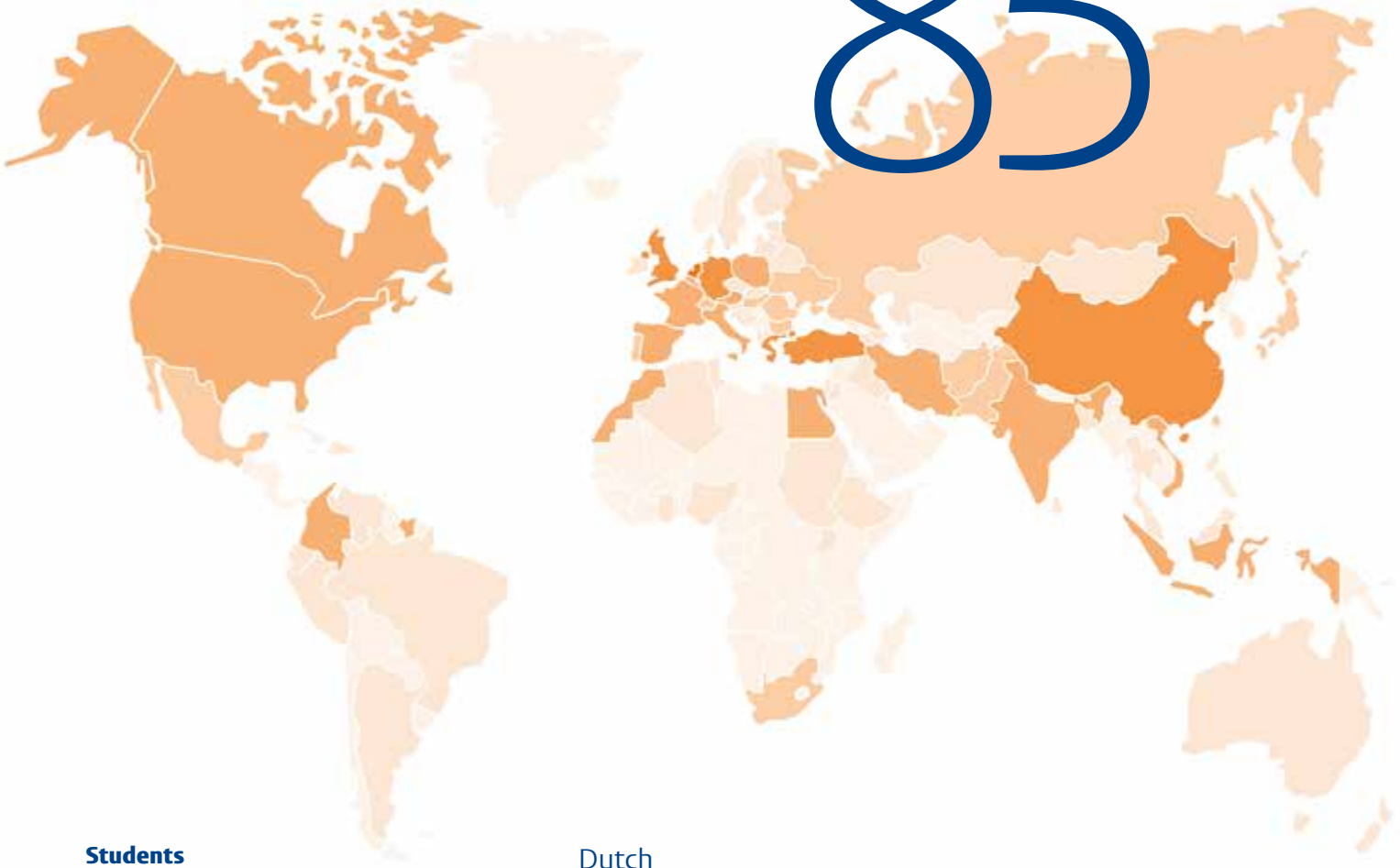
Female
761 35%

* End 2016, including guest lecturers and honorary staff members.

Our Students

85

Nationalities in our faculty*



Students
- 150+
- 51-150
- 11-50
- 6-10
- 1-5
- 0

Dutch
3495 90%

Other nationalities
385 10%

Students Faculty of Science

Total
3880

* End 2016, including dual nationalities.

Our People

One could say that invisible forces are acting at our faculty. These forces are the people who make all the wonderful research and education possible, while remaining mostly in the background. Without them, researchers and educators would often be unable to perform their jobs. Ever thought of the fact that exotic plants in the Hortus botanicus need intensive daily care? Or that many devices used by scientists need to be custom-made? Or that complex planning and continuous support is essential for practicals? These tasks are performed by people who deliver hard work and enable the faculty to flourish. Who are these people and what drives them? Let's find out!

Name: Mirthe Bergman
Works at: Fine Mechanical Department (FMD)
Works as: FMD employee

'We always say: nothing is impossible, because we are making machines that do not yet exist,' Mirthe Bergman explains. After finishing her education at the Leidse instrumentmakers School, Bergman started at the FMD, now almost nine years ago. 'Since then, I learned so much. Here at the workshop everybody works with all machines. There are some specialists, but they will teach you how to do something rather than doing it for you. 'My work starts when a researcher needs specialised equipment,' Bergman says. 'This can be a small component, or an entire machine.' It is important that she understands what the research is about. 'Otherwise we cannot deliver the solution that is needed. Often we have a different view on problems, which can be very helpful for the researcher.' She enjoys the collaboration with researchers. 'The variety in researchers is amazing, so many different cultures and people.' However, working with researchers entails one downside. 'It also means that people who you like often have to leave.'

Name: Rogier van Vugt
Works at: Hortus botanicus Leiden
Works as: Head gardener greenhouses

When hearing Rogier van Vugt talk about his work, one word comes to mind: passion. This is something that Van Vugt points out: 'For my job it is really important that plants are your passion.' In the past five years, Van Vugt has been working at the Hortus botanicus as head gardener of the greenhouses. It is a job that offers a great deal of variation. 'Think of cultivating and nurturing plants, performing computer work, maintaining connections worldwide, attending meetings, making plans for the future and working together with researchers', he sums up. 'One of my favourite tasks is cultivating the plants, especially the stubborn ones that require special care.' Another interesting part of his job is the collaboration with researchers. 'Today, we try to find the right researchers for our plant collection instead of altering an entire collection around a new researcher. During collaborations, I noticed that the mix of my practical knowledge works very well with the theoretical background of the scientists. These cooperations often lead to interesting and also practical results.'

Name: Gonnie den Dulk
Works at: Leiden Institute of Chemistry
Works as: Education and research staff member (TOA)

Walking ten kilometres a day between labs and offices? Gonnie den Dulk sometimes walks even more. 'But it's all worth it to ensure the quality of the practicals', says Den Dulk. She has been working as a TOA at Leiden University for a year. She enjoys her job and likes working in an environment with lots of young people. Her activities include everything that is necessary to facilitate the practicals. 'Think of setting up glassware, making chemical solutions and supplementing the supplies. But I also create the schedules. That is always a puzzle, especially with some 650 first-year students! Still, we always manage to make it work, in close collaboration with the teachers.' That fulfilling others' needs is an incentive that is much welcomed in this job becomes apparent from Den Dulk's motivation: 'What satisfies me the most is that at the end of the day I can look back and think to myself: the practicals ran smoothly and every student was able to work in an unimpeded manner.'

Honorary

Each year, a number of eminent scientists are appointed to occupy an honorary chair in the Faculty. The Lorentz chair has an illustrious history; 14 occupants of the chair later received a Nobel Prize in Physics, the most recent prize being awarded in 2016 to Duncan Haldane. In general, the honorary professors spend two months in the institute and give both advanced lectures for PhD students and staff and a public lecture for a broad audience. During the 441st Dies Natalis, an Honorary Doctorate was awarded and our Dean delivered the Dies Lecture.

Lorentz chair 2016 – Charles Kane

Prof. Charles Kane is a theoretical condensed matter physicist and Professor of Physics at the University of Pennsylvania. This world-renowned American physicist has made major contributions to theoretical condensed matter physics. He is most famously known for discovering topological insulators in the mid-2000's. For his work on this subject he received the Dirac Medal of the International Centre for Theoretical Physics in 2012, along with two colleagues. Furthermore, he shared the Physics Frontiers Prize 2013 with Laurens Molenkamp and Shoucheng Zhang, also for work on topological insulators.

Oort chair 2016 – Joseph Silk

Prof. Joseph Silk is one of the world's leading experts in theoretical cosmology, the cosmic microwave background, and dark matter, and he is an outstanding science communicator. He has done important work on density fluctuations in the early Universe, discovering a key mechanism in early structure formation, which is now called 'Silk damping' after him. After working at the University of California, Berkeley, for three decades, he moved to Oxford, where he was the Savilian Professor of Astronomy from 1999 to 2011. Currently, he is Professor of Physics at the Institut d'Astrophysique de Paris and Homewood Professor of Physics and Astronomy at The Johns Hopkins University in Baltimore. In 2011 he was awarded the Balzan prize for his pioneering work on the infant Universe.

Honorary Doctorate – Jennifer Chayes

Even without currently being a professor, Dr. Jennifer Chayes received an Honorary Doctorate based on her versatile work in the field of statistical physics, stochastics and discrete mathematics. Chayes is Managing Director at Microsoft Research New England and New York City. She graduated in physics and biology summa cum laude from the Wesleyan University in Connecticut, and completed a PhD in physics at Princeton University. She thereafter worked at Harvard University, Cornell University and the University of California, Los Angeles (UCLA). During her years at UCLA she collaborated on many discoveries in the study of phase transitions, in particular percolation theory and the theory of many-body systems. Under her leadership, an international Microsoft research group achieved great breakthroughs in the field of complex networks. Chayes' work has led to her enjoying great respect amongst both physicists and mathematicians.

Dies Lecture – Geert de Snoo

'Make more room for nature on farmland and you'll be surprised at the result', said our Dean and Professor of Conservation Biology Geert de Snoo during the 441st Dies Natalis. In his lecture, De Snoo pointed out that, simply due to their vastness, agricultural areas are important to the Dutch natural landscape. Although nature is doing well in the Netherlands, there is a decline in nature in agricultural areas. Species dependent on these areas are therefore suffering. De Snoo made a plea for more space for nature and the enhancement of soil quality. A soil filled with microorganisms and insects does not only mean more food for birds, but also a more resistant soil for farmers. This reduces the need for hazardous spraying. 'Leiden research, partly assisted by psychologists, shows that farmers want to be proud of their business and the natural environment that is part of it. Let us make use of this', says De Snoo. The bottom line: connecting nature protection with sustainable agriculture will benefit nature, the environment and agriculture.

Facts

Institutes

- Leiden Observatory (Observatory)
- Leiden Institute of Physics (LION)
- Mathematical Institute (MI)
- Leiden Institute of Advanced Computer Science (LIACS)
- Leiden Institute of Chemistry (LIC)
- Leiden Academic Centre for Drug Research (LACDR)
- Institute of Biology Leiden (IBL)
- Institute of Environmental Sciences (CML)

University research profile areas we participate in

Fundamentals of Science, Bioscience: the Science Base of Health, Translational Drug Discovery and Development

Staff

Postdocs

170

PhD's vs Guest PhD's

Financial Facts 2016 in K€

Total Turnover

Direct Funding

Ministry of Education, Culture and Science

€ 68,048

Research funding

National funding comprises funding from NWO, KNAW and STW

Other external (research) funding

Key Facilities

Our faculty hosts a number of key facilities, enabling our research groups to do their innovatory research. Furthermore, these facilities are made visible and accessible for international third parties through the Open Access Research Infrastructure platform (OARI). In 2016, Naturalis Biodiversity Center decided to reinforce the OARI platform by becoming a partner.

Cell Observatory

The Cell Observatory houses cutting-edge bio-imaging technology and other facilities, aimed at visualising the dynamic structures of life, from molecule to cell.

cellobservatory.leidenuniv.nl

NeCEN

The powerful electron microscopes at NeCEN make it possible to explore proteins, macromolecular complexes, bacteria and cell organelles, thus gaining valuable information for future drug development.

necen.nl

NMR Facility

With the NMR Facility, much can be learned about the structure and dynamics of proteins. This newly obtained knowledge provides the basis for medicine and vaccine development.

nmr.lic.leidenuniv.nl

Metabolomics Facility

The Metabolomics Facility brings together two research groups: the Biomedical Metabolomics Facility – consisting of experts in clinical metabolomics – and the Natural Products Lab – a pioneer in plant and herbal medicine metabolomics.

universiteitleiden.nl/en/research/research-facilities/science/metabolomics-facility

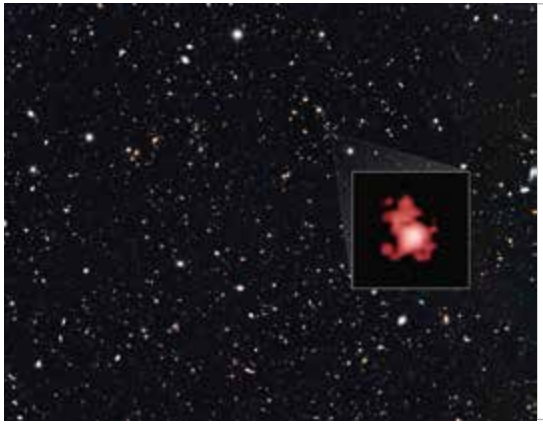
Leiden Centre of Data Science

The Leiden Centre of Data Science (LCDS) is a network of researchers from different scientific disciplines, joining their research efforts using innovative methods to deal with large amounts of data.

universiteitleiden.nl/en/science/leiden-centre-of-data-science

Breakthroughs

Academic research is vital for society. Our researchers from different disciplines work together to find innovative solutions to societal problems. This often results in valuable and sometimes surprising breakthroughs.



International team (Observatory) – **Furthest galaxy ever observed**

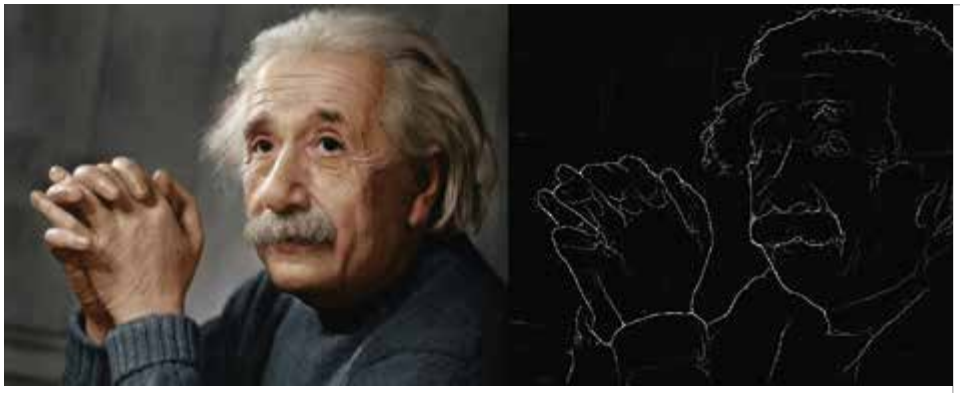
An international team including Marijn Franx, Ivo Labbé and Rychard Bouwens shattered the cosmic distance record by observing the furthest galaxy ever. The galaxy was seen as it was 13.4 billion years in the past, only 400 million years after the big bang. This discovery provides new insights in the evolution of the universe and formation of galaxies such as our Milky Way.

DOI: 10.3847/0004-637X/819/2/129

Martin van Hecke & Corentin Coulais (LION) – **Building with flexible blocks**

The internal spatial structure of these materials determines their behaviour. By combining flexible building blocks, any desired pattern can be programmed to occur when pressure is exerted. In the future, such metamaterials could lead to the development of new devices, from smart prostheses to wearable technology.

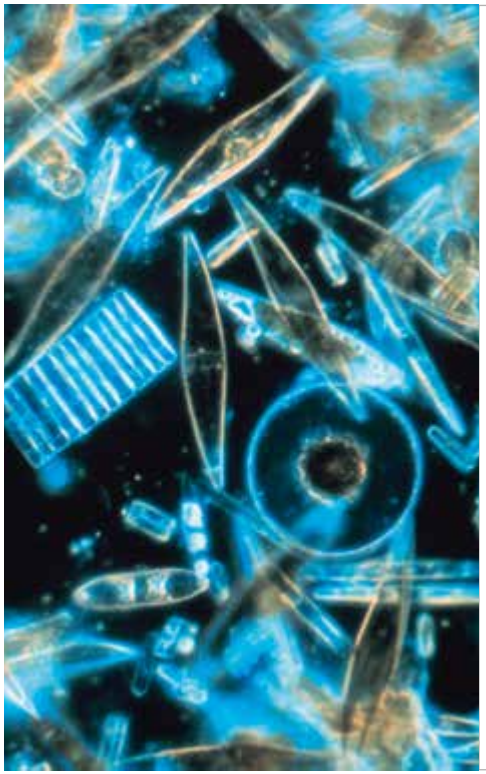
DOI: 10.1038/nature18960



Michael Lew (LIACS) – **Defining edges for visual concept detection**

Michael Lew's deep learning group has the world's best edge detector, greatly helping him solve challenging problems in computer science, biology, medicine, and digital humanities. The computer uses state-of-the-art deep neural networks to define the edges and recognise visual concepts and objects. In the near future, computer vision could detect tumours in X-ray pictures, identify plant species, help design new engines, and improve digital storytelling.

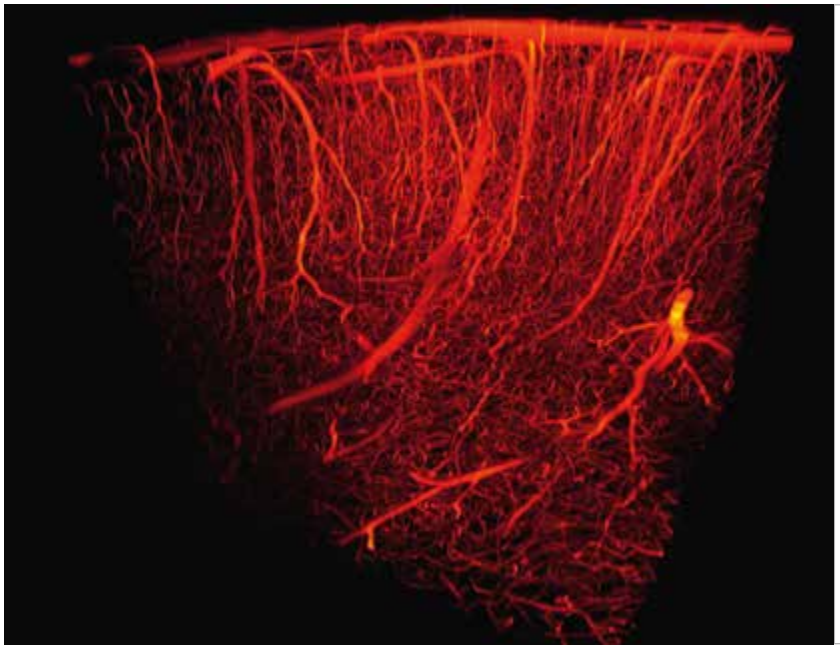
CVPR 2016 open access



Lotte Sewalt (MI) – **Patterns in nature**

Patterns can be found everywhere in nature, but Sewalt seems to connect the widest variety of systems. By using math – in this case differential equations – Sewalt connects plankton, stripes in vegetation, and tumours. Her research shows the importance of understanding the world around us in mathematical terms.

DOI: 10.1016/j.jtbi.2015.12.024



Liesbeth de Lange (LACDR) – **Predicting drug behaviour in the brain**

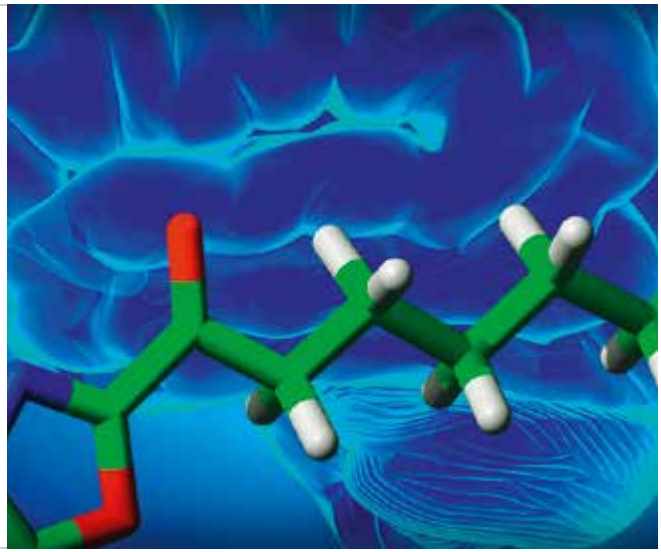
Does a drug enter into the human brain once administered in the body? With her group, Liesbeth de Lange created a model that can predict how fast a drug enters the human brain, and how much of it. This gives important information on drug concentrations for early clinical trial research.

DOI: 10.1007/s11095-016-2065-3

Hui Deng (LIC) – **Reducing inflammation in the brain**

Endocannabinoids are substances that exert similar activity as marijuana, and are found in our brain. They are associated with inflammation and degeneration of the brain. Hui Deng discovered molecules that can reduce inflammation processes in the brain by reducing the production of endocannabinoids. This research is the first step in the development of medicines to treat brain diseases such as Alzheimer's and Parkinson's disease.

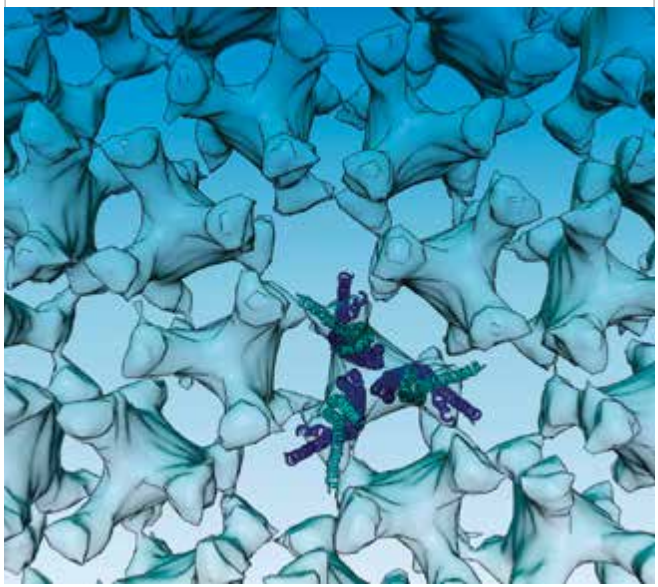
DOI: 10.1073/pnas.1522364112



Ariane Briegel (IBL) – **Understanding chemical sensing of bacteria**

Ariane Briegel gained new insights in how *Vibrio cholerae* – the bacterium causing cholera – senses its environment in order to survive. These insights may open the door to new cholera treatments. With her Briegel Lab, Briegel and her colleagues continue their important work in understanding the chemical sensing of bacteria. To do so, she recently started using the powerful equipment of the NeCEN facility.

DOI: 10.1073/pnas.1604693113



Laura Bertola (CML) – **Lions West and Central Africa are unique**

Lions in West and Central Africa form a unique group, only distantly related to lions in East and Southern Africa. This pattern is also present in many other savannah species, possibly reflecting a response to historic changes in African climate and vegetation patterns. This genetic uniqueness of West and Central African populations underlines the extreme importance of conservation in this region.

DOI: 10.1371/journal.pone.0149059

C.J. Kok Fund

The C.J. Kok fund was raised from the assets of Mr C.J. Kok, biology tutor from The Hague, who was strongly committed to the natural sciences. Upon his death in 1965 he left his entire estate to Leiden University. The C.J. Kok fund was established with this inheritance. In his will Mr Kok stated that both the Faculty of Science and the Leiden University Medical Center would annually be given the opportunity to use the fund's revenues to award outstanding performance to those demonstrating 'a pronounced, significant talent for mathematics or solving medical problems'. The will also states that the assessment of performance should be on purely scientific grounds and that no distinction should be made regarding 'rank, status, race, national character, origin, relationship and so on'.

C.J. Kok Awards

The Faculty of Science grants two C.J. Kok awards each year: the C.J. Kok Public Award, also known as the award for the 'Discoverer of the Year', and the C.J. Kok Jury Award, i.e. the award for the best PhD thesis from the past year. All institutes within the Faculty are given the opportunity to nominate candidates for both awards.

Winner 2015

Daniël Rozen
Institute of Biology

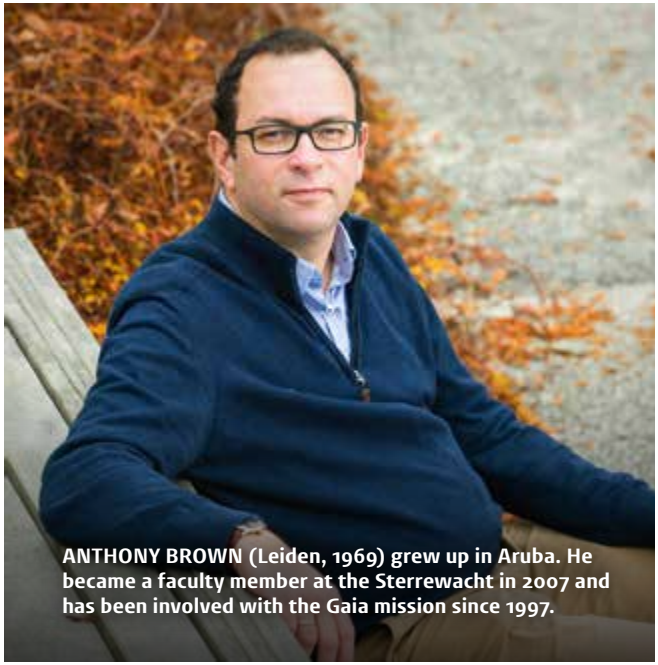
Daniël Rozen has been awarded the C.J. Kok Public Award 2015 for his research on bacteria that produce antibiotics. In his research, he proved that bacteria produce antibiotics to fight rival strains. A different theory – suggesting that bacteria use antibiotics for communication and cooperation – is now no longer plausible. Rozen's research is of great clinical importance, as it also shows how bacteria can be employed to produce new antibiotics in the lab. The voting staff, students and external parties chose Rozen with nearly 22% of the votes as the winner, entitling him 'Discoverer of the year 2015'.

ANTHONY BROWN Leiden Observatory

Mapping our skies for future generations

Astronomer Anthony Brown wants to bring order to the terrifying complexity of our galaxy. As head of the Gaia Data Processing and Analysis Consortium, Brown is responsible for the largest three-dimensional map of our night skies ever created. It is a herculean task that will change our perception of space for decades to come.

By George van Hal



ANTHONY BROWN (Leiden, 1969) grew up in Aruba. He became a faculty member at the Sterrewacht in 2007 and has been involved with the Gaia mission since 1997.

The 3D map of our night skies offers us the clearest view of the stars in the history of mankind. The first Gaia data release, mapping over a billion stars in the Milky Way, is the largest-scale survey ever conducted of our cosmos. It includes data on over one billion objects, including the distances and motions for two million stars, paving the way for a true 3D map of our cosmological environment.

'It is probable that every astronomer will end up using our database', says Anthony Brown, 'although some might not know of it.' Brown oversees the operations and logistics of the massive mission that includes over 450 people from more than 160 institutes.

They collect data from the Gaia space telescope and translate it into a form that astronomers can use. They do not, however, do any scientific analysis themselves. 'We promised ESA we would release the data to the astronomical community before doing any work on it ourselves,' says Brown.

That, of course, is already a mind-boggling operation. Each of the billion objects – distant galaxies, stars in the Milky Way and asteroids in the solar system – is measured approximately 70 times. These data points are converted into properties such as position, velocity and brightness. The data even includes measures for the amount of dust obscuring an object.

'This will be the most important astronomical reference catalogue for years to come. It will provide our first opportunity to really understand the Milky Way and its structure,' says Brown. In fact, Gaia might even give new insight into one of the largest mysteries in astrophysics: the true nature of dark matter, the mysterious 'stuff' that infuses galaxies with extra gravity. Brown: 'Gaia will be the first means to map the distribution of dark matter in the Milky Way.'

JOHANNES JOBST Leiden Institute of Physics

Viewing ‘nothing’ leads to revolutionary electronics

Physicist Johannes Jobst is a modern-day magician. His work conjures up images of hidden – and empty – electronic states from thin air. By cataloguing these states, he gains spectacular new insights into the fundamental properties of materials such as graphene. How looking at ‘nothing’ is paving the way for a new nanomaterials revolution.

By George van Hal

JOHANNES JOBST (Nuremberg, 1984) did his PhD on the electronic transport in graphene in Erlangen, Germany. He is currently working at Leiden University as a postdoctoral VENI fellow.

Solar cells, novel sensors and the computer chips of the future: these are only some of the things physicists and engineers might be able to design, using a new technique developed by physicist Johannes Jobst and his colleagues at Leiden University. Using a new type of low-energy electron microscopy he developed, Jobst is able to explore and control the cornucopia of Van der Waals materials, combinations of atom-thin materials such as graphene.

Van der Waals materials are created by combining layers of materials only a few atoms thick. Sticking these layers together - almost like Lego bricks - creates interesting electronic properties. ‘These are encoded in their band structure,’ says Jobst.

This structure describes the movement of electrons in the materials. ‘We are probing very high-energy bands,’ Jobst explains – so high that electrons occupying them move through free space, only loosely bound by their parent atoms. Usually these high-energy bands are unoccupied – nothing more than thin air. Jobst is able to reveal their presence by shooting at them with an electron beam. ‘If they have the right amount of energy, these electrons are absorbed,’ he says, thus unravelling the hidden band structure.

This is important when combining several layers to form a new Van der Waals material. Sometimes these layers start behaving like an entirely new material, while at other times they stay perfectly insulated, remaining clearly distinct. Whichever happens, the evidence shows up in their band structure.

Using this, Jobst showed that layers of boron nitride stay distinct from layers of graphene. ‘Boron nitride completely isolates graphene’, says Jobst. This comes in handy because graphene is very sensitive to its environment. A single collision with a molecule already changes its conductivity. Encapsulating graphene in boron nitride solves that problem. Jobst: ‘This is very interesting for the electronics of the future.’

LUCA AVENA Mathematical Institute

Random walks to explore Facebook or the brain

Facebook, city streets, even the brain - many complex systems can be analysed as a network of nodes and the links between them. Random walks through large networks bring their large-scale properties to light. Luca Avena's research aims for a better understanding of complex networks, such as brain scans or weaknesses in our banking system.

By Arnout Jaspers

LUCA AVENA studied mathematics in Italy, and came to Leiden for his PhD, which he obtained in 2010. After postdoc positions in Zürich and Berlin, he returned to Leiden, where he is now an assistant professor in Probability Theory.

Facebook has about a billion users, so it is a network with a billion nodes and hundreds of billions of links connecting them. The human brain is even much bigger than that. Researchers want to fathom structural properties of such huge networks. For many practical problems, it makes no sense to look at every node and link in a network. It is much more efficient to explore it with a random walk: start at an arbitrary node, and throw a dice to decide which link you will follow to the next node. There are many kinds of random walks. In his research, Luca Avena uses them as a tool kit, for instance to figure out how well-connected a network is. Recently, together with French mathematician Alexandre Gaudillière, he devised a new tool based on random walks to explore the architecture of a network. He calls it the 'random spanning rooted forest'. The roots of this forest form a subset of well-distributed nodes in the network under investigation. In a real-world network, for instance in an electricity grid, putting the power plants in place of the roots would render the most efficient energy distribution. Avena is further developing this new tool to address more real-world problems. He has recently started to interact with a group of engineers in Marseille, France, who need efficient algorithms for signal processing. Also, he started a collaboration with Diego Garlaschelli, a physicist from the Lorentz Institute, to analyse networks of banks. Analysing tightly connected communities in these networks reveals vulnerabilities in the financial system in case one of them goes bankrupt.

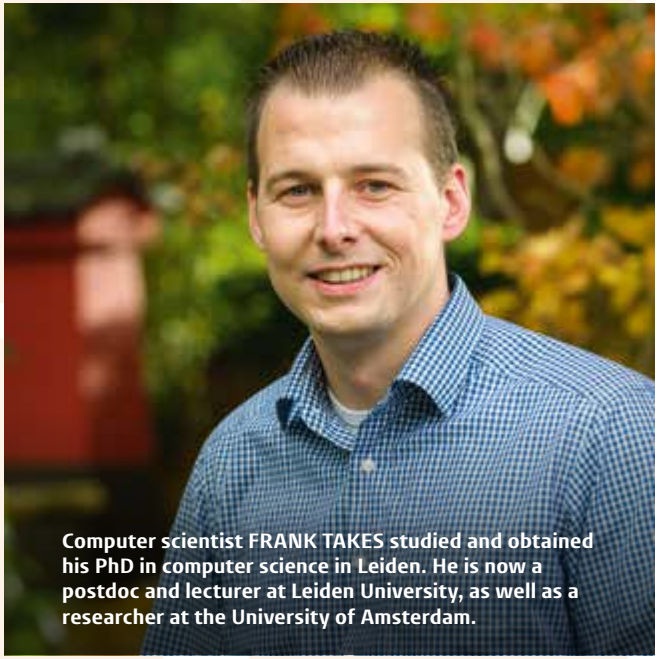
Avena: 'Random walk models have lots of real-world applications. You can also use them to model how prices evolve in the stock market, or how a virus spreads throughout a population. My work mainly concerns the mathematical foundations of these models. As is often the case in mathematics, new tools for real-world applications come out of this fundamental research.'

FRANK TAKES Leiden Institute of Advanced Computer Science

Mapping the structure of soccer violence and the corporate elite

It is a favourite of conspiracy theorists: how secret elites hold all the power in the corporate world. Frank Takes has the computer algorithms and data to support or refute those theories. He studies how millions of businesses worldwide are interconnected by mutual board members and shared ownership. He also discovered that even football hooligans have an elite.

By Arnout Jaspers



Computer scientist FRANK TAKES studied and obtained his PhD in computer science in Leiden. He is now a postdoc and lecturer at Leiden University, as well as a researcher at the University of Amsterdam.

Big data is not just a matter of collecting huge amounts of data, it is about extracting meaningful knowledge from these data. Frank Takes is interested in network science: studying interactions between objects in the data to better understand the information represented by the data. Apart from efficient algorithms, this requires domain knowledge from data experts. He therefore works closely together with social scientists at the University of Amsterdam.

One example of Takes' work is the corporate board interlock network: it links companies all over the world based on shared board members. By analysing this huge network, Takes can identify elites constituting powerful old boys' networks. Companies are also linked by owning shares in other companies. 'This reveals the global power of particular countries,' says Takes, 'but also the strategic positions of certain countries as offshore financial centres.'

Traditional algorithms, used for decades by social scientists to dissect corporate networks, would take years of computing time because of the sheer size of this data. Takes developed algorithms that perform these tasks in minutes: 'We make use of special properties of real world networks: for instance, they are sparse, having relatively few links. Also, they are 'small worlds', which means that on average any node is only a few links away from all other nodes. Our algorithms can mine patterns in real world networks that were so far intractable.'

This work makes it possible to characterise tax havens, but it can also unveil patterns in the activities of soccer hooligans. Takes, who also worked with the Dutch police: 'This allows us, to some extent, to move on from just describing, to actually predicting what these violent groups will do.'

Takes works on many other applications, such as improved suggestions for playlists on Spotify. He especially enjoys the multi-disciplinary part of his research: 'I regularly co-author publications in the social sciences. For perhaps twenty percent, I've also become a social scientist.'

OSCAR DÍAZ-MORALES Leiden Institute of Chemistry

Speeding up the production of renewable fuels

Until now, there has been no cheap and efficient way to produce hydrogen from renewable energy. Oscar Díaz-Morales tackled part of this problem by designing novel oxygen evolution catalysts that enhance the electrolysis of water. He published his discovery in *Nature Communications*, and a patent has been granted to the catalysts and the techniques to produce them.

By Willy van Strien

OSCAR DÍAZ-MORALES was trained as a chemist in Caracas, Venezuela. He came to Leiden University for a PhD project, after completion of which he stayed for another year for a joint project with the Japanese company Hitachi. He then transferred to Stockholm University as a postdoctoral researcher.

Increasing amounts of energy are harnessed from sunlight and wind. The challenge now is to store all this energy, so that it can be used when and where it will be needed. One of the most promising storage options is to convert energy into a current which is passed between two electrodes in an electrochemical cell, which is then used to split water. At the negative electrode, hydrogen gas is formed, which is a renewable fuel. However, until now, this process has not been cost-effective as at the positive electrode, oxygen gas evolves as a by-product. Not only is this process slow, it also limits the rate of water splitting. Therefore, the oxygen evolution should be catalysed on the electrode surface. The problem, however, is that the state-of-the-art catalyst iridium oxide is expensive, as iridium is scarce. To solve this problem, Oscar Díaz-Morales set to devising a new type of catalyst. He opted for compounds in which iridium atoms are embedded in a framework of cheaper materials. He tried 'iridium double perovskites': oxides consisting of a combination of barium, iridium and a third metal. These combinations contain three times less iridium than iridium oxide. When testing several of these compounds, a surprise awaited him: some of them exhibited a catalytic activity that was more than three times higher than that of the benchmarking iridium oxide. 'We still don't know why,' Díaz-Morales says. 'It has to do with the crystal structure. While iridium oxide is rigid, iridium double perovskites are able to "breathe", which probably facilitates oxygen absorption.'

New catalysts must not only be active, they must also retain their activity during long-term use. The best candidates for the third metal in the compounds are yttrium and praseodymium, metals which are classified as rare earth elements. Does it make sense to replace iridium with one of these to make catalysts cheaper? 'The funny thing is that, although yttrium and praseodymium belong to the rare earth elements, they are not rare at all. They are more common than iridium and, accordingly, they are cheaper.'

AMANDA FOKS Leiden Academic Centre for Drug Research

Tim-proteins control early atherosclerosis

In an early stage of atherosclerosis, dead cells are removed from plaque and inflammation is suppressed. Amanda Foks identified two proteins that are essential for this process, but apparently are unable to function in advanced stages of the disease. Her research, conducted at Harvard University, was published last summer in *Arteriosclerosis, Thrombosis, and Vascular Biology.*

By Willy van Strien

Biopharmaceutical scientist AMANDA FOKS carried out her PhD research at Leiden University and then moved to Harvard University for a postdoctoral project. She returned, and now holds a fellowship from the Dutch Heart Foundation.

'Until now, no cure has been found for atherosclerosis, the main cause of cardiovascular disease,' Amanda Foks says. 'Lifestyle adaptations and the use of statins at best stabilise atherosclerotic plaques and prevent that they occlude arteries or cause an infarct after rupture. But there is still no therapy that induces regression of plaques.'

Still, such a therapy is conceivable. Atherosclerotic plaques consist of accumulated lipids and immune cells. Lipid-loaded immune cells – foam cells – undergo programmed cell death (apoptosis). In an early stage, these dead cells are quickly and neatly cleared by other immune cells while inflammation is kept at bay. But for some reason, this clearance of apoptotic cells stops in a more advanced stage of atherosclerosis. The dead cells then become necrotic and lose their contents, which triggers further inflammation and growth of the plaques.

Foks: 'This means that, if we find a way to restore the removal of dead foam cells, we may be able to stop progression and possibly even induce regression of atherosclerosis.'

To help develop such a therapy, she first wanted to unravel the process of clearance. She elucidated the role of two proteins which are present on the surface of immune cells that are involved in clearance. These proteins, tim-1 and tim-4, recognise the 'eat me' signal that apoptotic cells emit, she showed. They then induce the clearing cells to ingest these apoptotic cells and to regulate inflammation. When Foks blocked either tim-1 or tim-4 with antibodies, atherosclerotic plaques progressed. Atherosclerosis aggravated even more when she blocked both proteins simultaneously. 'The reason is that tim-1 and tim-4 occur on partly different subsets of immune cells,' she explains.

Now that she has shown that tim-1 and tim-4 play an essential role in the clearance of apoptotic cells, she aims to understand why these proteins no longer respond to the 'eat me' signal of apoptotic cells in advanced plaques. The next step will be to investigate how this response can be restored.

MICHELLE SPIERINGS Institute of Biology Leiden

Birds with grammar skills

Recognising abstract grammar structures was believed to be a typically human skill. Michelle Spierings discovered that a parakeet species has this ability too. Zebra finches, however, use a different strategy to categorise sounds.

By Nienke Beintema

Humans are able to discern general grammar patterns. This allows them to make an infinite number of language constructions by applying a limited set of general rules. It is a complex skill that seems to be unique to human language learning. But does this skill evolve in humans only, setting us apart from other animals, or did it evolve much earlier? If so, researchers should be able to find it in other animal groups as well.

MICHELLE SPIERINGS (1987) studied biology in Leiden and neuroscience and cognition in Utrecht and Cambridge. Following her PhD in Leiden (2016), she moved to Vienna for a postdoc position.

To investigate this, Michelle Spierings studied two bird species: the zebra finch, which learns only one song early in life, and the budgerigar, a parakeet. Parakeets make much more complex sounds, and can learn new sounds throughout their lives.

'We designed an experiment to test both species' grammar abilities,' says Spierings. 'We placed them in a room with two buttons. Birds are curious and tend to press buttons with lights in them. If they pressed the first button, they would hear a three-syllable song made up of two different sounds. For instance XXY, or XYX. If they pressed the second button after first hearing XXY, they would get a treat. If they pressed the second button after hearing XYX, however, the light would go out, which they find unpleasant. So we were conditioning them. Both species were able to learn the rule.'

However, when she then tested whether the birds could apply the rule to the exact same structures, composed of new sounds (such as AAB versus ABA), she observed a striking difference. Budgerigars can apply the grammar rule to new sounds. Zebra finches, however, cannot. They had mastered the trick in the learning phase by memorising the position of the sound, for instance: 'Y at the end'. While they would not react to AAB, they would to ABY. Although impressive, memory is not a complex cognitive skill.

'Budgerigars are now the only animal species known to have grammar abilities,' says Spierings. 'I think that is really exciting. Apparently we are not so unique after all.'

ALEXANDER VAN OUDENHOVEN Institute of Environmental Sciences

Quantifying nature's benefits

If you cut down a forest, the obtained wood is valuable. But what is the value of protecting a natural forest – how do you quantify that? Answering this question requires indicators that go beyond money. Alexander van Oudenhoven is an expert in selecting suitable new indicators for 'ecosystem services'.

By Nienke Beintema

The growing world population with its ever-increasing consumption is putting a strain on natural ecosystems. Global interventions are required, which leads scientists and policy makers to wonder what we will lose if we don't act, and what we will gain if we protect the natural world. To answer these questions, scientists define indicators – measurable entities – for what they call 'ecosystem services'. Alexander van Oudenhoven is one of the main players in the field.

'Ecosystem services don't only include tangible items such as wood, fish, or fruit,' he says. 'They also include regulating services such as carbon sequestration, water purification and flood protection. A very important category are the cultural services: intangible benefits such as recreation, education, spirituality, inspiration, and sense of belonging. Quantifying all this goes beyond economic evaluation.'

Van Oudenhoven's specialty is finding relevant indicators for ecosystem services, and enabling their evaluation for policy and management decisions. 'This is quite a challenge,' he says, 'because you have to identify which features of a complex socio-ecological system can possibly contribute to human well-being. In addition, there is often a trade-off between services: if you use one, you can't have the other. That has an impact on how you want to manage the system.'

Before coming to Leiden, ALEXANDER VAN OUDENHOVEN (1983) obtained his PhD in Environmental Sciences in Wageningen (2015). He is the lead author of IPBES, the global UN-based assessment of ecosystem services.

To find indicators and support decision-making, Van Oudenhoven first studies how an ecosystem functions, how the system changes when people use its services, and how this in turn influences their well-being. 'I focus on how different management strategies can result in different services, and how this in turn can affect people's health, welfare and social values.'

Well-chosen indicators, he points out, do not just help advance science – they also help in communication. 'After all, you want to tell citizens and policymakers about the consequences of their choices, and provide alternatives. You can only do that if they really understand the trade-offs.'

JURY CRITERIA FOR THE BEST THESIS OF THE YEAR

What makes a thesis a winning one? The members of the jury make their selection principally based on the thesis itself and the corresponding recommendation, which is usually written by the (co)promotor or the scientific director. Main criteria for assessment are:

- The scientific quality, such as innovative content for its field of research, other disciplines, and science in general.
- Do the research results bear direct relevance to society?
- Is the thesis easily accessible and clearly written?
- Career prospects after being promoted are also considered in the jury's assessment, if this information is available.

Members of the 2016 jury are:
- Prof. Carel ten Cate
- Prof. Miranda van Eck
- Prof. Bas Edixhoven
- Prof. Ignas Snellen
- Prof. Marcellus Ubbink

CUM LAUDE PHD

Adrian Hamers
Leiden Observatory

Djordjo Milovic
Mathematical Institute

Robert-Jan Slager
Leiden Institute of Physics

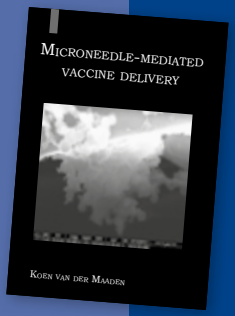
Sven Askes
Leiden Institute of Chemistry

Sung-Shik Jongmans
Leiden Institute of Advanced Computer Science

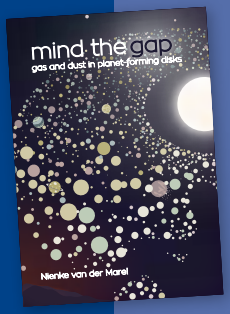
Changsheng Wu
Institute for Biology Leiden

Winners 2015

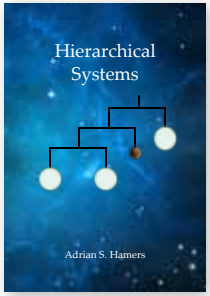
In 2015, the jury granted the C.J. Kok Jury Award to two theses. Both dissertations are of the highest scientific quality and have received a great deal of attention.



Koen van der Maaden (LACDR) was awarded for his thesis *Microneedle-mediated Vaccine Delivery*. His study provides important new insights for enabling pain free vaccination via the skin.



Nienke van der Marel (Observatory) was awarded for her thesis *Mind the Gap, Gas and Dust in Planet-forming Disks.* Using observations from the ALMA telescope, Van der Marel made discoveries that form a giant leap in our understanding of planet formation.



Hierarchical Systems

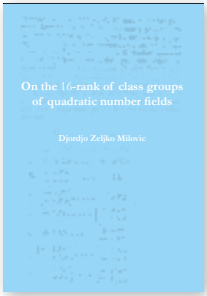
Adrian Hamers
Leiden Observatory

When astronomical objects such as stars and planets orbit each other, they can be studied as 'hierarchical multiple systems'. In this thesis, theoretical models are given to describe these systems and the way they change over time. One of them consists of the black hole in the centre of our galaxy, and the stars that orbit around it. How do the stellar orbits change over time? And how likely is it for stars to be disrupted by the black hole? Another system consists of small rocks – planetesimals – orbiting the black hole. When these rocks are disrupted by the black hole, observable light flares are produced. But how do planetesimals end up so close to the black hole? In his research, Hamers suggests that planetesimals in the centre of our galaxy are formed around stars, similarly to stars close to our Sun. The thesis also gives an explanation for the lack of planets found around closely paired binary stars.

The Symmetry of Crystals and the Topology of Electrons

Robert-Jan Slager
Leiden Institute of Physics

Topology is a branch of mathematics that catalogues geometrical figures that are similar by continuous deformation – such as stretching and bending, but not tearing. In topological terms, a coffee mug is similar to a donut, for each contains one hole. In his thesis, Robert-Jan Slager looked at topological insulators – quantum phases in which the electrons collectively tie topological distinct knots. Such a topological insulator necessitates a crystal lattice. First, Slager mathematically proved that different crystal grids result in different topological nodes. He then explored the physical consequences of this classification. By manipulating a grid by means of adding or removing atoms, a defect is made. Slager showed for example that on these real-life defects, special fractionalised particles arise, which carry only charge (plus or minus) or spin (up or down) in contrast to normal particles that always have both. These findings lead to new physical effects in the presence of electromagnetism and might become useful in the context of quantum computing.



On the 16-rank of Class Groups of Quadratic Number Fields

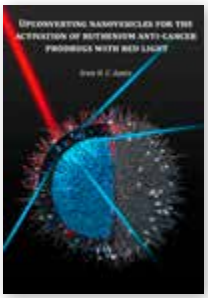
Djordjo Milovic
Mathematical Institute

The theory of factoring integers (whole numbers, such as 1, 2, 3, 4) into primes (numbers that cannot be decomposed further, such as 2, 3, 5, 7) has been of interest to mathematicians at least since the time of Euclid in classical Greece. Aside from its intrinsic beauty to mathematicians of different eras, this theory has very important modern applications to privacy and security in the digital sphere. In the 19th century, the famed mathematician Gauss invented the class group, a simple yet mysterious mathematical object which encodes useful information about factorisation in number systems with richer arithmetic than that of the integers. Djordjo Milovic's thesis builds on the work of Gauss and others to give some new perspectives on the structure of class groups (specifically, the 2-part of class groups associated to number systems obtained by expanding the number line into a grid). His main result answers the question of how often the size of the class group is a multiple of 16 in a certain family of number systems. Perhaps more important than the result itself is the method via which it was obtained. By applying a variant of Vinogradov's sieving methods, the proof of the main result all but guarantees that the behaviour of the 2-part of class groups in this family is not governed by certain widely studied geometric objects known as motives.

Automata-Theoretic Protocol Programming

Sung-Shik Jongmans
Leiden Institute of Advanced Computer Science

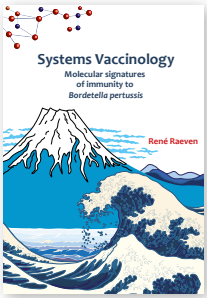
Imagine the kitchen of your favourite restaurant. As orders from customers come in, members of kitchen staff prepare dishes in parallel, after which dinners are served to tables. Modern computers work very similarly. While apps generate computational tasks (e.g. spell-checking a Word document while streaming music on Spotify), today's hardware has concurrent processing capabilities to execute those tasks in parallel, after which results are simultaneously presented back to the users (e.g., six underlined typos during a Beatles song). Parallel computing has become highly important in today's computing landscape. However, coordinating parallel computations using current mainstream programming tools and techniques is notoriously difficult. As hardware will become increasingly parallel in the foreseeable future, non-parallel software potentially decelerates the technological progress that modern society has become accustomed to. In his thesis, Sung-Shik Jongmans studied an approach to make coordination of parallel computations simpler for programmers. He presents a new programming language, specifically for programming coordination protocols among parallel computations. Programmers can use this language alongside existing mainstream programming languages.



Upconverting Nanovesicles for the Activation of Ruthenium Anti-Cancer Prodrugs with Red Light

Sven Askes
Leiden Institute of Chemistry

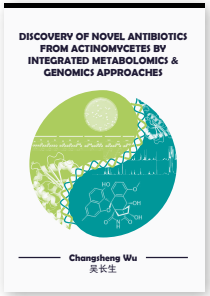
Light-activatable anti-cancer drugs based on the element ruthenium are promising alternatives to classical chemotherapeutic drugs. By shining light on tumors, toxicity can be triggered locally, while side-effects in the rest of the patient are prevented. However, ruthenium-based molecules are only sensitive for blue light, which does not penetrate human tissue well. Ideally, one would use red to near-infrared light, which penetrates much further. Therefore, Askes proposes to use light upconversion, which is the generation of high-energy blue light from low-energy red light. Askes successfully demonstrated light upconversion using a mechanism called TTA-UC for the first time in the membrane of small nanovesicles. The upconverted light was successfully used for the activation of a ruthenium anti-cancer drug. Red-to-blue upconversion could also take place in living cancer cells, Askes concludes, provided oxygen in the cell is limited. He demonstrates that antioxidants such as vitamin C could be useful for that.



Systems Vaccinology: Molecular Signatures of Immunity to Bordetella Pertussis

René Raeven
Leiden Academic Centre for Drug Research

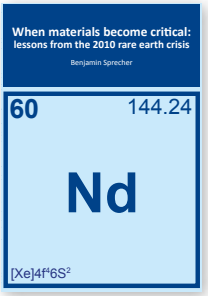
Whooping cough (pertussis) is resurging worldwide, even in highly vaccinated populations. This demands improved pertussis vaccines. René Raeven applied a systems vaccinology approach to deepen the knowledge of the immune responses evoked by different pertussis vaccines. He compared these responses with a *Bordetella pertussis* infection, which induces a robust protection and can therefore function as a benchmark. Raeven studied a promising experimental vaccine based on outer membrane vesicles (omvPV). He compared the immunological effects of vaccination with omvPV and two licensed vaccines with those of a *Bordetella pertussis* infection. OmvPV evoked a different immune response with respect to antibody levels, antigen specificity, and subclass distribution than the classical vaccines. Furthermore, the vaccine conferred equal protection in tests as one of the licensed vaccines, but with a lower inflammatory response. Finally, injecting omvPV under the skin was effective, but administration through the respiratory tract led to superior protection, comparable to infection-induced immunity, indicating that the immunisation route is critical. The molecular and cellular signatures described by Raeven may prove an important contribution to enhanced pertussis immunity.



Discovery of novel Antibiotics from Actinomycetes by Integrated Metabolomics & Genomics Approaches

Changsheng Wu
Institute of Biology Leiden

The explosive increase in drug-resistant pathogens causing diseases such as tuberculosis is a major problem in the clinic today. Changsheng Wu set out to find novel antibiotics produced by a class of bacteria called actinomycetes, whose biosynthetic potential has been grossly underestimated so far. These bacteria have so-called sleeping antibiotics: antibiotics that are not produced under standard growth conditions and that have therefore never been discovered by the industry. Wu used different antibiotics-eliciting strategies to enforce fluctuations in the production of bioactive compounds in actinomycetes. After that, he studied in detail what molecules were elicited in the bacteria. This pipeline allowed the discovery of new antibiotics. Wu discovered a number of different molecules with new chemical structures. Many of these were similar to already known molecules, but a pioneering discovery was that of lugdunomycin: an antibiotic with antibacterial properties to combat Gram-positive bacteria such as multiresistant MRSA.



When Materials Become Critical: Lessons From the 2010 Rare Earth Crisis

Benjamin Sprecher
Institute of Environmental Sciences

In 2010, the world experienced a Rare Earth Element crisis. There was a shortage of chemical elements that are only found in small quantities, and their prices rose. In this context, Benjamin Sprecher studied the rare earth element neodymium. This material is used in NdFeB magnets, both for sustainable energy technologies as well as the wider economy. Sprecher found that there is more than enough neodymium available across the globe, which implies that any supply constraints emerge as a consequence of a dysfunctional supply chain. Secondly, he discovered that the neodymium supply system is relatively small. Not much NdFeB is available for recycling, but provided you would manage to find a significant quantity of NdFeB, the environmental impact of recycling can be an order of magnitude lower than primary production. Primary production of rare earth elements can have an environmental impact in the same order of magnitude as primary production of aluminium, but only if modern production techniques are used. Overall, Sprecher finds that substitution is the most relevant one.

Prizes and honours

- Prof. Geert de Snoo delivered the Leiden University Dies Lecture 2016.

Leiden Observatory
- Kevin Govender of the Office of Astronomy for Development was awarded the Edinburgh Medal 2016, together wtih the International Astronomical Union.

Leiden Institute of Physics
- Dr. Bernard van Heck received the Christiaan Huygens Prize 2016 for his Leiden PhD research on electrical circuits for quantum computers.
- Dr. Johannes Jobst and Dr. Adrian Hamer were selected for participation in The Lindau Conference 2016.
- Prof. Michel Orrit received the Edison Volta Prize by the European Physical Society.
- Prof. Michel Orrit received the Physica Prize 2016 for his groundbreaking work on single molecule spectroscopy.

Mathematical Institute
- Dr. Jennifer Chayes received an Honorary Doctorate at Leiden University as part of the 441th Dies Natalis.
- An international research committee awarded the MI the 'highest' grade (a1).

Leiden Institute for Advanced Computer Science
- A research project by Developmental Psychology Prof. Carolien Rieffe and researchers of LIACS won the award Smartest Project of the Netherlands 2016.
- Dr. Bart Thomee received this year's Rising Star Award from the Multimedia group of ACM.
- Prof. Farhad Arbab was honoured by Sharif University of Technology in Iran as one of its fifty most outstanding alumni.
- Dr. Jurriaan Rot was awarded the IPA Dissertation Award 2015.
- Prof. Bas Haring received the Duidelijketaalprijs 2016.

Leiden Institute of Chemistry
- Freek Janssen MSc received an award for the best oral presentation during the Young Medicinal Chemist Symposium.
- Prof. Marc Koper won the Brian Conway Prize for Physical Electrochemistry of the International Society of Electrochemistry.
- Prof. Marc Koper was appointed as Fellow of the International Society of Electrochemistry.
- Hui Deng MSc received an award for the best oral presentation during the 26th International Cannabinoid Research Society conference.
- Dr. Bart Limburg received the KNCV-Van Arkelprijs.
- Prof. Hans Aerts received the Cle du Lysosome Award of Vaincre les Maladies Lysosomales.

Leiden Academic Centre for Drug Research
- Dr. Amanda Foks obtained a fellowship from the Dr. E. Dekker programme.
- Wilbert de Witte MSc received the Poster Award at the Dutch Pharmacological Society Spring Meeting.
- Margreke Brill MSc received the TOP publication award of the Dutch Society for Clinical Pharmacology and Biopharmaceutics.
- LACDR ranked #21 in the QS World University Rankings by Subject 2016.
- Prof. Wim Jiskoot was in this year's list of highly Cited Researchers in the field of Pharmacology & Toxicology.
- Prof. Wim Jiskoot was honoured by the American Association of Pharmaceutical Scientists as an AAPS Fellow.

Institute of Biology Leiden
- Dr. Jatna Supriatna, a senior lecturer at Universitas Indonesia, was appointed as visiting scholar at the Faculty of Science.
- Prof. Ionica Smeets was elected in the Opzij Top 100 of most influential women in The Netherlands.
- Dr. Chris Jacobs received the national Dissertation Award for best PhD thesis of the year on insects.

Institute of Environmental Sciences
- Dr. Rene Kleijn received the Stans societal award 2015.

Appointments

- Maxim Allaart was appointed assessor of the Faculty Board 2016-2017.
- Prof. Cock van Duijn, Prof. Thomas Hankemeier (both LACDR) and Prof. Maryleen Dogterom (LION) were apointed Medical Delta professors.
- Drs. Dirkje Schinkelshoek was appointed as Director Operational Management.

Leiden Observatory
- Prof. Koen Kuijken was elected member of the Royal Holland Society of Sciences and Humanities.
- Prof. Ewine van Dishoeck was chosen as president-elect 2018-2021 of the International Astronomical Union.

Leiden Institute of Physics
- Prof. Wim van Saarloos was appointed Professor of Theoretical Physics and vice president of the Royal Netherlands Academy of Arts and Sciences (KNAW).

Mathematical Institute
- Prof. Jacqueline Meulman was appointed programme director of the master Statistical Science.
- Prof. Hester Bijl was appointed professor in Numerical Mathematics.

Leiden Institute for Advanced Computer Science

- Dr. Wessel Kraaij was appointed Professor of Applied Data Analytics.
- Dr. Simcha Jong was appointed Professor and Director of Science Based Business.
- Prof. Mirjam van Reisen was appointed Professor Computing for Society.
- Dr. Marcello Bonsangue was appointed Programme Director of the bachelor's and master's programmes of LIACS.
- Prof. Aske Plaat was appointed as Scienctific Director of LIACS.
- Prof. Joost Kok was elected member of the Royal Holland Society of Sciences and Humanities.

Leiden Academic Centre for Drug Research

- Prof. Hubertus Irth was appointed Scientific Director of LACDR.

Leiden Institute of Biology

- Dr. Martijn Bezemer was appointed as Professor in Ecology of Plants-Microbe-Insects Interaction.
- Dr. Remko Offringa and Dr. Arthur Ram were appointed Directors of Education of IBL.
- Dr. Ariane Briegel was appointed Professor of Ultrastructural Biology.

Grants

- The Hortus received an EU Horizon 2020 grant for Big Picnic.
- The Ministry of Health donated 6 M€ to a consortium with Prof. Gilles van Wezel, Prof. Thomas Hankemeier and Dr. Choi for research on new antibiotics.

Leiden Observatory

- Dr. Jacqueline Hodge received a NWO VIDI grant for Shedding New Light on Star Formation in the Early Universe.
- Prof. Simon Portegies Zwart received a NWO Medium Grant for an energy-efficient supercomputer.
- Dr. Henk Hoekstra received a NWO VICI grant for Turning Galaxy Alignments Into Cosmological Weighing Scales.
- Prof. Koen Kuijken, together with colleagues from Groningen received a 1,985 M€ NWO Groot grant for dark matter and dark energy research.
- Dr. Richard Bouwens, Dr. Jarle Brinchmann and Dr. Ivo Labbé received a NWO TOP grant for The Growth of Baby Galaxies in the Early Universe, as Seen by Multi-Wavelength Views of Unprecedented Sensitivity.
- Prof. Harold Linnartz and Prof. Xander Tielens received a EU Innovative Training Network grant for The Extensive and Ubiquitous Role of Polycyclic Aromatic Hydrocarbons in Space.
- Dr. Renske Smit received a NWO Rubicon grant for Galaxies During the Cosmic Dawn.
- Prof. Ignas Snellen received an EU ERC Advanced Grant for Exoplanets, Planets That Orbit Around Other Suns Than Ours.
- Dr. Alvaro Hacar received a NWO VENI grant for his ORION-4D research on the birth of stars.
- Dr. Maria Drozdovskaya wasn awarded The Gruber Foundation Fellowship.

Leiden Institute of Physics

- Dr. Stefano Coppola received an AXA RF Fellowship to study Pancreatic cancer.
- Dr. Luca Giomi received a NWO VIDI grant for From Active Matter to Artificial Cells: a Mechanical Insight Into the Fabric of Life.
- Dr. Alexey Boyarsky, together with colleagues from Lausanne and Copenhagen received an ERC Advanced Grant to research an extension of the standard model of particle physics.
- Dr. Jelmer Renema received a NWO Rubicon grant.
- Prof. Tjerk Oosterkamp received a 2,8 M€ NWO grant for Experiments on Quantum Effects at Extremely Low Temperatures.
- Dr. Scott Waitukaitis received a NWO VENI grant to research the Leidenfrost effect for squishy materials.
- Prof. Carlo Beenakker received a FOM project grant for Quantum Transport in Weyl Semimetals.
- Dr. Milan Allan received a FOM project grant for Visualizing the Emergence of High-temperature Superconductivity Using the Spin Hall Effect.
- Dr. Stefan Semrau received a FOM project grant for Understanding Cancer Through Physics: Is Tumor Initiation a Phase Transition?
- Anne Meeussen MSc recevied the KHMW Shell Graduation Prize in Physics.

Mathematical Institute

- Dr. Botond Szabo received a VENI grant for his research Bayesian Uncertainty Assessments in Complex Models.
- Dr. Hermen Jan Hupkes received a NWO VIDI grant for Preparing MFDEs for the Modelling World.
- Dr. Charlene Kalle received a NWO TOP grant for A (W)hole Lot of Number Expansions.
- Dr. Tim van Erven received a NWO TOP grant for Online Convex Optimization for the Effective Curvature.
- Prof. Joost van Batenburg received a NWO VICI grant for Real-time 3D Tomography.
- Dr. Anselm Schmidt-Hieber received a NWO TOP grant for Nonparametric Bayes for High-dimensional Models: Contraction, Credible Sets, Computations.
- Prof. Peter Grünwald received a NWO TOP grant for Safe Bayesian Inference: A Theory of Misspecification Based on Statistical Learning.

Leiden Institute for Advanced Computer Science

- Dr. Siegfried Nijssen received a NWO TOP-grant for Probabilistic Features for Intelligent Declarative Data Science.
- Dr. Michael Lew received a research grant from the graphics hardware company NVIDIA.
- Sport Data Center received a grant from the Sportinnovator programme of NWO ZonMw.

Leiden Institute of Chemistry

- Dr. Jeroen Codée received a NWO ECHO grant for A Combined Theoretical and Experimental Approach to Understanding the Stereoelectronic Substituent Effects in Oscillations in the Furan Series.
- Dr. Jeroen Codée received an ERC CoG grant for Understanding and Controlling Glycosylation Reactions.
- Prof. Gijs van der Marel and Prof. Adriaan Minnaard (University of Groningen) received a NWO TOP-PUNT grant for their research proposal.
- Dr. Remus Dame received a NWO VICI grant for his proposal Dynamic Bacterial Chromatin Organisation: Unravelling the Code Translating Environmental Cues to Transcriptional Changes.
- Dr. Sander van Kasteren received a NWO ECHO grant for his proposal A Fourth Dimension for Immunology.
- Dr. Anjali Pandit was awarded a FOM Projectruimte research grant for her proposal Tuning Into the Photosynthetic Membrane with Atomistic Precision.
- Alexander Kros received a NWO M-ERA grant Designed Nanostructured Bioactive Surfaces for Precision Medicines.
- Dr. Francesco Buda and Prof. Huub de Groot received a NWO Solar to Products grant for Design and Optimization of a Photoanode for Solar Fuel Production.
- Dr. Frank Versluis received a NWO VENI grant for Building Functional Nanostructures in Living Cells Using a Self-Assembly Approach.
- Dr. Irene Groot and Dr. Ludo Juurlink received a NWO-CW CatC1Chem grant for Bridging the Pressure and Materials Gaps in Methanol Steam Reforming.
- Dr. Irene Groot received an EU ESRF grant for Operando X-ray Scattering - Toward Atomic Scale Understanding of Practical Catalysis.
- Dr. Irene Groot received an EU FET Open grant for Development of Continuous Two-dimensional Defect-free Materials by Liquid-metal Catalytic Routes.
- Dr. Irene Groot received a NWO New Chemical Innovations Technology Area grant with Prof. Bert Weckhuysen (Utrecht University), Shell, DSM-Resolve and LPM.
- Dr. Ludo Juurlink received an STW Open Technology Program grant with Prof. Harold Zantvliet (Twente) for Growth of Defect- and Dislocation-free Single Metal Crystals by Electromagnetic Levitation.
- Prof. Marc Koper received an EU FET Proactive grant for An Artificial Leaf: a Photo-electro-catalytic Cell From Earth-abundant Materials for Sustainable Solar Production of CO_2-based Chemicals and Fuels.
- Prof. Marc Koper received an EU ITN Grant for Electrochemical Conversion of Renewable Electricity Into Fuels and Chemicals.
- Prof. Marc Koper and Dr. Wilson Smith (TU Delft) received a NWO Solar to Products grant for An Integrated Device to Directly Convert Sunlight, Water, and CO_2 to Syngas Using Only Earth Abundant Materials.
- Prof. Marc Koper, Prof. Guido Mul (University of Twente) and Prof. Petra de Jongh (Utrecht University) received a NWO Solar to Products grant for Electrochemical Reduction of CO_2 to Ethylene.
- Prof. Marcellus Ubbink received a NWO ECHO grant for Evolutionary Robustness of β-lactamase: The Roles of Conserved Amino Acid Residues.
- Dr. Raj Pannu and Dr. Mario van der Stelt received a NWO-ZonMW Middelgroot grant for A Macromolecular Crystallization and Structure Solution Facility.

Leiden Academic Centre for Drug Research

- Prof. Thomas Hankemeier together with Prof. Robert Hall (WUR) and Prof. Age Smilde (UvA) received the Technology Area Prize.

Leiden Institute of Biology

- Dr. Katharina Riebel together with an international team was awarded a Human Frontier Science Program grant for "Seeing voices": the Role of Multimodal Cues in Vocal Learning.

Institute of Environmental Sciences

- The European Institute of Innovation & Technology Raw Materials granted 6 projects of CML
- Dr. Mingming Hu and Dr. Jeroen Guinée received a new Horizon 2020 project.
- CML and the Leiden-Delft-Erasmus Centre for Sustainability received 4 M€ for an EU Marie Curie Innovative Training Network.
- Dr. Nadia Soudzilovskaia received a NWO VIDI grant for her proposal Do Mycorrhizal Fungi Mediate Soil Carbon Fate?

Facts

BSc programmes

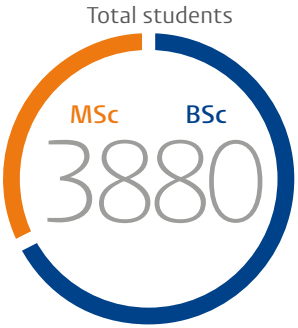
Astronomy, Bio-Pharmaceutical Sciences, Biology, Computer Science, Life Science and Technology *, Mathematics, Molecular Science and Technology *, Physics

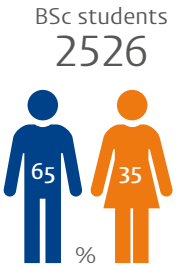
MSc programmes

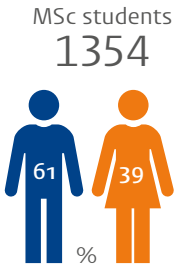
Astronomy, Bio-Pharmaceutical Sciences, Biology, Chemistry, Computer Science, ICT in Business, Industrial Ecology *, Life Science and Technology, Mathematics, Media Technology, Pharmacy **, Physics, Statistical Science for the Life and Behavioural Sciences***

If appropriate with MSc specialisations:
Science Based Business, Science Communication and Society, Education

* Joint programme with Delft University of Technology
** Joint programme with Leiden University Medical Center
*** Joint programme with Leiden University Medical Center and Faculty of Social and Behavioural Sciences







Diplomas 2015-2016	Total	Cum Laude	Summa Cum Laude
Propedeuses in one year	448	104	6
Propedeuses	653	114	6
BSc	471	48	5
MSc	337	81	12
Honours College	30	9	-

Breakthroughs

Throughout the years we have continuously refreshed our teaching in order to provide our students with the best possible learning conditions. Not only do we make use of the latest technologies and teaching methods, we also put much effort into keeping our programmes up-to-date and setting up new programmes. This year, we started two new master's programmes and a Massive Open Online Course (MOOC) together with Naturalis.

Statistical Science for the Life and Behavioural Sciences

A Mathematics Master's specialisation at first, Statistical Science for the Life and Behavioural Sciences has become an official master's programme at the Mathematical Institute this year. In collaboration with the Leiden Institute of Advanced Computer Science, this programme also offers a new specialisation in Data Science.

Flipping the Classroom – Biochemistry II

Flipping the Classroom is a form of blended learning with a focus on online learning and face-to-face activities in class. Students of the Biochemistry II course prepare for their class online, which leaves them more time in class for group discussions and integration of existing knowledge.

MOOC Evolution Today

For this Massive Open Online Course (MOOC), our faculty joined forces with Naturalis. The course is online available for free and shows that evolution is not just a thing of the past, but is ongoing. The MOOC further shows that evolution takes place on various levels, from molecules and cells to individuals and cooperating groups.

Pharmacy

In September 2016, the new Master's Programme in Pharmacy started. The curriculum is offered in collaboration with the Leiden University Medical Center. The programme responds to the developing role of the pharmacist in the treatment of patients. The distinctive aspect of the Leiden programme is that it will train pharmacists to be patient-focused care professionals.

Study Associations

All programmes of our faculty are represented by five study associations. These study associations greatly contribute to the connection of the students and alumni with each other and with our faculty. The study associations organise all sorts of activities that offer students the opportunity to enrich their studentship.

S.V. LIFE

One of the biggest events of LIFE is the LIFE Science Symposium, which takes place every two years. Last year's edition was titled Bioenergy: Engineering a Greener Future, and was located in Delft. Renowned speakers from all over the world participated in this successful symposium.

L.P.S.V. Aesculapius

For their 130th anniversary, Aesculapius organised symposia for the Bio-Pharmaceutical students on 'Advanced Therapies' and 'Illustrious Inventions'. Furthermore, they celebrated their dies with an excursion to Sanofi Genzyme in Naarden in the Netherlands and Geel in Belgium.

Leidse Biologen Club

Parents often remain ignorant about what students do and learn. Therefore, the Leidse Biologen Club organised a parents day. During some of the activities on this day, students did experiments together with their parents.

Chemisch Dispuut Leiden

The study associations keep students involved, also after their graduation. Alumni gathered for the 90th anniversary of the Chemisch Dispuut Leiden. At the alumni reunion, some eighty former members visited the new Gorlaeus building and explored the city by boat.

De Leidsche Flesch

The association De Leidsche Flesch proved that content and fun can be combined. They organise post-exam meetings where students can discuss their exams, or student lunch lectures hosted by Leiden professors. Last year they also participated in the Benelux Algorithm Programming Contest.

Seven of our teaching staff members were nominated by their students for the Faculty Award for Teaching 2016. The nominees have three qualities in common: inspirational teaching methods, a personal approach, and a passion for their field of research.

The jury, consisting of the presidents of the student associations and the assessor of the Faculty Board, assessed each of the nominees on the following three criteria:

- The nominated teachers' didactic skills.
- The ways in which the teacher establishes connections between the course and recent developments in relevant research disciplines.
- The ways in which the teacher establishes connections between his/her own discipline and other (beta) disciplines.

The jury will have the final decision on who will be granted the award. The faculty's assessor will present the winner at the faculty's new year's reception.

Winner 2015

Jeroen van Smeden
LACDR

Van Smeden was awarded the Faculty Award for Teaching 2015 for making a real connection with his students. His youthful and enthusiastic mindset enables him to engage his students. Not only are his lectures interactive, he is also able to quickly transfer knowledge to others. Besides for his teaching skills, Van Smeden is also popular amongst students for his social skills. Add his passion for his research, and it becomes clear why he was the 2015 prize winner.

FACULTY AWARD FOR TEACHING

Michiel Hogerheijde
Leiden Observatory

Nominated for: Praktische Sterrenkunde

'Michiel Hogerheijde is a very dedicated and kind teacher. He is cooperative if you are unable to make a deadline, and always looks for solutions to your problems. His teaching style is best summarized as brief and to-the-point, which allows students to get to work quickly in his practical lessons. Furthermore, Michiel is innovative in his way of teaching: as opposed to other teachers, he uses the state-of-the-art "studio classroom" (Huygens 111) to allow his students to work together on programming assignments. This set-up also allows working together on mathematical problems. In this way, the students combine various disciplines to work out a single project. This challenging approach of combining disciplines renders the students the necessary practice for future research. Michiel's progressive idea of teaching in the studio classroom really enriches his course in the aforementioned way. Furthermore, he uses actual astronomy papers with recent research for the assignments. Students not only get introduced to the latest discoveries, but get the hang of doing real research too. Last but not least, his blackboard page is always up-to-date and the whole course is well-organised.'

Jan van Ruitenbeek
Leiden Institute of Physics

Nominated for: Elektrische en Magnetische Velden, Classical Mechanics b

'Jan van Ruitenbeek deserves this award for his outstanding work. He managed to choose the conceptually challenging course Electromagnetic Fields and present it in his unique way. The students' understanding of both the physics involved as well as its role in history and academia benefit greatly from his approach. His mini-quizzes "elementary questions about concepts discussed" are an elegant way to provoke students' thoughts during the lecture. Edwin Slosson's quote, "College is a place where a professor's lecture notes go straight to the students', without passing through the brains of either", is true in many cases. However, Jan makes it very clear that the subjects of the lecture notes have more than passed through his brains, and he makes every effort to have it pass through the students'.
To do justice to Jan in a short text is an impossible assignment, but one remarkable trademark should be mentioned: he concludes every lecture with a short story about one of his historical heroes. By adding context to the theories discussed, he manages to transcend the concepts and make the students understand some of their relevance to other branches of physics and the world.'

Martina Chirilus-Bruckner
Mathematical Institute

Nominated for: Complex Function Theory, Dynamical Systems Seminar

'Martina Chirilus-Bruckner is a member of the Analysis and Dynamical Systems group. She has been connected to the Mathematical Institute for approximately two years. She is an enthusiastic teacher and takes good care of her students. Her lectures are well-organised and structured. Add to that a clear voice and nice handwriting on the blackboard, and it becomes obvious that she has a good mix of teaching skills – one that is really appreciated by her students. Apart from her teaching skills, both inside and outside class Martina ensures that her students are doing well and stay on track with her course. During the supervision of a thesis, Martina is interested in the person writing it and willing to help whenever necessary. She always finds time to talk about anything that might hamper the project, thereby giving her students confidence and a positive feeling about their work. In 2017, Martina will teach a course for the national Mastermath programme on nonlinear waves, which is in fact close to her research area. In this way she will connect current master students in mathematics with advanced subjects that are currently being researched.'

Frank Takes
Leiden Institute of Advanced Computer Science

Nominated for: Social Network Analysis, Business Intelligence

'Frank Takes' research focuses on analysing and discovering knowledge from Big Data networks, of which it is essential to understand the importance for many contemporary real-world issues. This, and the commonalities with other disciplines such as social sciences, economics, biology, physics, and mathematics, keeps many students intrigued to follow up on the developments in the field of Network Science for Big Data. Students are enthusiastic about his clear explanation and thorough knowledge of the course subject. His teaching is never dull, and he always engages the students to think along and participate. "His best qualities are enthusiasm and knowledge. He motivates and inspires me", says a student of Takes. He successfully manages to transfer his enthusiasm for his course to his audience, leaving many inspired to continue their research in the subjects presented during the course. Moreover, he gives interesting and challenging assignments on practical problems with real data. His students appreciate working with these real-life problems, because they experience first hand how actuality works. Flexibility to work on own project interests within the domain is also actively encouraged. In addition, Frank is very involved with the students' progress on their projects, scheduling regular meetings throughout the course to assure everyone is able to keep up.'

Nora Goosen
Nominated twice

Leiden Institute of Chemistry (Life Science & Technology)

Nominated for: Life Sciences, Moleculaire Genetica en Gentechnologie

'Nora Goosen is an exceptional teacher who knows how to inspire her students in learning the life sciences. She manages to teach difficult subjects to her students in an old-fashioned and lucrative way. New knowledge can immediately be applied during practicals, clarified by her lucid explanations. During her classes and the practical course, she also discusses the latest breakthroughs and techniques in gene technology. The subject is evolving fast, and Nora always manages to instantly use the most recent discoveries in her courses. For example, new findings as the CRISPR-Cas system and breakthrough DNA analysis methods were discussed during her classes. Another reason she is nominated is that she is dedicated to improve the education of the bachelor's programme by participating in the education committee, in which she has been doing terrific work as a voluntary chairman. She was also nominated many times for an education award in Delft, but never managed to win it. Her students believe that Nora finally deserves to win.'

Leiden Academic Centre for Drug Research

Nominated for: Moleculaire Genetica 1

'Nora Goosen teaches the first course for the first-year students of the Bachelor's programme Bio-Pharmaceutical Sciences, called Moleculaire Genetica 1. This first course is challenging for the new students, and the switch from high school to university is always quite difficult. Nora manages to stimulate new students in such a way that they get through the first period of their university career successfully. During her lectures, she visualises certain processes on a molecular level in a way that strongly appeals to the students. She is able to break down complicated processes into interesting and understandable lectures that inspire her students. Her enthusiastic attitude and passion for her field of work radiate during the lectures, and result in well-informed students. Furthermore, Nora does her utmost best to make sure that all students are participating in her lectures, and to ensure that each student understands the subject. All these characteristics make a lecturer who enthuses the first-year students and provides a proper foundation for their further bachelor's programme.'

Ludo Juurlink

Leiden Institute of Chemistry
(Molecular Science & Technology)

Nominated for: Algemene en Anorganische Chemie (AAC), Surface Science

'Ludo Juurlink is one of the teachers of the first-year course Algemene en Anorganische Chemie. With this course, he has taken the large responsibility of preparing new students for their upcoming studies. He does this by giving the students an intensive study programme, demanding a great deal of dedication from them. As chairman of the Educational Committee for Molecular Science and Technology, he was greatly involved in education. While in this position, he made some very positive changes regarding the students' evaluations of the courses. He also wrote a book, communicating his knowledge of chemistry to the outside world. This indicates his passion of sharing his knowledge, which certainly shows during his course. During his lectures, he never hesitates to give the students more information about chemistry or to emphasize the importance of fundamental research.'

Tonny Regensburg-Tuïnk

Institute of Biology Leiden

Nominated for: Basispracticum

'For the past couple of years, Tonny Regensburg-Tuïnk has been teaching the Basispracticum course for first-year students. During the course she teaches the basics of current techniques used in the lab, forming the foundation for the student's study and later career. When new techniques become available, she updates her course accordingly. This year, big adjustments were made in order to update all techniques currently taught during the course. By doing so, her successor will be able to give the new students an up-to-date course. She keeps a tight discipline, yet remains helpful to the students in case of problems. Not only does Tonny keep in close contact with the students during the practicals; her involvement during study trips and excursions of the study association also helps students to gain information they would not normally experience in the laboratory. Unfortunately, the academic year 2015-2016 was the last year in which Tonny teached the Basispracticum course. She has had a tremendous impact on all biology students of Leiden and will be sorely missed.'

Prizes and Grants

- Lars Suanet, Lars Koekenbier, Joris Carmiggelt and Erik de Vos were elected for the educational programme Seeds for the Future in China.
- Team Garden on Mars won a bronze medal at the global iGEM competition.
- Five Leiden teams reached the finals of the Benelux Algorithm Programming Contest, team Z/3Z became seventh.

Leiden Observatory

- Dieuwertje van der Vlugt and Isabel van Vledder published the results of their BSc research in *Monthly Notices of the Royal Astronomical Society.*

Mathematical Institute

- Bob Zwetsloot, Daan Becker, Loek Veenendaal and Onno Berrevoets have won three medals during the International Mathematics Competition in Blagoevgrad, Bulgaria.
- The MSc Programme Statistical Science was approved by the NVAO and officially started in September.
- The BSc Programme Mathematics received the honorary title Topopleiding and together with Nijmegen was chosen as the best Mathematics programme in the *Keuzegids Universiteiten 2017*.

Leiden Institute of Chemistry

- Tim de Jong, Diaz Knöbel, Jitske van Ede and Marieke Warmerdam received a Young Talent award from the Royal Holland Society of Sciences and Humanities.
- Thomas Hansen received an AKZO Nobel award from the Royal Holland Society of Sciences and Humanities.
- Hugo Minnee received a Topsector Chemistry scholarship from the Association of the Chemical Industry in the Netherlands.

Leiden Academic Centre for Drug Research

- The Edisen Foundation has won the 2016 Mr. K.J. Cath Prize.

Leiden Institute of Biology

- Niall Hodgins won the prize for best student entrepreneur.
- Bregje Brinkmann received the annual award for best bachelor student from the Stichting Professor Dr. K. Bakker-fonds.
- Flor Rhebergen received the 2015 Unilever Research Prize for his outstanding work in the field of Evolutionary Biology.

Institute of Environmental Sciences

- Kevin Groen received the Stans Prize 2015 for his master's thesis.

For Youth

Junior Science Lab

The Junior Science Lab offers primary and secondary school pupils the opportunity to conduct experiments in a real lab. Last year, more than 3,000 visitors attended. The subjects range from physics and chemistry to biology and general science. One of the highlights of last year was the visit of refugee children from the Internationale Schakelklas in Katwijk.

Stichting Rino

Rino is a foundation of enthusiastic Leiden physics students. They visit schools across the country in order to close the gap between natural sciences and their (young) public. Last year, Rino contributed to a new science show on molecular food, organised by the Moleculinair platform.

Physics Ladies' Day

During the Physics Ladies' Day, girls in 5th and 6th grade of pre-university education (the Dutch vwo) can get acquainted with the physics bachelor programme. Questions such as 'What is physics?' and 'What are the future job opportunities with a Physics degree?' are answered by students, professors and alumni of physics during this elucidating day.

UNAWE

Universe Awareness (UNAWE) is an international education programme that takes astronomy to disadvantaged children in over sixty countries. UNAWE uses the vastness and beauty of the universe to inspire children and stimulate their interest in science and technology. This year, Universe Awareness celebrated its tenth anniversary by organising various contests, courses and educational events across the globe.

For General Public

Natuurwetenschappelijk Gezelschap Leiden

The Natuurwetenschappelijk Gezelschap Leiden (NGL) is an alumni network which was founded in 1870 by enthusiastic Leiden professors. The NGL organises lectures and excursions about socially relevant topics from a scientific point of view. The events are suitable for a broad public and touch the fields of biology, chemistry, pharmacy, medicine, environmental science, physics, mathematics, astronomy and geography. Last year, lectures included Vincent Icke discussing the new Einstein, Frank den Hollander about complex networks and Bas Haring about the challenges in science communication. This year's excursion took the NGL to Airbus Defence and Space Netherlands, forerunner in the development of solar panels and producer of rocket motors and satellites.

Vereniging van Oud-Sterrewachters

The Vereniging van Oud-Sterrewachters (VO-S) connects alumni and people that are associated with the Leiden Observatory. Everyone who is currently connected with the Leiden Observatory can become a member, including students and employees, young or old. The VO-S organises events on recent developments in astronomy. Therefore, it is not only a meeting place, but also a platform stimulating the exchange of knowledge. Every year, the VO-S organises an excursion, the Oort lecture and a joyous barbecue at the end of the year. The excursion of 2016 comprised a visit to CAMRAS in Dwingeloo, a monumental, sixty-year-old radio telescope.

Night of Arts & Science

The Night of Arts & Science is a science, culture and arts festival in the heart of Leiden. This year's edition attracted thousands of visitors. Our faculty greatly contributed to the festival, for instance with Ionica Smeets telling about math and her passions, Vincent Icke giving an introduction to a Higgs boson inspired opera, Arnold Tukker sharing information on a circular economy, and our iGEM team showing their bacterial art.

Living Lab

The Living Lab is a successful crowdfunding campaign initiated by the Institute of Environmental Sciences. This outdoor laboratory, in real nature, is essential for testing the effects of chemical compounds in a natural situation. The digging of 36 experimental ditches started in November 2016.

iGEM Leiden

Supported by the crowdfunding campaign Garden on Mars, a team of thirteen Leiden students participated in the annual iGEM competition. They studied *E. coli* bacteria to detoxify the soil on Mars in order to make life on this planet possible. Their efforts yielded a bronze medal, which they received during the finals in Boston.

Edisen Foundation

The Edisen Foundation was set up by our students Christophe Mombers and Arian Khoshchin, and aims to bridge the gap between youngsters and senior citizens. Their initiative to give lectures to the elderly was awarded with the Mr K.J. Cath prize, amongst others for their contribution to the mental health and vitality of older people.

For Professionals

Hortus botanicus Leiden

The Hortus botanicus Leiden is the oldest botanical garden in the Netherlands and one of the oldest in the world. Already founded in 1590, the Hortus is still a relevant player in plant collection and remains highly useful for students, researchers and visitors.

Researchers from across the globe come to the Hortus for its renowned collection, while visitors can take a relaxing walk in a beautiful environment. Last year, the Hortus welcomed almost 3,000 children from primary and secondary schools and 145,000 regular visitors. The visitors were able to enjoy the exhibition 'Japan and Von Siebold', about the scientist who brought over 700 unknown plant species from Japan to the Netherlands almost 200 years ago. The Hortus is looking forward to participating in the Big Picnic project in 2017: an EU-project on food safety and certainty. Together with Waag Society, the Hortus will bring science to its audience during a number of science café events.

Lorentz Center

The Lorentz Center is a national meeting point for international workshops in all scientific disciplines. Its guiding philosophy is that innovative research thrives on interaction between creative researchers.

Lorentz Center workshops focus on new collaborations and on interactions between highly diverse researchers from different countries and with a variety of scientific viewpoints. The Center aims to have as wide a variety of participants as possible where age, gender and cultural background are concerned. Last year, 77 workshops were hosted for 3,000 people from 64 different countries. To stimulate creativity and transboundary collaboration, the Lorentz Center organised the successful crowdfunding campaign Good Research Starts with Good Coffee to establish a new common room. Next year, the Center will celebrate its 20th anniversary with a series of events for everyone who has been involved in Lorentz Center activities. Furthermore, public lectures will be organised in collaboration with Museum Boerhaave, featuring renowned scientists who participate in Lorentz Center workshops.

Leiden Science 'Our Talents and Discoveries in 2016'

Editorial team
Bryce Benda, Dennis Hoencamp, Jeroen Scharroo, Geert de Snoo, Rianne Tabak, Ron van Veen, Han de Winde.

Contributing writers
Bryce Benda, Dennis Hoencamp, Iris Nijman, Poppy Savenije, Jeroen Scharroo. With a warm thank you for their input: all chairs of our student associations (nominations Faculty Award for Teaching 2016).

Photo credits

Page 7	Pictures new Gorlaeus Building: Stijn Poelstra (Stijnstijl)
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Page 12	Joseph Silk: Liesbeth van der Veld
Page 13	Jennifer Chayes and Geert de Snoo: Monique Shaw
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All other photographs, including portraits of the C.J. Kok Public Award 2016 nominees and the Faculty Award for Teaching 2016 nominees: Pim Rusch.

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