University of Amsterdam
Faculty of Science

2021 IN REVIEW

research

education

valorisation

Two years ago, we started developing our Faculty Strategic Plan (or FSP for short) entitled: Connecting Science in a Changing World. The title shows what our primary focus is for the coming years: to strengthen the connection between our fundamental science and society. This magazine is testament to how we worked towards this goal in 2021. I am very proud of what we realised together, in yet another year affected by the pandemic.

As you would expect from the Faculty of Science, fundamental research is our heart and soul. Because in order to reach breakthroughs in science, basic research is indispensable. It also helps us educate the next generation of academics. I firmly believe that acquiring detailed, deep knowledge of the world around us is key for the future of our planet. And as the Faculty of Science we embrace our responsibility.

In order to address today's and tomorrow's challenges we share our knowledge with future generations. In 2021, we had more than 7,000 students enrolled in our programs. No matter their motivation, whether they are interested in science or its applications, they are more than welcome to be a part of our community. And by engaging with each other and our lecturers, I hope each and every one of our students will find their own road to discovery.

Another integral part of all that we do as the Faculty of Science, is co-creation. Working together with other disciplines and public and private partners helps us find innovative solutions for today's urgent problems. Explaining the impact of our findings is very important, especially now the public confidence in science is under pressure. By interacting with the general public and ensuring transparency in what we do and what we stand for, we want to promote trust in science and the scientific method.

Whether student, researcher, lecturer or staff, we are all fascinated by the discovery of the functioning of the world around us, and eager to make meaningful contributions to society. This magazine is a display of that passion. I hope you enjoy reading it as much as I did.

Peter van Tienderen
Dean of the Faculty of Science
June 2022

organisation

education

research & valorisation

research institutes

interviews

PURE

Networks continues to build on Dutch network tradition

Michel Mandjes, professor of Applied Probability

Cees Snoek, Professor of Intelligent Sensory Information Systems
Pascal Mettes, Assistant Professor at the Institute of Computer Science
Maarten de Rijke, University Professor of AI and Information Retrieval and
Harrie Oosterhuis, PhD, Information and Language Processing Systems Research Group

SMART

Brains that remain

HEALTH

Epigenetics offers a new view on cancer treatment

Pernette Verschure, professor of Functional Dynamics of the Epigenome

GREEN

Climate targets: collaboration and optimism are essential for the energy transition

Bob van der Zwaan, Professor of Sustainable Energy Technology

Mission • of the Faculty of Science

The mission of the Faculty of Science is coined by a single phrase: *Connecting science in a changing world*. Our goal is to strengthen the connection between our fundamental science and society in research with partners, in education and in creating impact by valorisation.

OUR AMBITION

The Faculty of Science stands for excellent science and excellent education, with a strong societal impact. Our fundamental research is the foundation on which education and valorisation can flourish. Our ambition is to give our students a state-of-the-art education, preparing them for different career paths. We embrace the responsibility to tackle the challenges of today's world. From our fundamental core we invest in research topics where we can have an impact. Key to our success in research and education are two elements: a strong community of all the talent we have at the Faculty of Science (in research, education and support) and the great ecosystem we built at Science Park together with other institutes and our public and private partners.

A CHANGING WORLD

Our world is facing a great number of enormous challenges. Issues of climate change, biodiversity loss, social injustice and controlling a pandemic. These issues are global, complex, systemic and interrelated, and our knowledge is often incomplete. Top science is needed to develop proper responses to the challenges the world faces.

UNIVERSAL IMPACT OF DATA

Another trend is the universal impact of data. The development of advanced instrumentation and data science, most notably ongoing developments in Artificial Intelligence (AI), gives an enormous boost to our research power and methodological possibilities in studying complex systems. At the same time, it also presents new challenges, for instance in bringing together the required expertise for team science. Moreover, legal and ethical aspects on monopolisation of data, and thus who benefits from the transition, have to be dealt with.

EDUCATION

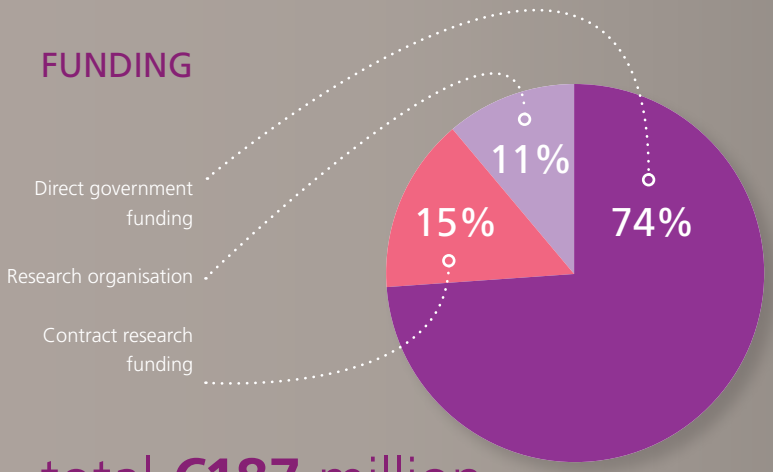
In education, there are a number of new trends and challenges. The pandemic has led to a quantum leap in online education, but the crisis also underpinned the importance of personal contacts and a sense of belonging of students and teachers alike. Another trend is the growing interest in student engagement, i.e. connecting teaching activities to urgent questions from the outside world in student labs. Last but not least, the shortage of science teachers has a severe qualitative and quantitative impact on enrolment of students.

DISTRUST OF SCIENCE

An unfortunate new trend is an increasing distrust of science and scientific evidence in parts of our society. The scientific method and scientific findings are no longer accepted by some groups in society as the foundation for educated policy decisions. Collaboration of scientists with private partners is seen as a threat to the university's independence rather than an asset of co-creation with mutual benefits. The position of universities is under pressure in a world where 'alternative truths' are disseminated through social media and other channeld.

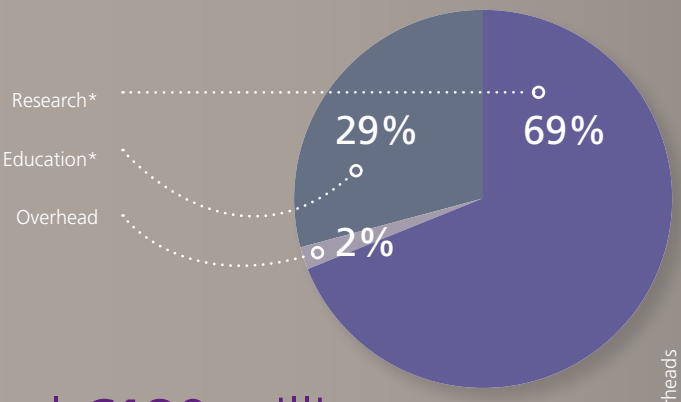
Funding & expenses

FUNDING



total **€187** million

EXPENSES



total **€180** million

*included most overheads

Education

AT THE FACULTY OF SCIENCE

More than 7,000 students at the Faculty of Science all share an unwavering curiosity. Some want to go deep into a subject and want to research it for a lifetime, while others are eager to apply it within the field. No matter their interest, with our research-based Bachelor's and Master's programmes we offer a home to all of them at our Amsterdam Science Park Campus.

Our students are part of a community of dedicated peers and lecturers, who themselves are eager to learn more. Whether to develop their didactic skills or to find innovative teaching methods, our aim remains clear:

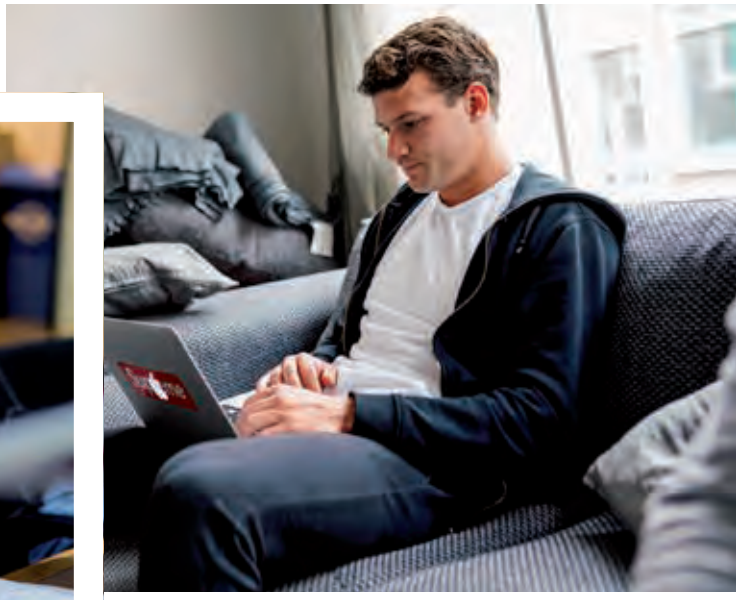
we want to inspire the next generation of scientists and set them on their own road to discovery

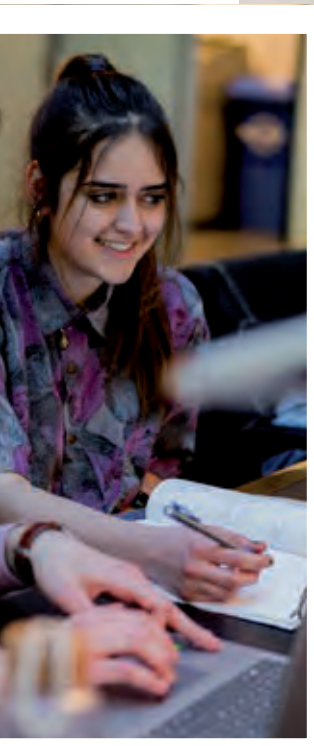
VISION PROJECT FUNDED BY ERASMUS+ PROGRAMME

The educational innovation project Virtual Interface for Smart Interactions Online (VISION), in which the Faculty of Science takes part, received a 296,725 euro grant from the European Erasmus+ programme. The funding was brought to life specifically in response to the COVID-19 pandemic, with the aim of helping higher education institutions deliver high-quality and inclusive digital education. VISION develops innovative tools based on artificial intelligence, intended for teachers and students to personalise learning in a goal-oriented way. Its impact extends beyond national borders and institutions: by identifying, assessing and sharing best practices and knowledge within higher education worldwide, VISION can disseminate developments more widely and permanently strengthen education, even after COVID-19. The project started in June 2021 and lasts 2 years.

NEW MINOR MAKES STUDYING AI ACCESSIBLE FOR ALL

Artificial intelligence (AI) has numerous applications that you can encounter in all kinds of places. To provide students with a hands-on introduction to the technology that drives AI, UvA created a new minor specifically designed for students with no prior experience of computer programming or (university level) mathematics. The aim of the intensive 5-month programme is to demystify preconceptions surrounding AI technology and its uses, and open up the subject to a much wider audience. 'We hope that with this knowledge students will be better able to assess the technology surrounding them,' explains Tim Doolan, coordinator of the minor, 'and make informed decisions about whether or not to apply AI to a problem they want to solve.'





PANDEMIC: MENTAL HEALTH IN FOCUS

In February 2021, Ingrid van Engelshoven, former Minister of Education, Culture and Science joined two online UvA lectures to speak with students about their wellbeing. She took part in Big History (IIS) and Cellular Biology (Psychobiology), experiencing online education mid-pandemic first-hand. Students indicated that they appreciated Van Engelshoven's visit and at the same time did not mince their words: asking critical questions and sharing concerns about (the lack of) tuition fee compensation, the Ministry's focus on wellbeing of lecturers versus students, proctoring and privacy.

The former Minister in turn shared her concerns about the students' mental health and especially that of international students, as they often have no family and fewer friends in the Netherlands: 'Do not be ashamed if you are feeling lonely or depressed. Let people know. Also, pay attention to each other and find ways to relax and meet other people, despite active measures.' Students shared creative tips to achieve this, e.g. background Zoom calls while working on their respective projects, allowing students to ask each other for help, motivate each other and find companionship. One student even indicated that fewer parties yielded better study results.

There also was room to discuss the positive aspects of online education: 'Microlectures and being able to revisit lectures at a later time are valuable developments,' said Van Engelshoven, not to mention, the influx of online knowledge exchange between universities worldwide. 'Post-pandemic, we hope to create a nice blend of the benefits of online learning and small-scale interactive education on campus.'

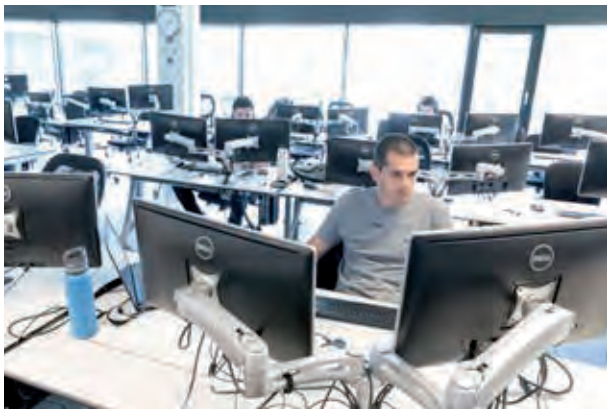
Credit: Aranda Oomen / Rijksoverheid

INNOVATIVE PROJECTS TAKE ROOT IN 2021

In 2021, employees and students were again called upon to apply for financial support for so-called Grassroots: small-scale, low-threshold projects in which students and/or teachers use an ICT application to enrich, improve and/or intensify education at the Faculty of Science. This year, two teams of teachers were awarded grants. For the first project, *Antoni van Leeuwenhoek's Time Travel to Science Park,* Ricardo Paap led a team that developed an online Escape Game, brimming with puzzles and assignments, to enthuse prospective Biomedical Science students to discover all available online learning tools before they start the academic year. The second project, *Mind the gap!,* is led by Stefania Grecea and deploys concept maps at different points in the learning process so students gain insight into and can bridge their knowledge gaps. These concept maps can also be used by teachers to finetune their teaching methods.

IIS: A TESTING GROUND FOR TRANSITION-FOCUSED EDUCATION

Society is facing urgent, complex issues, e.g. the development of sustainable energy supplies, accessible healthcare and inclusive digitalisation. These types of challenges are firmly embedded in existing societal structures and institutions, and demand radical changes in structural thinking and action. As a testing ground for transition-focused education, the Institute for Interdisciplinary Studies is developing education in which students learn to relate to and actively manage such societal transitions, by teaching them to look beyond the borders of their discipline and to integrate different areas of expertise. The testing ground allows students and lecturers to experiment in a safe, small-scale setting with close contact. Moreover, with hybrid learning, the ISS can create international classrooms, involve experts and offer broader accessible education.



PERSONALISED FEEDBACK FOR LARGE-SCALE COURSES

Prompt tailor-made feedback is essential to a student's learning process, but very time-consuming for large-scale courses. In a collaboration between three universities, led by Erwin van Vliet, a new SURF project called Feedback GO (Grootschalig Onderwijs or large-scale courses) took flight: a two-year endeavour enabling personalised feedback for large-scale courses and providing insight into which feedback tools contribute to the intended learning outcomes – all integrated in one dashboard, IguideME (I guide My Education). Learning data from various educational activities and assessments is collected and visualised for each student, then linked to learning outcomes and used to calculate the final course grade. The dashboard works as an early warning system for lecturers to detect students who may drop out, allowing them to tailor their feedback methods to those students' needs.

DEVELOPMENT PROGRAMME FOR JUNIOR LECTURERS

In 2021, the Faculty of Science appointed twenty new junior lecturers. To guide them into their new role, UvA designed the *Docent Ontwikkelprogramma* (DOP, Lecturer Development Programme), in which part of their contracted hours is reserved for personal and professional development. The lecturers themselves can indicate which subjects they need help with. A coach then joins one of their lectures, observes and discusses feedback during one-on-one sessions. Part of DOP is a starting course in didactics. Trainer Laura Koenders: 'We provide teachers with tools to use in difficult situations arising in student groups and help them build self-confidence.' Through roleplay and theory, the lecturers practise ways to create constructive learning environments where students feel safe. They practise design lectures, conduct mentor interviews and motivate students. Lecturers' reviews of DOP are laudatory – Lotte Schreuders (Analytical Sciences) says the programme provided guidance, not only in how to approach students and manage expectations, but also in setting boundaries. Two of Dennis Kruijssen's (Psychobiology) take-aways are that asking open-ended questions and listening are vital. Additionally, the lecturers attend several workshops, e.g. in unconscious bias, in which they learn that (un)conscious bias affects thoughts, feelings and behaviour. Through exercises, the lecturers become aware of their own biases and learn how to deal with them in the classroom and in collaborations with colleagues. Sara Mahdavi Hezavehi (Information systems) explains: 'I am now better at recognising my own behaviours. Am I overly polite? Am I biased? I have really learned how to improve those traits.' The effects of the programme even extend to the students – Annike Bekius (Psychobiology): 'Working with the coach boosted my self-confidence. Now, teaching comes more naturally to me and students say I radiate serenity. It makes me happy when my students leave one of my tutorials with smiles on their faces.'

JOHN VAN BOXEL ELECTED LECTURER OF THE YEAR

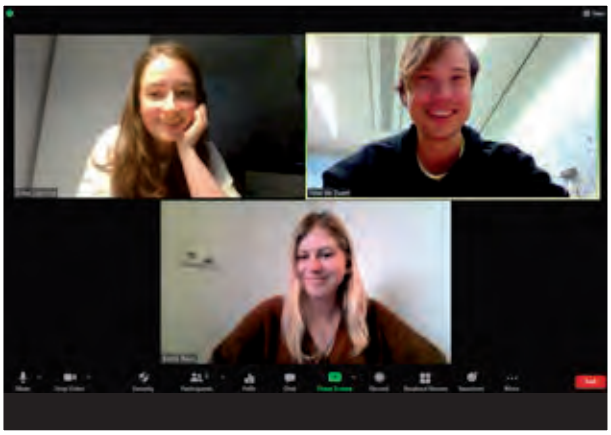
John van Boxel, who teaches meteorology, climatology and climate change, was elected Faculty of Science Lecturer of the Year by students and employees of the faculty. 'According to his students, van Boxel is a passionate teacher who knows a lot about his field of meteorology and climate,' explains rector magnificus Karen Maex. 'Even during the corona period, he was able to convey his knowledge to his students in a very enthusiastic way. In addition, according to the voters, he also incorporates a lot of humour and interaction into his lessons to ensure that every student understands the material. His stories resonate with students.' Every year since 2007, the lecturers of the UvA Teaching & Learning Center organise the Lecturer of the Year election in collaboration with the students of the Central Student Council. The election is intended to put teachers in the limelight.

STUDENT AS FIRST AUTHOR SCIENTIFIC PUBLICATION

Sophie Blinker, a double Master's student in Biomedical Sciences and Medicine, conducted research into the structure and dynamics of the spore membrane protein GerAB from *Bacillus subtilis*, a model organism associated with food spoilage and foodborne diseases. Blinker's study results, published in the *International Journal of Molecular Sciences*, provide a starting point for unravelling the mechanism of L-alanine mediated signalling by GerAB. The scientific publication lists Blinker as the first author, which is very exceptional for a student: 'Not many students complete such a large research during their studies. I understand that. I have been working with bacterial spores for about 5 years,' explains Blinker. Blinker would like to be a doctor and a researcher: 'I find infectious diseases very interesting.'

PREDICTING TRAFFIC DENSITY AT PUBLIC TRANSPORT STATIONS

As part of the Data Systems Project and commissioned by the municipality of Amsterdam, Master's students Rajeev Kalloe, Priya Jogie, Damian den Ouden, Priyanka Singh and Fajar Fathurrahman worked to predict the traffic at the city's three busiest public transport stations. By analysing a year of GVB's check-in and check-out data and KNMI data, the team used machine learning to design, implement and evaluate an interactive system to make accurate predictions about traffic density. As part of his Master's thesis, Kalloe is currently researching how exceptional situations, such as the pandemic, affect traffic density.



CREATIVE LOCKDOWN PROJECT LEADS TO SCIENTIFIC PUBLICATION

Under the supervision of HIMS researcher Felix de Zwart, Bente Reus and Anna Laporte performed online studies to determine chemical details of molecules relevant to De Zwart's research. Their results led to a publication describing an empirical model for the oxidation state of 1,4-diazabutadiene ligands. Due to the pandemic, Reus and Laporte had to work remotely on their second-year Bachelor's project, while an internship such as theirs normally involves plenty of laboratory work. De Zwart found a way out of the impasse by turning to large chemical databases. By statistical analysis of a wealth of geometrical information in the CCDC database, they found a strong correlation between oxidation state and length of chemical bonds of 1,4-diazabutadiene ligands and developed a model that can predict one based on the other.

LOTTE MERTENS AWARDED UVA THESIS PRIZE

Lotte Mertens was awarded the coveted UvA Thesis Prize 2021 for her thesis 'Spontaneous Unitary Violations and Effective Non-linearity in Relation to Quantum State Reduction'. In short, her thesis touches the research into transition of quantum mechanics on the smallest scale to the bigger world around us. The UvA Development & Alumni Relations Office organises the annual UvA Thesis Prize. This year, alumni who graduated at the UvA between 1 February 2021 and 1 February 2022 and received a mark of 8.5 of higher for their Master's thesis could participate. The jury then judged the submissions by quality and originality. 'Judging the submissions each year is a lot of work but certainly no punishment,' says chairman of the 2020 jury Fred Weerman. 'It is a pleasure to take note of interesting, original, well-researched and well-worded findings of students about the many different topics.' Lotte and the other nominees – one from each faculty – won 1,000 euros for being nominated; Lotte also won the grand prize of 3,000 euros.

STUDENT RECYCLING AWARD 2021

Hannah Flerlage won the Student Recycling Award from the Dutch industry association BRBS Recycling. She beat three co-finalists with her Master's thesis on the synthesis of high quality, sustainable and biodegradable phosphorus compounds from waste. In her thesis report, Flerlage focusses on a systems approach to the production of organophosphate flame retardants suitable for the circular economy. The jury awarded her for the innovative character of her thesis coupled with practical feasibility and potential impact on the industry. Additionally, she impressed with a smart scientific and well-founded elaboration of synthesising flame retardants and rendering them biodegradable and circular. In 2022, Flerlage continues her research as a PhD student at the Van 't Hoff Institute for Molecular Sciences.

AWARD-WINNING SELF-LIFTING SALT CRYSTALS

Alum Herish Salim won the Unilever Research Prize 2021 for his Master's thesis on the unexpected dynamics of salt crystallisation. In his thesis 'Self-lifting NaCl crystals', Salim unveiled two major surprises in the crystallisation of salt, namely that if salt water is in contact with a surface, the salt crystals can 'creep' up even if the surface is vertical and that if a drop of salt water is evaporating on a water-repellent surface, macroscopic salt crystals forming from evaporating drops of aqueous salt solutions can spontaneously lift themselves up and away from a hydrophobic surface. The prize consisted of a cheque of 2,500 euros and a special artwork bowl, which symbolises the collaboration needed between industry and science to face global challenges together.

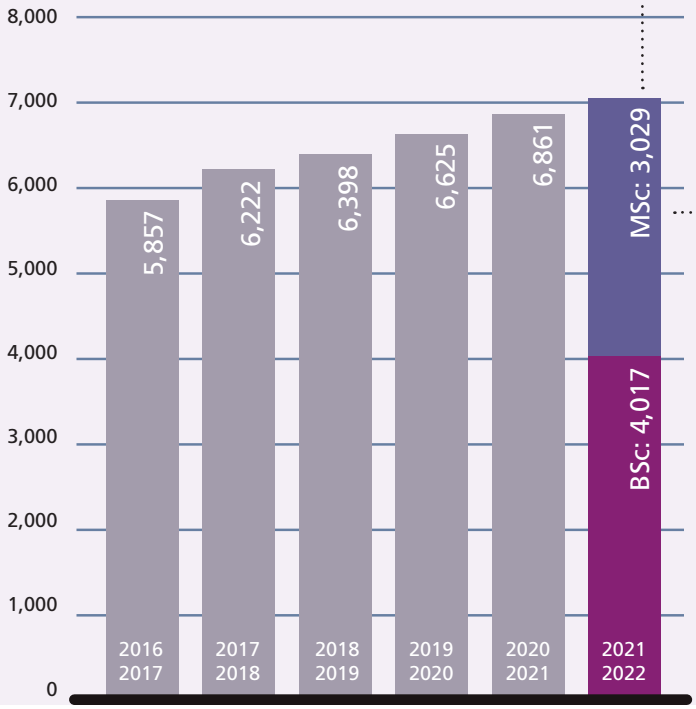
SCAVENGER HUNT AT SCIENCE PARK

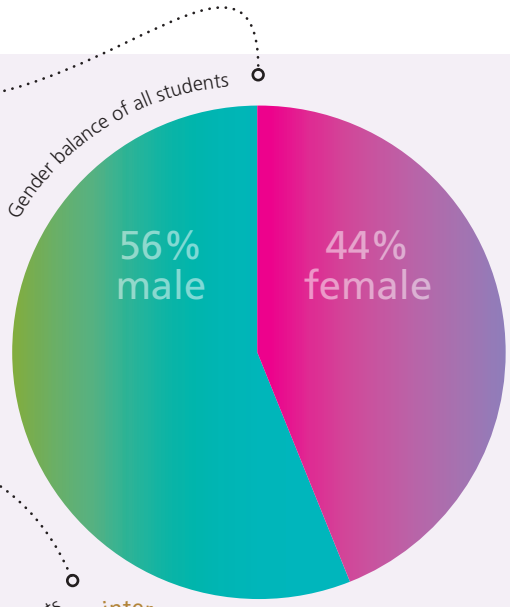
Jessie Goldman, Feline Lindeboom and Donny Peeters created an online scavenger hunt to introduce secondary school students to the Amsterdam Science Park campus and the bachelor Mathematics. With a good set of brains and a good dose of creativity, you can navigate from puzzle to puzzle, visit special places on our campus and crack the meaning of the word CALFABBEN.

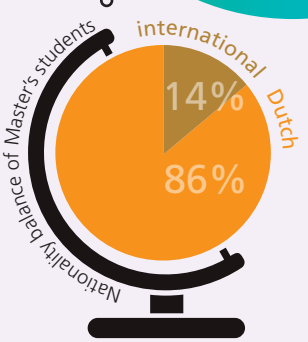
Students facts & figures

TOTAL STUDENTS 2021-2022 FULLTIME

7,046 students







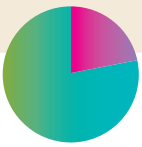
BACHELOR'S STUDENTS

FULLTIME | ALL PROGRAMMES TAUGHT IN DUTCH

ARTIFICIAL INTELLIGENCE

students	448	▲ 8%
first year enrolment	162	▲ 33%

99

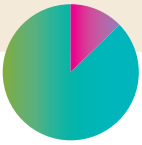


22% female
78% male

COMPUTER SCIENCE

students	373	▼ 1%
first year enrolment	131	▲ 19%

75

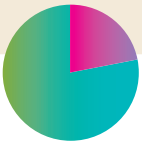


13% female
87% male

INFORMATION SCIENCE

students	358	▲ 4%
first year enrolment	108	▼ 10%

67



22% female
78% male

▲▼ compared to final figures of 2020-2021

BIOLOGY

students	206	▲ 11%
first year enrolment	86	▲ 46%

45

51% female
49% male

BIOMEDICAL SCIENCES

students	386	▲ 5%
first year enrolment*	142	▲ 8%

93

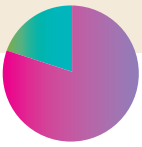
66% female
34% male

* enrolment quota

PSYCHOBIOLOGY

students	756	▲ 8%
first year enrolment*	233	▼ 3%

152



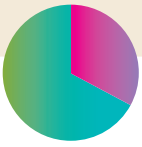
80% female
20% male

* enrolment quota

CHEMISTRY*

students	166	▼ 12%
first year enrolment	43	▼ 19%

51



33% female
67% male

* joint degree with VU Amsterdam

MATHEMATICS

students	223	▼ 2%
first year enrolment	74	▲ 6%

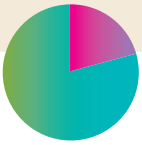
45

24% female
76% male

PHYSICS AND ASTRONOMY*

students	447	▶ 0%
first year enrolment	151	▲ 3%

96



21% female
79% male

* joint degree with VU Amsterdam

FUTURE PLANET STUDIES

students	504	▼ 13%
first year enrolment	115	▼ 24%

156

57% female
43% male

NATURAL AND SOCIAL SCIENCES

students	424	▲ 1%
first year enrolment	117	▼ 3%

82

56% female
44% male

MASTER'S STUDENTS

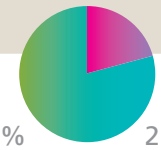
FULLTIME | ALL PROGRAMMES TAUGHT IN ENGLISH

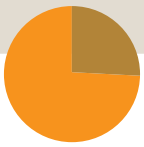
male female international

ARTIFICIAL INTELLIGENCE

students 382 ▲ 4%
first year enrolment 147 ▲ 15%

110



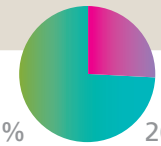


26%

COMPUTATIONAL SCIENCE*

students 200 ▼ 1%
first year enrolment 70 ▼ 22%

60



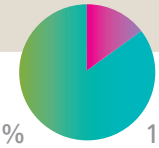
33%

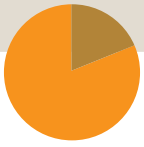
* joint degree with VU Amsterdam

COMPUTER SCIENCE*

students 97 ▲ 17%
first year enrolment 20 ▲ 67%

74





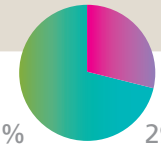
19%

* joint degree with VU Amsterdam

INFORMATION STUDIES

students 261 ▲ 6%
first year enrolment 196 ▲ 2%

172

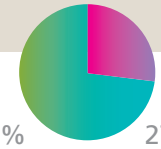


33%

LOGIC

students 133 ▼ 4%
first year enrolment 43 ▼ 17%

34

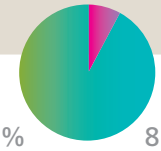


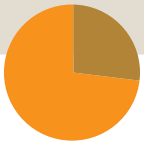
60%

SOFTWARE ENGINEERING

students 77 ▲ 20%
first year enrolment 41 ▲ 5%

14



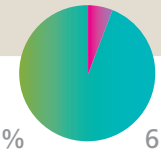


27%

SECURITY & NETWORK ENGINEERING

students 36 ▲ 3%
first year enrolment 24 ▲ 41%

15

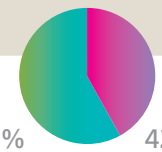


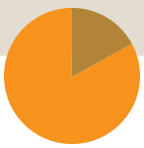
25%

BIOINFORMATICS AND SYSTEMS BIOLOGY*

students 76 ▼ 6%
first year enrolment 21 ▲ 91%

68





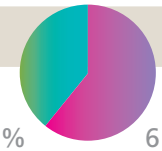
17%

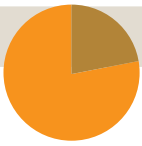
* joint degree with VU Amsterdam

BIOLOGICAL SCIENCES

students 247 ▲ 15%
first year enrolment 97 ▲ 23%

59

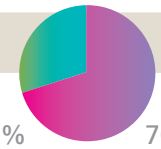


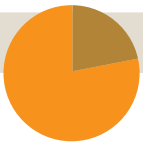


BIOMEDICAL SCIENCES

students 532 ▲ 7%
first year enrolment 177 ▲ 15%

123

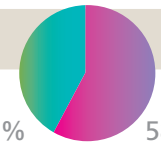


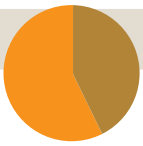


EARTH SCIENCES

students 79 ▼ 11%
first year enrolment 25 ▲ 9%

37

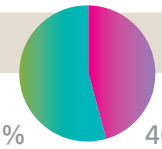


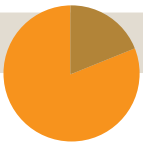


CHEMISTRY*

students 344 ▶ 0%
first year enrolment 63 ▶ 0%

99



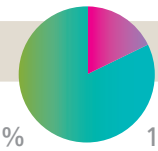


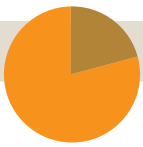
* joint degree with VU Amsterdam

MATHEMATICS

students 116 ▲ 5%
first year enrolment 34 ▼ 23%

25

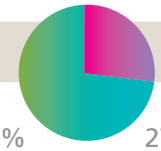


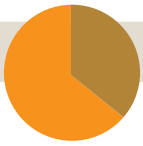


PHYSICS AND ASTRONOMY*

students 394 ▲ 12%
first year enrolment 175 ▲ 30%

116



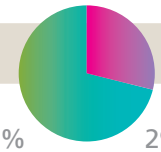


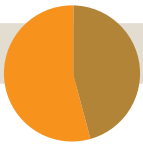
* joint degree with VU Amsterdam

STOCHASTICS AND FINANCIAL MATHEMATICS

students 56 ▲ 51%
first year enrolment 41 ▲ 105%

5

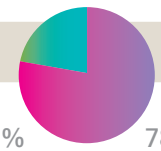


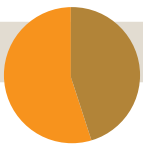


FORENSIC SCIENCE

students 82 ▼ 10%
first year enrolment 30 ▼ 3%

33

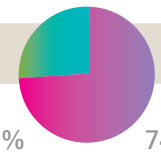


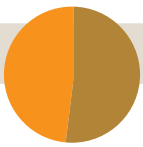


BRAIN AND COGNITIVE SCIENCE RESEARCH MASTER

students 126 ▼ 7%
first year enrolment 51 ▲ 4%

48





male female international

▲▼ compared to final figures of 2020-2021

Research

AND VALORISATION AT THE FACULTY OF SCIENCE

Researchers at the Faculty of Science are driven by a shared passion for wanting to know how things work. Whether our chosen instrument is a microscope or a telescope, whether we are unraveling the origins of life or shaping its future for generations to come, we share a curiosity that knows no bounds. But our interest goes beyond satisfying our own curiosity;

we want our research to have impact

Positioned at the beginning of the knowledge value chain, our research has the potential to lead to innovations and new products through further development. That is why we work together with national and international peers. With partners from across industries and society. This magazine illustrates our road from curiosity to impact.

TREMENDOUS BOOST FOR QUANTUM RESEARCH

Quantum Delta NL, a foundation launched in 2020 with the mandate to coordinate and execute the Netherlands' National Agenda for Quantum Technology, was awarded 615 million euros from the Dutch Ministry of Economic Affairs and Climate Policy to power the advancement of quantum technology. 'It is wonderful to see that the field of quantum technology has moved to this point in time where the Dutch government sees the economic benefit and feels the need to support the joint effort of quantum science and industry in a tremendous way,' says Harry Buhrman (ILLC). Florian Schreck (IoP) was also glad to see that the government is investing in this revolutionary technology: 'The Netherlands has a strong presence in quantum research and unique high-tech industry. This funding allows us to combine both strengths and thereby bring advances from fundamental research to society.' The new funding benefits many of the activities undertaken by the foundation's innovation hubs, such as quantum awareness programs for companies, a Talent and Learning Centre aimed at educating the quantum workforce of the future, and a programme focussing on Ethical Legal and Social Aspects of quantum technology. 'It is fascinating to see how fundamental insights and progress in quantum physics enable new technologies with great promise for society,' says Kareljan Schoutens (IoP). 'The Quantum Delta NL programme will give a strong push to this development, by supporting research and progress, transferring quantum technology to businesses and society, creating quantum awareness and educating a new generation of quantum scientists.'

MEMORANDUM OF UNDERSTANDING FOR QUANTUM APPLICATION LAB

In 2021 a Memorandum of Understanding was signed by the Quantum Application Lab (QAL). QAL is fully aligned with the Quantum Delta NL foundation's roadmap and fulfils the much-needed connection between scientific developments of quantum hardware and software and demand-driven solutions. By developing a public-private partnership that will bridge the gap between academic research and industrial applications of quantum computing, some of our most pressing societal challenges in health care, energy, technology and security might be solved. The six partners of QAL are the Netherlands Organisation for Applied Scientific Research (TNO), Centrum Wiskunde & Informatica (national research institute for mathematics and computer science), SURF (Dutch collaborative ICT organisation for Dutch higher education and research), TU Delft (on behalf of QuTech and Quantum Inspire), the Netherlands eScience Center and the University of Amsterdam.

Professor

full professors

Jason Hessels was named professor of Observational High-energy Astrophysics, in particular Radio Astronomy. His research focusses on using large radio telescopes to explore the astrophysics of some of the most energetic objects and phenomena in the universe. Hessels's past research highlights include the discovery of the fastest-spinning neutron star and a hyper-massive neutron star, as well as the discovery and detailed study of repeating fast radio bursts.

Christof Monz was appointed professor of Language Technology. In his research, Monz focusses on automated access to information, in particular language technology and machine translation. As a professor, Monz will be attempting to bridge the gap between the challenge of modelling the complexity of human language, and on the other hand, focus on the development of practical information technology in the field of language.

Judith Good was appointed professor of Human Factors in the Internet of Things. Good's research focusses on how best to enable and empower people (in particular those with a disadvantage) through the design of innovative and inclusive digital technologies. Good will focus on developing impactful technologies which start from a true understanding of users and their needs, and make use of the latest advances in Artificial Intelligence and The Internet of Things (like smart devices).

JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE

professors by special appointment

Somaya Ben Alouch was appointed professor by special appointment of Human System Interaction for Health and Wellbeing, a position established on behalf of the Beta Plus Foundation and in collaboration with the Amsterdam University of Applied Sciences (AUAS). Ben Alouch is a leading expert on the interface of ubiquitous computing, human-computer interaction and health. She combines her professorship by special appointment with her position as professor of Digital Life at the AUAS.

Wim Noorduin was named professor by special appointment of Self-Organising Matter. The chair was established on behalf of the Foundation for the Advancement of Atomic and Molecular Physics. Noorduin's research focusses on the dynamic interplay between chemical reactions and crystallisation phenomena to control the emergence of complexity in the solid state. He will combine his chair at the UvA with leading the Self-Organising Matter group at the NWO-Institute AMOLF.

Frank Pijpers was appointed professor by special appointment of Complexity for Official Statistics, a position established on behalf of Statistics Netherlands (CBS). 'Using complexity theory, important phenomena in society and the economy can become more understandable. This theory can be used by the CBS in order to better describe complex phenomena from a statistical point of view.' Pijpers will combine his professorship with his functions at the CBS.

Guido Schäfer was appointed professor by special appointment of Algorithms, Optimisation and Game Theory. The chair was established on behalf of the Beta Plus Foundation. Schäfer's research focusses on the development of efficient algorithms for complex optimisation problems, specifically in economic environments. Schäfer will focus on further promoting research, education and student supervision activities at the interface of Economics and Computation.

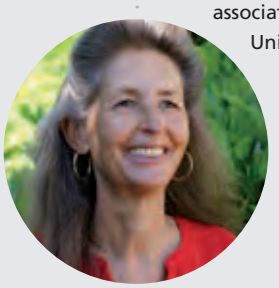
Rob Schuurink was named professor of Plant Specialized metabolism and defence. An important goal of Schuurink's research is to identify the molecules, proteins and genes that contribute to the defence of plants against pests and how the production of these molecules is regulated. His research also focusses on insects, by studying how they modulate plant defences.

Christian Schaffner was appointed professor of Theoretical Computer Science, with special attention to Quantum Computing. Schaffner is researching the theoretical foundations of computer science to seek greater understanding of fundamental computational techniques and their inherent limitations. Within the algebraic specification used for developing theory and tools to specify, analyse, and verify concurrent communicating and programmed systems, Christian brings in expertise on quantum cryptography, both in post-quantum cryptography and cryptography of quantum data.

JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER

appointments 2021

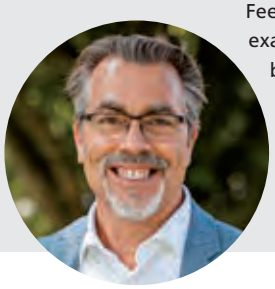
Vivi Rottschäfer was appointed professor by special appointment of Industrial Mathematics, a position designated on behalf of the Beta Plus foundation. She will combine her chair by special appointment at the UvA with a position as an associate professor at Leiden University.



Elizabeth von Hauff was named professor by special appointment of Non-equilibrium Thermodynamics in Energy Conversion, a position established on behalf of the Beta Plus foundation. Von Hauff works in the field of solar energy. Her research is focused on fundamental questions at the interface between physics and chemistry. As professor, she focusses on the role of dynamic processes at the functional interfaces in energy conversion.

Cees van Rijn was appointed professor by special appointment of Microfluidics and Nanotechnology. Van Rijn will combine the rapid developments in soft matter physics and chemistry to focus on emulsification, encapsulation, filtration and atomisation, making use of microfluidics devices, partly made using nanotechnology. The chair was established on behalf of the Van der Waals Foundation. Van Rijn will combine the professorship by special appointment with his work at Medspray B.V.

Katrien Keune was appointed professor by special appointment of Molecular Spectroscopy, a position established on behalf of the John van Geuns Foundation. Keune will focus primarily on the application of molecular spectroscopy for the study of historic paints and their degradation. She will combine her chair at the UvA with her position as Head of Science at the Rijksmuseum, where she is – among other tasks – responsible for the scientific research during 'Operation Night Watch'.



Michael Wise was named professor by special appointment of Observational High-Energy Astrophysics, in particular Black-Hole Feedback. Wise's research uses radio and X-ray observations to examine how the gases in galaxies interact with their central black holes and thus affect the evolution of the galaxy and the growth of the black hole itself. The chair was established on behalf of the Stichting Het Jan van Paradijs Fonds. Wise will combine the professorship with his work as the general and scientific director of the Netherlands Institute for Space Research (SRON).

DUTCH RESEARCH COUNCIL

NWO GROOT

DR JACCO VINK

API | Astrophysicist Jacco Vink received a grant of 1.5 million euros from the Netherlands Organisation for Scientific Research (NWO). The funds will enable the Netherlands to develop and manufacture highly specialised cameras for the Cherenkov Telescope Array (CTA), to be built in northern Chile to seek the sources of gamma rays.

NWO VICI

DR RENE GERRITSMA

IoP | Ions in electric fields form one of the best miniature quantum computers. Increasing their size while maintaining control is a major challenge. Gerritsma will employ optical tweezers to scale up the system and to program interactions in a new way.

DR CHRIS SLOOTWEG

HIMS | Phosphorous compounds are essential for life on earth and play a prominent role in modern science and technology, but current production methods are not sustainable. This project will use P-based waste as a resource to contribute to environmental pollution reduction and to create high-value products using novel, eco-friendly methods.

NWO VIDI

DR FLAVIA DE ALMEIDA DIAS

IoP | We still know little about the particles and forces that define our universe. Experiments at the Large Hadron Collider could provide answers and reveal new physical principles. The researchers in Almeida Dias's group will develop an innovative analysis to investigate the existence of new particles hidden deep in the data.

DR JORIK VAN DE GROEP

IoP | Optical lenses and filters are heavy, bulky, and have fixed functionality. Can light be manipulated by a single layer of atoms? Leveraging unique quantum mechanical effects in layered semiconducting materials, the researchers aim to develop lightweight and atom-thin optical coatings that can steer light dynamically.

DR JORDY DE VRIES

IoP | Many questions remain about the matter in our universe. Scientists do not know what dark matter is, where all the anti-matter went, or how neutrinos acquire their masses. This research will determine whether new neutrinos can solve these puzzles and how to reveal their existence experimentally.

DR SILVIA TOONEN

API | The first detection of gravitational waves opened up a new window to the universe. With dozens of detections so far, and hundreds more coming, their sources are still heavily debated in the scientific community. This research investigates pathways that involve multiple star systems.

DR VERENA SCHOEPF

IBED | Coral reefs are home to an enormous diversity of marine life and provide livelihoods for millions of people. Climate change threatens the reefs' survival. This project investigates whether frequent exposure to hot, acidic and oxygen-poor seawater could help corals adapt and survive in a future ocean.

DR BEN MARTIN

IBED | Predators are generally bigger, faster and stronger than their prey. Nonetheless, the vast majority of attacks are unsuccessful. By developing the first-of-its-kind underwater observatory to film predator-prey interactions among fish on coral reefs, the researchers aim to shed light on how prey evade their predators.

NWO VENI

DR ERIC NALISNICK

IvI | Artificial intelligence (AI) systems need to adapt to new scenarios, but the new behaviours and skills they acquire must be safe. Nalisnick aims to develop AI techniques that allow autonomous systems to adapt cautiously and under human guidance.

DR VLAD NICULAE

IvI | Artificial intelligence agents can approach nearly-human performance in natural language tasks like automatic translation and dialogue. However, such systems can get out of control, even learning to produce harmful language unprompted. Using recent machine learning breakthroughs, Niculae rethinks language generation for trustworthiness and controllability.

DR JAMIE TOWNSEND

IvI | The brain is an extremely efficient system for storing and communicating information. Inspired by the mechanisms in the brain, Townsend studies the use of artificial neural networks for data compression, enabling faster internet communication and more efficient information storage.

DR FABIAN EISENREICH

HIMS | Sustainable technologies are the key to reducing our future environmental footprint. In terms of green chemistry, developing efficient methods for performing chemical reactions in pure water has top priority. Eisenreich uses tailor-made nanoreactors to conduct valuable chemical transformations in aqueous solutions with the power of (sun)light.

DR GIULIA GIUBERTONI

HIMS | Osteogenesis imperfecta is a life-changing, sometimes lethal, disease caused by mutations in the genes encoding collagen, the main building block of all human connective tissues. Giubertoni will investigate the molecular origin of this disease and identify the molecular properties determining the success or failure of collagen biomaterials.

DR JONAS GROSCHWITZ

ILLC | When computers talk to us – answering a question, for example – they must translate their answer from an inner computer representation to fluent human language. This project combines linguistics and state-of-the-art machine learning to create a language-generation system in which the output text expresses exactly what the computer meant to say.

EUROPEAN RESEARCH COUNCIL

DR JAN VAN ROESTEL
API | Double white dwarf stars are a rare but important type of binary star. Some give birth to supernovae, some merge to form massive rotating white dwarfs. Combining data from the Dutch BlackGEM telescope with other surveys using novel machine learning methods, Van Roestel aims to reveal the population of white dwarf binary stars across the entire sky.
A comparison with population synthesis models will reveal how these stars die.

DR JEROEN ZUIDDAM
KdVI | Strassen's theory of asymptotic spectra aims to understand dualistic problems in mathematics, computer science and physics – in particular, the problem of fast matrix multiplication. Zuiddam's research develops novel directions in the study of the structural aspects and applications of this theory.

RUBICON
DR KLAAS VAN LEEST
HIMS | The production of ammonia pollutes and high levels of nitrate in the soil (the nitrogen problem) hinder the circular use of nitrogen. Van Leest's research aims to develop an environmentally friendly process for the conversion of nitrate to ammonia using light.

DR IRIS PIT
IBED | European rivers contain mixtures of synthetic chemicals from wastewater discharges but the effect of these chemicals on biodiversity is unknown. Identifying the synthetic chemicals that cause biodiversity loss and the degree of their impact will assist water-quality managers towards a toxin-free environment.

ERC ADVANCED RESEARCH GRANT
PROF. ALBERT POLMAN
IoP | Professor of nanophotonics and photovoltaics Albert Polman aims to develop a new type of quantum electron microscope allowing for an entirely new method of analytical electron microscopy. The new method involves generating intense laser pulses to tailor the electron wave packet in space and time, exciting materials using these wave packets and detecting the light that is emitted.

MARIE CURIE FELLOWSHIPS
DR BALDER TEN CATE
ILLC | Computational learning theory (CLT) studies the mathematical underpinnings of machine learning. With the rapid rise of artificial intelligence, CLT provides a way of classifying the computational feasibility of various learning problems. In this research, Ten Cate explores the ties between computational learning theory and algebra. Project results will have significant implications for data management and knowledge representation.

DR LUCA CAPALDO
HIMS | Hydrogen atom transfer (HAT) is a fundamental chemical reaction, the movement of elementary particles between substrates in a single kinetic step. It offers unique opportunities in organic synthesis. With photocatalyzed HAT, an excited catalyst activates a substrate, enabling the smooth activation of bonds. This research describes Capaldo's adaptation of this chemistry to flow conditions, which will allow the processes to be scaled up.

DR AKASH JAIN
IoP | In his research, Jain offers a quantum mechanical explanation of the properties of multiple-particle interaction with matter and other fields.

DR TOBIAS KAPPÉ
ILLC | With experience in programme verification and formal languages, Kappé performs research at the Institute i.a. on the effects of limiting programming languages on readability and maintainability. Limiting fragments in a semantic domain can introduce more efficient algorithms for verification and analysis.

DR TOMER SHENAR
API | Most massive stars interact with companion stars during their lifetime. Shenar studies these interactions and their implications for stellar evolution. His research involves collecting and analysing multi-wavelength spectroscopic, photometric, and interferometric data from the world's largest telescopes. The goal is advancing our understanding of the evolution of massive stars and binaries and the production of gravitational-wave sources.

The slow dance of binary stars

A team of astronomers, including Frank Backs and Hanneke Poorta, discovered how it is possible that massive binary stars are often found in close orbits: while massive stars that orbit a common centre of mass are born in wide orbits, they gradually move towards each other within a million years. The team used various spectrographs to measure the radial velocity of individual massive stars, combining their data to obtain the velocity dispersion: the statistical spread of the radial velocity that results from having a partner. They found that the dispersion increases considerably within a million years. Partners are formed in the outer parts of gas disks, where gas condenses to form a star, and only then do they approach each other for an intimate dance. 'This timeline gives us an important indication of the efficiency of the approach mechanism,' says Poorta. 'Now we need to focus on unravelling it.'

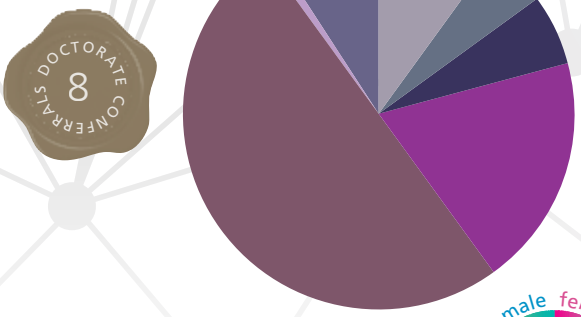
A research team led by Robert Farmer uncovered another interesting insight using computer simulations: massive stars in binary systems produce twice as much carbon as their singular counterparts and are responsible for the majority of cosmic carbon production. These findings are an important step towards better understanding the cosmic origin of the elements we are made of. 'So far we have only investigated one type of binary interaction,' says co-author Eva Laplace. 'There are many other possible fates for a star born in the close vicinity of a companion – and many other elements to investigate.'

The findings of these studies were published in *Astronomy and Astrophysics* and *Astrophysical Journal* respectively.

New research using data from ESO's Very Large Telescope has revealed that the hottest and brightest stars – so-called O stars – are often found in close pairs. Many of such binaries transfer mass from one star to another, a kind of stellar vampirism depicted in this artist's impression. Credit: ESO/M. Kornmesser/S.E. de Mink

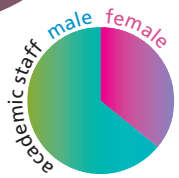
Anton Pannekoek Institute for Astronomy

Researchers at the Anton Pannekoek Institute for Astronomy (API) seek to understand the universe, the objects in it and their history. They test the laws of nature and find new laws.



- Full professor **10%**
- Associate professor **5%**
- Assistant professor **6%**
- Postdoc **19%**
- PhD candidate **50%**
- Lecturer **1%**
- Support and management **9%**

people **85**
FTEs **79.1**



Betelgeuse's mystery brightness dip solved

A team of astronomers, including Alex de Koter, solved the mystery surrounding the sudden dimming of the star Betelgeuse. This red supergiant in the constellation Orion suddenly became darker at the end of 2019 and then brighter in March 2020. Most red supergiants explode as supernovas at some point. Prior to such an explosion, the star may dim. However, based on images from the Very Large Telescope, the research team now assumes that the star emitted a large gas bubble. When part of the star's surface cooled, the gas bubble condensed into a cloud of solid silicate particles, overshadowing the star. De Koter: 'Such a dust cloud probably forms once every 5 to 10 years, but the fact that one is exactly in front of the star only happens once a century.' The team's findings were published in *Nature*.

Carsten Dominik took over as API director

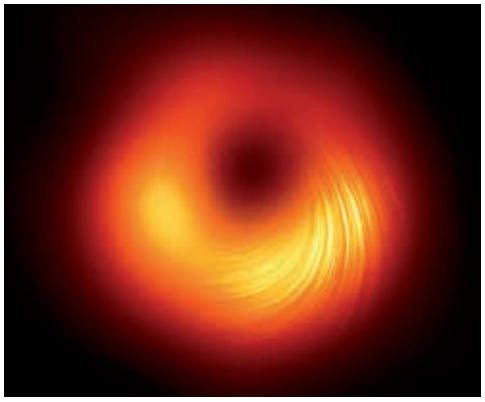
As per 1 January 2021, Carsten Dominik took over from Ralph Wijers as director of the Anton Pannekoek Institute. Dominik has been associated with the API since 1999. His research focusses on the formation and evolution of stars and planets. As director, Dominik wants to give scientists and students scope to promote their teaching, research and the interdisciplinary collaboration within and beyond the faculty.

Credit: ESO/Ginski et al

Flying on planet-forming wings

SU Aur, a star much younger and more massive than the Sun, appears as a bird with wings outstretched in the expanse of space. A team led by Christian Ginski captured an image using the SPHERE instrument on ESO's Very Large Telescope, showing the giant disc around SU Aur in unprecedented detail, including the long dust trails connected to it. These trails are composed of material from a surrounding nebula flowing into the disc. This nebula is likely the outcome of a collision between the star and a huge gas and dust cloud, resulting in the unique shape. This new study, published in *Astrophysical Journal Letters*, shows that the nebula is still feeding material to the disc and underscores how complex planet-forming discs can be.

A new view of the black hole M87* (first imaged in 2019): how it looks in polarised light, revealing magnetic fields in extreme gravity. Credit: EHT Collaboration

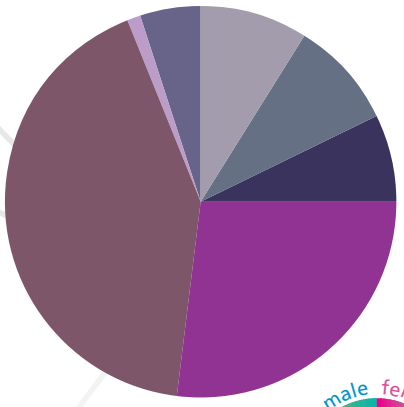


Into the black hole

2021 was a good year for black hole physicists. The mass of stellar black hole Cygnus X-1 turned out to be not 15, but 21 solar masses, making it the 'most massive stellar black hole with a companion star'. Also, new images of famous black hole M87* were released. Data from 19 different telescopes resulted in a composite image showing how M87* looked, across the entire electromagnetic spectrum, during the same period that data was collected for its very first image. Another ground-breaking image shows what M87* looks like in polarised light, revealing magnetic fields in extreme gravity. These observations give unparalleled insight into black holes and the system they power. Sera Markoff, member of the Royal Holland Society of Sciences since 2021, took part in all three researches.

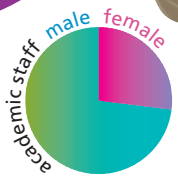
Institute of Physics

The Institute of Physics (IoP) covers a broad spectrum of both experimental and theoretical physics. Topics range from string theory, particle physics and astrophysics, to hard and soft condensed matter and quantum computing.



- Full professor **8%**
- Associate professor **6%**
- Assistant professor **9%**
- Postdoc **26%**
- PhD candidate **46%**
- Lecturer **1%**
- Support and management **4%**

people **241**
FTEs **237**

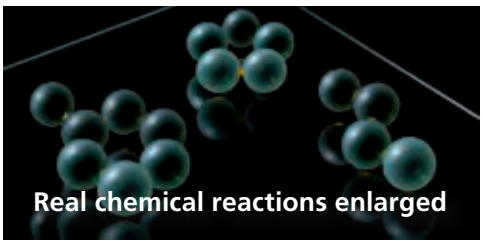


Slippery ice: an intriguing interplay of temperature, pressure and speed

Ice is exceptionally slippery due to a thin layer of liquid surface water. The mobility of that water's molecules enables sliding with low friction and thus ice skating. By measuring friction for various types of ice skates on a miniature ice rink, Rinse Liefferink, Feng-Chun Hsia, Bart Weber and Daniel Bonn showed that we can make these molecules less mobile by increasing contact pressure (caused by skate shape and surface irregularities on ice and skate) or lowering the temperature, consequently rendering skating difficult. Additionally, they found that close to ice melting temperatures, raised pressure resulted in the skate leaving ploughing tracks. This means that skating speed also plays an important role. Liefferink: 'The ultimate resistance to sliding is set by an intriguing interplay of temperature, pressure and speed.' The findings were published in *Physical Review X*.

Zoom in on mysterious double neutron decay

In a follow-up publication to their 2018 findings showing that physicists use a model for double-beta decay calculations that does not capture all subtleties, Jordy de Vries and colleagues provided insight into the extent to which the calculations are wrong. In neutrinoless double-beta decay, two neighbouring neutrons in a nucleus decay simultaneously, with the resulting anti-neutrinos destroying each other. Consequently, so-called Majorana states occur: particles that are their own antiparticles. These Majorana states are yet to be demonstrated in experiments, but could provide insight into the matter and antimatter puzzle of our universe. This is where the findings of De Vries and his colleagues come in. Further research is still necessary: 'The anomaly we pointed out holds up for a system of about ten nuclear particles, not necessarily for heavier nuclei,' says De Vries. The findings were published in *Physical Review Letters*.



An artist's impression of some molecules that can be made and studied using the new modelling kit. Image: Laura Quarto.

Atoms are everywhere, yet so small that we cannot see them with ordinary microscopes. UvA and New York University researchers collaborated to build micrometre-size model molecules using 'colloidal particles'. The team equipped the particles with patches and finetuned interactions between these patches so that the model atoms could form bonds and split up again, just like real atoms. This allowed the researchers to follow their formation and internal motion in real time and great detail. The results, published in *Nature Communications*, open the door to designing complex new materials, directly under the microscope, with host of applications ranging from artificial tissue to functional nanostructures.

Constraining quantum measurements

All objects in our world consist of quantum particles, and yet the crossover between our world and the quantum realm remains vastly elusive. Finding out details of how measurements work when using an everyday object to measure a quantum system (e.g. the number of quantum particles that are needed to create a measurement device) is called the *quantum measurement problem*. A team led by Jasper van Wezel and Lotte Mertens took stock of models that attempt to solve this problem by proposing slight modifications to *Schrödinger's equation*. Their findings, published in *Physical Review A*, showed that while such modifications can lead to consistent proposals for solving the problem, only non-linear non-unitary models also satisfy key postulate *Born's rule*. The results bring us closer to defining the dividing line between the quantum and macroscopic worlds.

Oligomodal metamaterials with multifunctional mechanics

In recent years, the popularity of metamaterials has increased significantly. These materials are not found in nature or made by using chemical reactions but are designed geometrically in the physics lab. Due to their geometrical structure, metamaterials can be given special, often counterintuitive, properties. For example, materials can now be engineered to be very light and very stiff, or to exhibit strange mechanical behaviour. They can for example shrink sideways when compressed, whereas ordinary materials would expand. They can even behave as programmable shape-changers. But what if you need a material that has two special properties or if, depending on the circumstances, you want to be able to switch between two properties?

For the first time, physicists developed a toolbox to create materials that feature multiple such properties simultaneously. The research was carried out by physicists Aleksi Bossart, David Dykstra, Jop van der Laan and Corentin Coulais. Using the toolbox, they created a material that changes its behaviour as it is compressed, depending on how fast the compressing force is exerted. The key to the material's functionalities is in the pattern of its holes; when pressure is exerted, the holes collectively deform, but this collective behaviour differs based on whether the pressure is exerted slowly or quickly. Such materials could be very useful for all sorts of industrial applications, for example as shock absorbers in cars, for construction materials that can withstand earthquakes or for flow regulating pressure valves. The findings were published in *Proceedings of the National Academy of Sciences*.

Networks continues to build on Dutch network tradition

The Netherlands has been playing a significant role in the world of network theory for years. Mathematician Edsger Dijkstra became world-famous for his theory of the shortest path, commonly used in navigation systems. The Netherlands is also internationally renowned for its network models in which uncertainty plays a role. This tradition is being continued within the *Networks* long-term research programme. Michel Mandjes, professor of Applied Probability, has been a project leader on this programme since it was launched in 2014.

Networks such as traffic, communication and energy networks form the backbone of our society. These networks are becoming increasingly complex.

'As a result of this increasing complexity, there is a greater chance over time that something will go wrong or that a network will become unstable,' explains Mandjes. 'As scientists, but also across society as a whole, we must have the courage to think creatively in order to ensure that these networks, which are increasingly subject to intensive use, will continue to be used efficiently in the future while still remaining reliable. That's why the research we are conducting within *Networks* is so important.'

Different researchers, different ideas

Networks is a 10-year research programme, funded by a Gravitation grant of 22.7 million euros from the Netherlands Organisation for Scientific Research (NWO). In addition to the UvA, Eindhoven University of Technology (TU/e), Leiden University (UL) and the Center for Mathematics and Computer Science (CWI) are involved.

Mandjes: 'We wrote the research proposal with the common thread that we really wanted to tackle this topic together, and that helped us to get this project off the ground. And these are not just empty words – all the parties are genuinely willing to learn about other disciplines.

For example, we are increasing the interaction between principal investigators. This sometimes works well already, to be honest, but it is often a challenge because senior researchers all have their own agenda.'

Scientists with their own agenda? What's new, you might say. As a project leader, this means that you must be able to be flexible. Mandjes was able to find his own way here: 'I try to be an invisible leader. My aim is to listen to what people want themselves, certainly without forcing them to go in a certain direction. Within these margins, it still seems possible to do all kinds of things to achieve a great deal of synergy.'

A broad field of research

This approach seems to be working well. The research within the broad *Networks* programme focusses on the stochastic (the outcome depends on chance or coincidence) and algorithmic (instructions are used to achieve a goal) aspects of networks. The focus lies on modelling, understanding, controlling and optimising networks that are complex and highly volatile. The programme comprises two branches: 'Network structure', which is more about describing networks, and 'Network shaping', which is more about the design of the networks.

One example of deep and challenging research takes place within 'Network structure' when scientists look at the limits of graphs. A graph is a schematic network of points, nodes, paths etc. You can allow such a network to grow, subject to certain regularity requirements, after which you can investigate the graph limits. In recent work, Mandjes has been examining the stochastic behaviour of graph limits, building on the work of people such as mathematician S.R.S. Varadhan, winner of the Abel Prize or the unofficial Nobel Prize in mathematics.

Understanding each other

Although this is the fundamental aspect of the programme, the *Networks* scientists increasingly start to look at concrete applications. 'We seek to connect with fields such as social sciences and economics, to ensure that our knowledge is well received,' says Mandjes. 'These types of collaborations are not self-evident because every field of study has its own language. First you look at a particular topic from your own experience, then you have to talk a lot and adapt your models in order to achieve a result that is relevant in practice.'

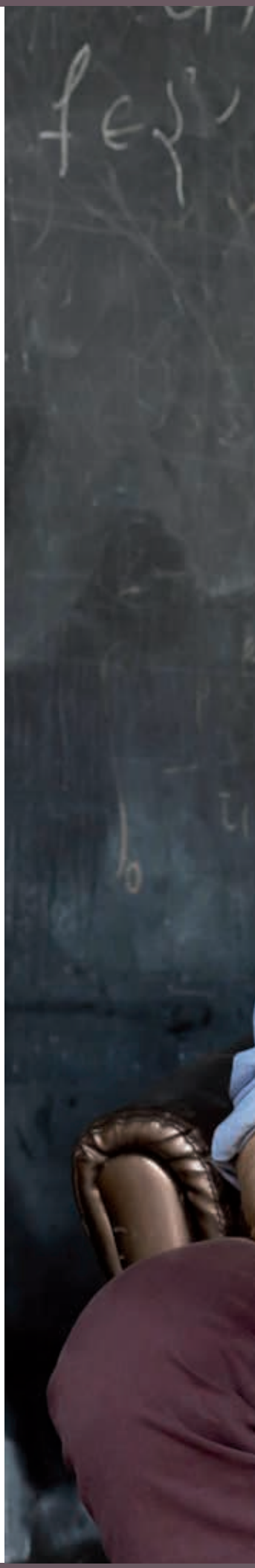
For example, one of the studies was about the dynamics of opinion-forming, in order to understand phenomena such as polarisation. The researchers worked on models that can explain a broader spectrum of opinion dynamics. *Networks* also ran a project with civil engineers, which recently led to a publication in a renowned academic transport journal.

Mandjes: 'The research was about routing in a network in which accidents can occur. This model goes back to Dijkstra in a way, but our model allows you to take all kinds of extra effects into account: daily patterns and less predictable events such as accidents. We will be talking to TomTom about this soon.'

Ongoing development

Back to Edsger Dijkstra. One of his most famous statements is: 'It is not the task of the University to offer what society asks for, but to give what society needs.' A university must respond to what will be needed in our society in the future. This is the only way to stay at the top as a 'network country'. In order to do so, you must constantly develop as a researcher.

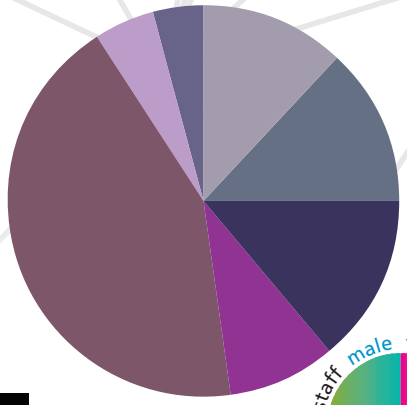
Mandjes confirms this: 'The challenge is to keep up with developments. For example, take the large amounts of data that have become available in recent years. How can you use this data when managing networks? To find out, I will need to learn about areas that are new to me, such as machine learning and other data-driven techniques. There are fantastic opportunities here.' ■



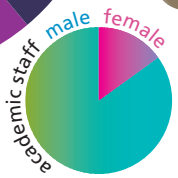

there are
fantastic
opportunities
here

Korteweg-de Vries Institute for Mathematics

The Korteweg-de Vries Institute (KdVI) advances the science of mathematics, both in its theoretical and applied aspects, and aims to stimulate the application and appreciation of mathematics in other academic disciplines and in society as a whole.



people **89**
FTEs **84.4**



COFUND grant for NETWORKS

After receiving the COFUND grant from the Horizon 2020 programme for 14 PhD positions, NETWORKS received a COFUND grant of €1.0 million to appoint 14 postdoctoral researchers for 2 years. The consortium's grant application made an exceptional impression on the evaluation committee. They praised the quality of the research options within NETWORKS and the way NETWORKS is organised: 'The proposal convincingly demonstrates that the fellows will be excellently prepared for high-level positions in academia and industry.' NETWORKS started in the summer of 2014 as a 10-year programme and covers a broad range of topics dealing with stochastic and algorithmic aspects of networks. The aim of the programme is to address the pressing challenges posed by large-scale networks with the help of stochastics and algorithmics, with a focus on modelling, understanding, controlling and optimising networks that are complex and highly volatile.

Diletta Martinelli organised a workshop algebraic geometry in Nairobi

On 23 August 2021 Diletta Martinelli organised a workshop in algebraic geometry, in close collaboration with Jared Ongaro (University of Nairobi) and Balazs Szendroi (University of Oxford). Initially, the workshop was to be held at the University of Nairobi, but due to the pandemic it was hosted online. The workshop revolved around the interplay between algebraic geometry and combinatorial structures such as graphs, polytopes, and polyhedral complexes. In particular, the workshop fostered dialogue among groups of researchers who use similar combinatorial geometric tools for different purposes within algebraic geometry and adjacent fields.

Four new PhD positions awarded by NWO Domain Science

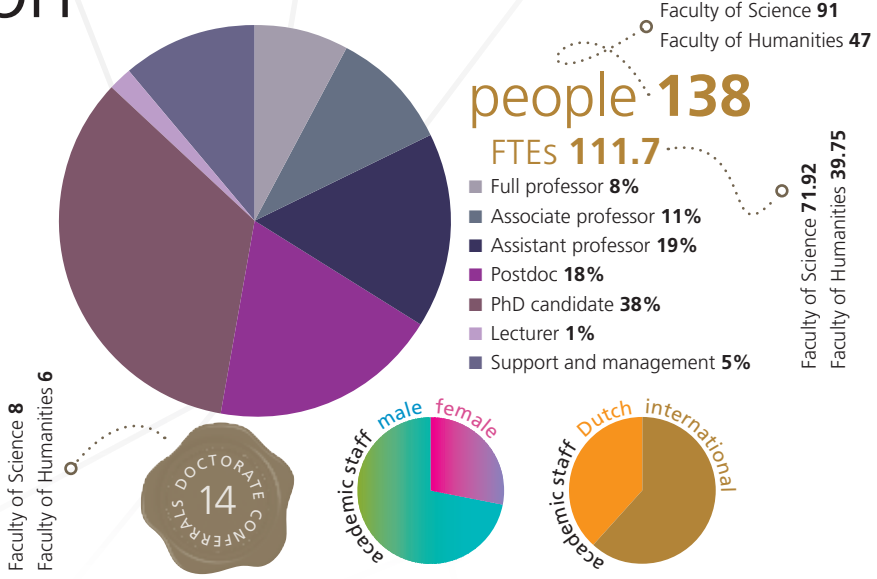
The board of NWO Domain Science awarded 24 applications for PhD positions within the mathematics clusters. Four of these were awarded to members of Korteweg-de Vries Institute for Mathematics: Sonja Cox with her proposal *Positivity for stochastic partial differential equations* (STAR cluster), Arno Kret with his proposal *The cohomology of Newton strata in the endoscopic case* (DIAMONT cluster), Mingmin Shen with his proposal *Extensions and degenerations of Hodge classes* (GQT cluster) and Rob Stevenson with his proposal *Simultaneous space-time solvers for parabolic data-assimilation problems* (NDNS+ cluster). The aim of awarding these PhD positions is to give an additional boost to the pooling of resources of mathematics in the Netherlands and to its international position. The PhD students will be supervised by experienced mathematicians.

Shanti Venetiaan first science faculty professor at Anton de Kom University in Suriname

In December, alumna Shanti Venetiaan was appointed as the first professor of the Faculty of Mathematics and Natural Sciences at the Anton de Kom University of Suriname. She is the fourth female professor to be appointed since the university's inception. In her inaugural lecture *Wiskunde is nooit af. Een korte verhandeling over onderzoek in de wiskundige statistiek* (Math is never finished. A short treatise on research into mathematical statistics) she included examples of practical applications of mathematical statistics and showed probability theory plays an important role.

Institute for Logic, Language and Computation

ILLC studies the processes involved in the encoding, transmission and comprehension of information. The concept of 'information' is given a broad interpretation, encompassing not only the characteristics of formal languages and information flows in natural language processing, but also human cognitive activities, such as reasoning and listening to music.



Robert van Rooij appointed scientific director of ILLC

In July Robert van Rooij was appointed as the scientific director of the Institute for Logic, Language and Computation. Van Rooij is professor of Logic and Cognition and works on the semantics of natural language, informed by insights of cognitive science and using formal tools from logic, (probabilistic) causal models and decision and (evolutionary) game theory. As director of the ILLC, Van Rooij stimulates research that for example contributes to a better (logical) understanding of machine learning algorithms, such as those used for the analysis of natural language.

Stereotypes in AI language models

Artificial intelligence (AI) continues to permeate our daily lives. However, AI models are only as good as the data used to train them. Rochelle Choenni, together with Ekaterina Shutova and Robert van Rooij, researched the role stereotypes can play in AI language models by determining common stereotypes through the autofill function in search engines and matching them and associated emotions to five widely used AI language models. When they refined the language models with extra data from specific media, the team found that the stereotypes can shift surprisingly quickly. 'For example, if we trained the models with articles from The New Yorker, some terms associated with "police officer" became more negative, while articles from Fox News led to more positive associations,' says Choenni, who received a Google PhD fellowship award in the category of Natural Language Processing in 2021. The findings, as published in *ACL Anthology*, underscore that AI algorithms can inadvertently discriminate or perpetuate stereotypes.

Double grant for Henkjan Honing

Henkjan Honing was granted a PDI-SSH funding and the KNAW Science Communication prize for his work on music-related listening experiments. Data science had an enormous impact on music research in the last few years, with several international labs basing their scientific insights on large amounts of empirical data. Research showed that engaging games can serve as a powerful method to attract hundreds of thousands reliable participant responses. This unprecedented scale is necessary to characterise how musical behaviour varies among individuals and across societies. Both music and citizen science require infrastructural support that is currently not addressed by any of the existing digital infrastructures. The aim of Honing's proposal is to fill this gap by developing a flexible and sustainable open-source infra-structure for music-related citizen science listening experiments. He focusses on domains that have special needs with regard to high-quality, platform-independent audio presentation, processing and timing of responses.

Rens Bod awarded with two medals

Following a nomination by the faculties Arts and Philosophy of the universities of Ghent and Antwerp, Rens Bod was awarded the Francqui Medal and a medal from Ghent University as holder of the International Francqui Chair. Bod held the chair at Ghent Univerity from February to June 2021. The chair is intended for high-level researchers who are highly active in their professional field. The faculties saw Bod as the perfect candidate because of his unprecedented ability to connect alpha and beta disciplines, such as history of science, computational linguistics and musicology.

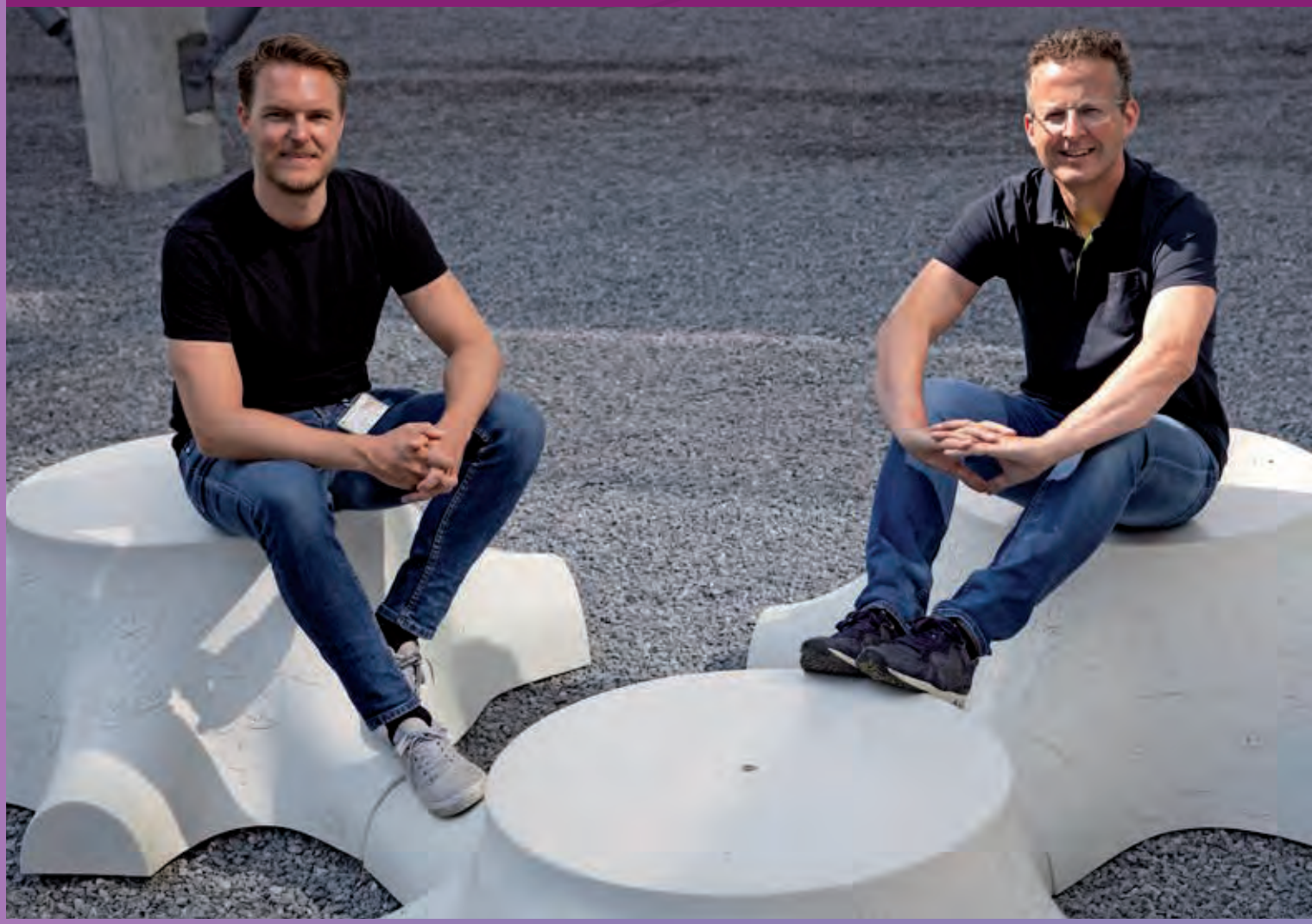
Prestigious prize awarded to Ilaria Canavotto

Ilaria Canavotto was awarded the prestigious E.W. Beth Dissertation Prize 2021 for her PhD dissertation *Where Responsibility Takes You: Logics of Agency, Counterfactuals and Norms.* Canavotto wrote this dissertation under the supervision of Franz Berto and Sonja Smets. She now works as a postdoctoral researcher at the Department of Philosophy at the University of Maryland.

Brains that remain

ai
technology
for people

There is a war for talent raging within the field of AI, with young researchers being lured away by big tech companies. Yet there are also talents who consciously choose an academic career. Two professors and two rising stars talk about their work.



leading by example

INTERVIEW

CEES SNOEK, PROFESSOR OF INTELLIGENT SENSORY INFORMATION SYSTEMS
PASCAL METTES, ASSISTANT PROFESSOR AT THE INSTITUTE OF COMPUTER SCIENCE

Credit: Bob Bronshoff

Cees Snoek is Professor of Intelligent Sensory Information Systems and Pascal Mettes is Assistant Professor at the Institute of Computer Science.

What are you working on?

Mettes: 'We ensure that artificial intelligence is able to recognise objects and behaviour in videos. What or whom do you see in the video, with what object, what are they doing?'

Snoek: 'If AI can interpret videos correctly, there are all kinds of applications that can be imagined. For example, AI can assess medical scans. But you can also think of cameras at Schiphol that monitor what happens to your suitcase. And we are working with TomTom, for example. There are TomTom cars driving around capturing the area. With those images, we create advanced maps for self-driving vehicles.'

What makes this field challenging?

Snoek: 'AI works on the basis of machine learning. If you show a learning system what a tree looks like a hundred times, the software can learn to recognise trees. We try to encapsulate that learning process in algorithms.'

Mettes: 'The old strategy was to impose rules on a system. Suppose you have a camera system in a nursing home that monitors if someone has fallen. Previously, you would tell that system: if someone is lying on the floor in his or her room, they have fallen, and you have to warn the staff. But practice is more complex than that. Hard rules won't get you anywhere. What we do now is to give a computer examples of images and their correct interpretation. The machine itself learns to take the step from image to comprehension.'

Snoek: 'This is how we ensure that AI can assign meaning to pixels.'

Credit interview: New Scientist

customised searching

INTERVIEW

MAARTEN DE RIJKE, UNIVERSITY PROFESSOR OF AI AND INFORMATION RETRIEVAL
HARRIE OOSTERHUIS, PHD, INFORMATION AND LANGUAGE PROCESSING SYSTEMS RESEARCH GROUP

Maarten de Rijke is University Professor of AI and Information Retrieval and Harrie Oosterhuis completed his PhD in the Information and Language Processing Systems Research Group, both at the University of Amsterdam.

What is the core of your work?

De Rijke: 'We research how, for example, search systems and recommendation systems can learn from user behaviour.'
Oosterhuis: 'These systems search large collections of, for example, websites, films or products. They have to show a selection that meets the needs of the user. By keeping track of what people click on, what questions they ask, and how quickly they make choices, such a system can learn to do that better and better.'

What makes the task of a search engine complex?

De Rijke: 'Each action by the user provides the system with additional information. So, it's a constantly changing issue. Moreover, users have different needs at different times. Suppose someone always reads the same genre of books. But one day that user is searching for a gift for someone else. A search system must be able to deal with unexpected signals like that.'
Oosterhuis: 'Another challenge is if several people use the same account. You watched Stranger Things on Netflix; your kid watched Peppa Pig. If the system doesn't understand what's going on there, it's going to offer very strange suggestions. A smart interactive system understands the situation and doesn't suggest children's programmes after bedtime.'

Why does this require artificial intelligence?

Oosterhuis: 'In his lectures, Maarten compares a search engine to a librarian. On the one hand, they know which books are available, and on the other hand, they understand what you are looking for. Even if you don't know it yet. In such a role, you have to make decisions based on countless uncertain factors. That's too complex for programmes that follow simple rules. That takes AI.'
De Rijke: 'What is also crucial is that AI learns from new information through user interactions and can improve a search engine.' ■

Credit: Bob Bronshoff

Brains that remain

HARRIE OOSTERHUIS AND MAARTEN DE RIJKE WON BEST PAPER AWARD AT WSDM 2021

Harrie Oosterhuis (until recently a PhD student at the Informatics Institute, now an assistant professor at Radboud University Nijmegen) and Maarten de Rijke received the best paper award at the 14th ACM International Conference on Web Search and Data Mining (WSDM 2021) for their paper 'Unifying Online and Counterfactual Learning to Rank'. Optimising ranking systems based on user interactions is a well-known problem. Their paper proposed a novel intervention-aware estimator for both counterfactual and online Learning to Rank (LTR). Their experimental results showed that, unlike existing counterfactual LTR methods, their intervention-aware estimator can greatly benefit from online interventions.

Smart

Valorisation theme

€8 MILLION GRANT FOR AI

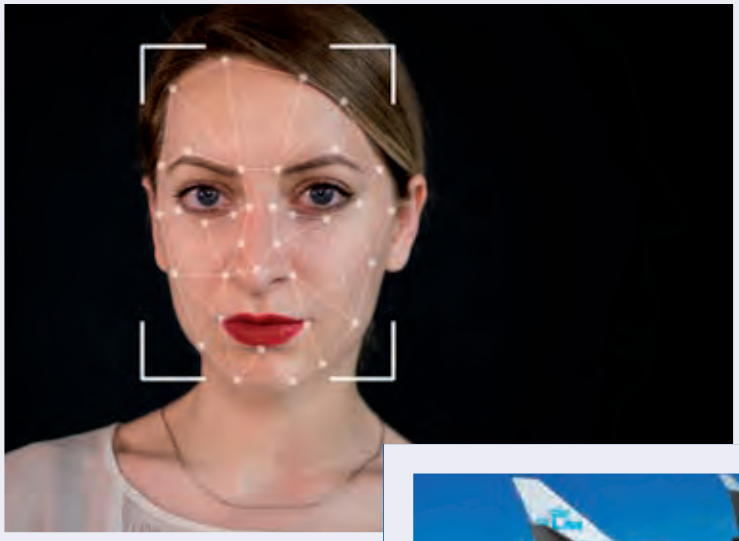
A consortium of Dutch universities and a venture capitalist recently received an €8 million grant to accelerate the application and market introduction of innovations in the field of Artificial Intelligence (AI). The TTT.AI consortium, led by UvA and with LUMO Labs as the investor, focusses on AI knowledge transfer and early-stage funding for start-ups. The grant was awarded by the Netherlands Enterprise Agency (RVO). Until now, there was no national approach to the promotion of AI start-ups. This consortium addresses that need, bringing together an unprecedented number of influential Dutch players in the field of AI, including universities, research institutes, innovation centres and entrepreneurs. Peter Westerhuijs, the consortium's project leader: 'With the extensive cooperation among consortium members and the scope for granting early-stage funding, this AI consortium will enable us to move the AI initiatives developed by our knowledge institutions to the market and out into society.' The TTT scheme will accelerate the application and marketing of AI innovations in the health care, security and human-centred AI domains, among others. The consortium also reinforces the position of the Netherlands as one of Europe's most advanced AI hubs.

AI TO MAKE CROPS MORE RESILIENT

Agricultural crops have traditionally been bred to achieve the highest possible yield. Less attention was paid to the resilience of the crops in the face of heat, disease, salinisation and other unfavourable conditions. Climate change and other threats are changing this calculus. In a collaborative effort under the name of Plant-XR, a consortium of universities and companies funded by the Dutch Research Council (NWO) will connect specialists in plant sciences, data sciences, artificial intelligence (AI) and breeding companies to develop resilient crops that can be grown sustainably. NWO will ultimately fund 30 percent of the total programme budget of €50 million. Harrold van den Burg (SILS) is part of the core team that came up with the idea of using AI to investigate how complex plant properties are controlled genetically and physiologically. 'We will examine how these properties make plants more resilient and then model these interactions computationally. Here at the UvA, we can add considerable knowledge and data about plant diseases, salt tolerance, gene regulation and interactions between plant viruses and insects.' Programme leader Guido van den Ackerveken (Utrecht University): 'With the help of data sciences and AI, we hope to pinpoint those genes and processes that make plants resilient. Converting that knowledge into models enables breeding companies to make crops more resilient.' AI expertise can optimise the data analysis.

DETECTING DEEPFAKES AND HIDDEN MESSAGES LEFT BY CRIMINALS

The technology used to create deepfakes and hidden messages is evolving constantly. And its use is increasingly criminal, warn police and the public prosecutor. The Netherlands Forensic Institute (NFI) and UvA joined forces to develop computer models aimed at combating this trend. The research at the Innovation Center for Artificial Intelligence (ICAI) will incorporate the use of Artificial Intelligence (AI) in forensic evidence. Studies will focus on the detection of deepfakes and hidden messages (steganography), voice recognition and vehicle data. The collaboration will eventually be expanded into an independent forensic research lab of ICAI. Annemieke de Vries (NFI) is a great believer in the benefits of collaboration between the NFI and academia: 'The aim of this cross-fertilisation is to prevent abuse and contribute to society.'



RESEARCH INTO BETTER RECOMMENDATION SYSTEMS

Every day, millions of travellers make multiple decisions on Booking.com about their travel plans. All these clicks have generated a wealth of data insights that the company uses to improve customer experience. These huge data sets offer a unique opportunity to a group of researchers from UvA, TU Delft and Booking.com to test AI techniques safely and ethically. Researchers at the Mercury Machine Learning Lab and Booking.com will work to develop methods for identifying bias and generalisation. Jan Mooij (UvA): 'Testing AI techniques on real-world data provides a better understanding of the limitations of current methods for reinforcement learning. The lab's focus on improved algorithms is highly relevant to our society since these systems guide many of our digital interactions.' The machine learning methods developed hold promise in other domains including mobility, energy and healthcare. The Mercury Machine Learning Lab will be part of ICAI, providing world-class opportunities for graduates to remain in the Netherlands and lead innovative research.

UNRAVELLING REACTION MECHANISMS VIA MACHINE LEARNING

Improved computing hardware and algorithms have made simulations a powerful tool for understanding all sorts of (bio)molecular processes. Handling the large data sets involved requires a condensed set of descriptors to model a particular process. Proposing an adequate set of descriptors, however, is often extremely difficult. Researchers at the Computational Chemistry group have presented a framework for finding optimal descriptors using a combination of artificial neural networks and genetic algorithms. With a pool of descriptors as input, the network uses machine learning to find the variables that best describe complex reactions and molecular transitions. The software, developed by Ferry Hooft and Alberto Pérez de Alba Ortíz, is now made freely available. The researchers successfully demonstrated the framework's ability to retrieve optimal descriptors. Using their method on a biologically relevant transition in DNA allowed them to describe the energy profile and reaction rate of that transition. The framework also helps avoid the costly calculation of attending functions, while enabling parameter optimisation and augmentation of simulation data.

A year of new research groups

The past decade has seen computer science becoming ubiquitous. The Informatics Institute aims to cover the complete research and valorisation chain, developing fundamental research all the way to knowledge for society. *We do research that shapes our future*. Our four research themes are Artificial Intelligence, Computational Science, Data Science, and Systems and Networking.

Our institute has grown in recent years: large research groups split up, new research groups were set up and collaboration with external partners increased. This includes setting up projects with national and international parties and as well labs with public and/or private partners. An overview can be found on the IvI website. Of our sixteen research groups, four started in 2021.

The group *Socially Intelligent Artificial Systems (SIAS)* aims to advance society through inclusive AI technology by focussing on civic-centred and community-minded artificial intelligence (AI), which aims to reduce inequality and promote equal opportunity in society.

In today's society people are confronted with complex information all the time. The group *INtelligent Data Engineering Lab (INDElab)* works on intelligent systems that help people with the preparation, management, integration and reuse of this data.

The mission of the *Quantitative Healthcare Analysis (qurAI)* group is to enhance patient care by designing and enabling responsible AI solutions for data analysis challenges in healthcare.

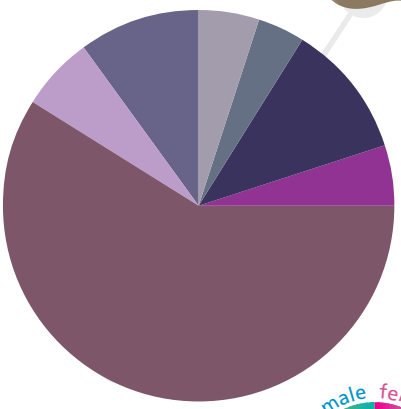
The research of the *Digital Interactions Lab* bridges the gap between the technology-oriented and market-led formulation of the smart agenda with a sociological and psychological under-standing of what people need artificial intelligence to be, and how data science might enhance our societies.

Accelerating the drug discovery with a new neural network

Victor Garcia Satorras, Emiel Hoogeboom, Clément Vignac (ELLIS visiting PhD student from EPFL) and Max Welling created a new neural network, which can lead to a better understanding of known molecules. The network analyses molecular data as 3 dimensional geometric objects and employs deep learning to make predictions about its properties and even generate new molecules with given properties from scratch. The model takes all the symmetries of our world into account: i.e. the predicting molecular properties or generating new molecules does not depend on the location or orientation of the molecule. Predicting molecular properties is important for material or drug discovery, potentially resulting in a more efficient design process for sustainable materials and more effective drugs. The team's research paper was accepted to the ICML congress.

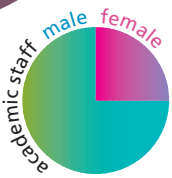
Informatics Institute

The Informatics Institute performs curiosity-driven and use-inspired fundamental research in Computer Science involving complex information systems at large, with a focus on collaborative, data driven, computational and intelligent systems.



- Full professor **5%**
- Associate professor **4%**
- Assistant professor **11%**
- Postdoc **5%**
- PhD candidate **59%**
- Lecturer **6%**
- Support and management **10%**

people **292**
FTEs **277.1**



NWO support for programme on trustworthy AI

UvA's ROBUST programme, which is led by Maarten de Rijke and focusses on the development of trustworthy AI-based systems, was awarded a €25 million grant by the Netherlands Organisation for Scientific Research under the auspices of their Long-Term Programme scheme. Artificial intelligence has the potential to help bring about sustainable solutions to many of society's most intractable problems and in doing so, to create great opportunities for the Netherlands. To ensure that AI technology is widely adopted and benefits all sections of society, it is essential that the systems that we develop are trustworthy. The ROBUST long-term programme was set up to tackle this challenge.

Developing the new Amsterdam Data Exchange

AMS-IX, deXes, SURF, the Amsterdam Economic Board and UvA are developing the new Amsterdam Data Exchange: a neutral, non-commercial, digital infrastructure. The goal is to enable secure and reliable data exchange without reliance on third parties and consequently facilitate access to data for the purpose of innovations such as artificial intelligence, subject to the consent and conditions of the data owners. Participants of the exchange share costs to create a fair and open online data playing field, contributing to the development of a more equitable society with equal opportunities for all.

Boosting processor performance

Sobhan Niknam, Anuj Pathania and Andy Pimentel proposed a new power budgeting algorithm for multi-core processors called Transient-Temperature Based Safe Power Budgeting (T-TSP), which effectively exploits variations in cores, improving overall performance. Existing techniques perform predictive power budgeting based on projected steady-state temperatures, resulting in core temperatures that remain significantly lower than the critical thermal threshold and wasting a lot of thermal headroom. T-TSP instead bases its power budgeting on current instantaneous temperatures of the cores and assigns them a high-power budget when they are at room temperature. To prevent thermal violations in the long term, the algorithm reduces a core's assigned power budget when its transient temperature rises. ICCD, the premier conference in the area of Electronic Design Automation, accepted the team's article. An EU patent for T-TSP was also successfully filed.

Epigenetics offers a new view on cancer treatment

Why does one cell in our body respond to a treatment, while another does not? The answer to this question could offer a breakthrough in the treatment of pathological, deregulated cells, as in the case of tumours. Pernette Verschure, professor of Functional Dynamics of the Epigenome, devotes her research to this important topic.

Although a tumour often consists of different cell types, even tumour cells of the same cell type can differ from each other. This results in small groups of tumour cells with an altered function. We call this a tumour-cell clone. In many cases, one cell clone of a tumour responds to treatment while another does not.

'Why is that?' Verschure wondered. With her research group, she focusses specifically on this cell-to-cell variability and the contribution of dynamics in epigenetic control mechanisms.

But what is epigenetics? Every human being receives one copy of the genome of the father and one of the mother, and carries this package of genetic information in every cell of its body from birth. However, during embryonic development, cells mature into unique cell types each with their own function, such as a liver cell or a brain cell, despite the same DNA information. Epigenetic regulatory proteins ensure that each cell is programmed to turn a part of the genes of the genome 'on' while another part is maintained 'off'. In the field of epigenetics, researchers are interested in the processes that can interfere with epigenetic programming, e.g. external factors such as stress or nutrition.

'At the molecular level, epigenetic processes are time and spatially-resolved,' says Verschure. 'Every gene in the genome that is programmed to be "on", is not active all the time, but displays a certain rhythm. Moreover, although the epigenetic layer is stably maintained during life to maintain cell identity, it is also reversible. It is precisely this dynamic flexibility that I find so interesting. We want to understand how the epigenetic programme directs the dynamic rhythm of gene activity and whether we can exploit this as a read-out of susceptibility to changes in epigenetic programming. Eventually, such insights can be used to predict deregulated cell behavior.'

Insensitive to treatment

This understanding is essential for the treatment of cancer patients. Due to the differences between tumour cells, it is often noted that only part of the tumour cells are treated effectively.

As the coordinator and initiator of an international consortium, the EpiPredict project funded by the European research programme Horizon2020, Verschure has studied the contribution of epigenetics to the development of non-responsiveness to hormone therapy of breast cancer cells. 'In order to understand the causal relationship between dynamics in the epigenetic layer and variability in the response of breast cancer cells, we have invested in the further development of quantitative, highly sensitive "single molecule" measurements in individual cells.'

In her lab, Verschure uses a combination of quantitative experimental measurements and computer analyses, machine learning and bioinformatics to predict the system behaviour of the epigenome. 'We have identified classes of genes with defined dynamic gene activity and have started to unravel their epigenetic composition. Such deregulated epigenetics may be involved in the process of preventing patients from long-term responsiveness to hormonal treatment. By reprogramming the epigenetic composition of these genes in a targeted manner ("epigenetic editing"), we might be able to adjust the non-responsiveness to treatment responsiveness.'

Dialogue with patients

Verschure's research team is also very active in the communicating of research findings to patients and the general public. 'I think it is important to reach a broad audience and to conduct a dialogue with various stakeholders, such as patient groups and policymakers.

In the context of the EpiPredict project, we have actively reached out to involved stakeholders with blogs, videos and Science Cafés. We have organised a Science Café in London, where we interviewed patients, former patients and their representatives. That was a very valuable experience. It allows you to find out what's really going on with a patient, for example, how they feel about a particular treatment.'

Responsiveness to long-term epigenetic editing

Verschure will soon be launching a major interdisciplinary research programme on the responsiveness of genes to long-term epigenetic reprogramming. Several research universities, two applied universities, the Rathenau Institute (a parliamentary technology assessment institute) and a wide spectrum of companies are involved in this research, which is funded by the Dutch Research Council.

'We can reset epigenetic programmes and gene functioning by targeting epigenetic regulatory proteins to specific genes using a variation of the CRISPR/Cas platform. This is known as epigenetic editing,' says Verschure. 'However, long-term gene activity reprogramming by epigenetic editing is difficult to achieve because not all genes respond in the same way. We are developing the rules and tools for long-term epigenetic editing as a new key technology to address major societal challenges, such as age-related diseases and global demand for food.'

Epigenetic reprogramming offers a unique opportunity for the research team to adjust deregulated cells. 'We will focus not only on the responsiveness of breast cancer cells, but also on cells of the immune system and on skin cells that have been altered by ageing and, from a biotechnological perspective, on the creation of plants with new properties that will allow them to survive for example climate changes.'

Responsible innovation

Genome engineering is a sensitive area. Verschure is aware that this is a serious matter. We will engage with various stakeholders at an early stage. 'We want to enable social debate on this subject. How does the public feel about epigenetic reprogramming? Do people understand the pros and cons? Together with the Rathenau Institute, we are going to make an inventory of the public perception of epigenetic editing, so we can responsibly innovate this technology and eventually maximise its applications.' ■


we want
to enable
social
debate
on the subject
of genome
engineering

Valorisation theme

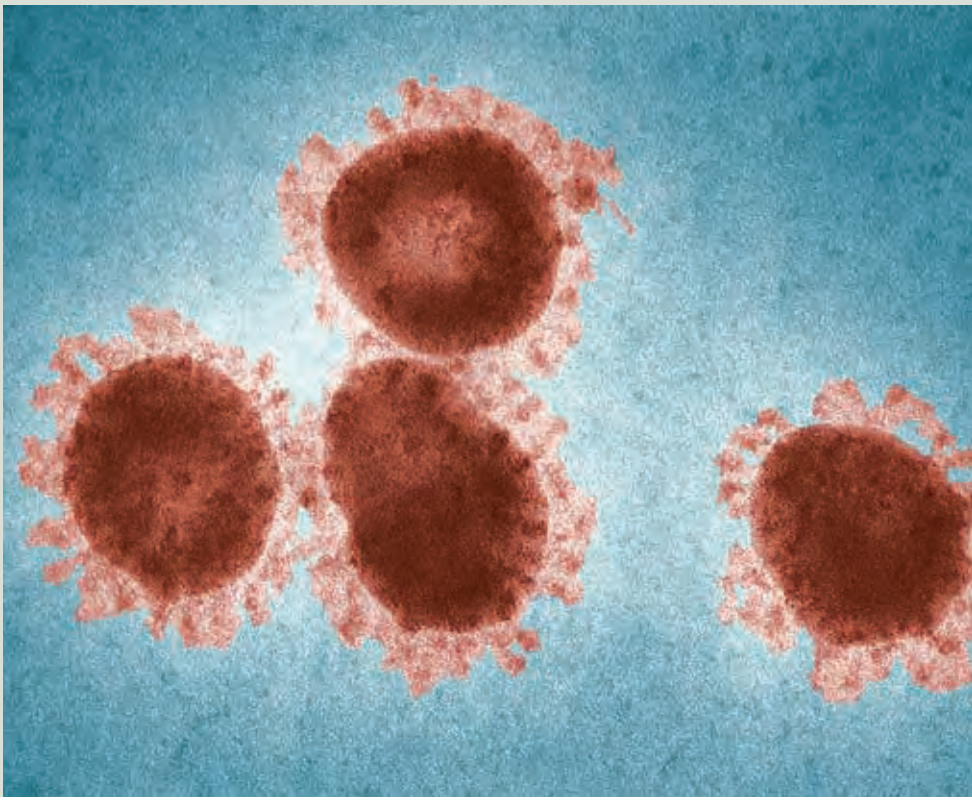
Health

AEROSOL TRANSMISSION IN COVID-19

During a KNAW webinar in March, speakers from several relevant disciplines gathered to discuss the recent insights into transmission of the coronavirus. As a result, scientists from UvA (including physicists Daniel Bonn and Mazi Jalaal), Cambridge University and Twente University drafted an information document with the latest scientific insights, highlighting the potential role of aerosols and effective indoor ventilation techniques. Since the start of the pandemic, the spreading through aerosols has led to numerous discussions, underlining the importance of up-to-date information on aerosol persistence and ventilation techniques that can diminish infection risk. The document can be accessed in the research section of the UvA website (available in Dutch only).

NEW FLUORESCENT PROTEIN TO MEASURE CELLS' CALCIUM LEVELS

Fluorescent proteins are a crucial part of the toolkit of modern day biologists: elements of cells that are normally transparent and invisible can be made visible under a microscope by tagging them with these proteins. Joachim Goedhart, Franka van der Linden and colleagues developed an addition to this toolkit: a cyan-coloured fluorescent protein that can be used as a biosensor to detect calcium levels in cells. Calcium ions play a key role in many cellular processes, e.g. muscle contraction. The team deviated from standard methods for measuring changes in cell concentration by using the fluorescence lifetime. As it does not depend on the fluorescence intensity, the fluorescence lifetime is an ideal parameter for measurements in cells. Test results yielded precisely quantified calcium dynamics, showing the potential of the biosensor as a new and accurate measurement device. The findings were published in *Nature Communications*.



WHITE BLOOD CELLS MOVE THROUGH VESSEL WALLS

When a pathogen invades our body, white blood cells rush to the site of the infection to clear the invader. At some point these cells pass through their vessel's wall to get into the infected tissue. A team led by Jaap van Buul unravelled a molecular mechanism regulating this. A blood vessel's wall can take on a sandpaper-like texture to which white blood cells stick. The cells then crawl along until they find a small hairy structure to pass through. 'We discovered that a protein called Rac1 controls the formation of the hairs,' says Van Buul. Eike Mahlandt and Joachim Goedhart recreated this protein in the lab, combined with a molecular light-sensitive sensor that ensured the protein only became active under a light of a certain wavelength and intensity. This allowed the team to locally control the hairs' production and study how white blood cells pass through them. The team hopes their discovery, as published in eLife 2021, may in the future help certain groups of patients, e.g. cancer patients receiving immunotherapy: 'Blood vessels in tumours are often poorly differentiated and do not easily allow the administered white blood cells (in the form of T cells) to enter. If we could ensure that the tumour's blood vessels do allow the T cells entry [through medication], immunotherapy might become more efficient.'

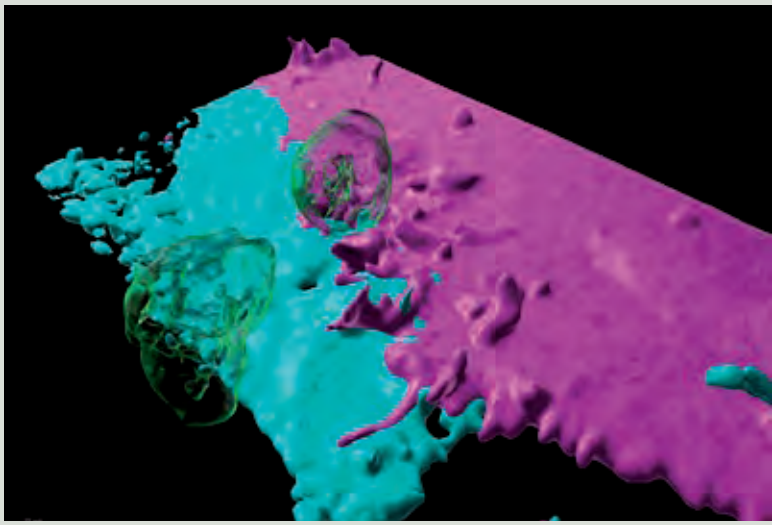


Image: Janine Arts et al (for UvA/Sanquin)

Credit: Netherlands Cancer Institute

AI TO BATTLE CANCER

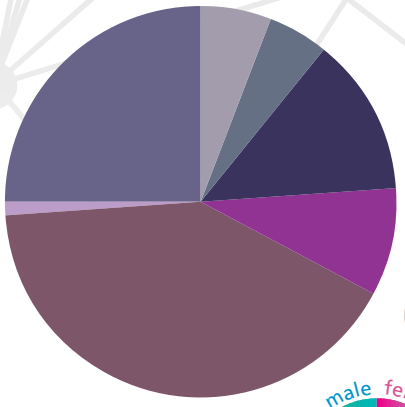
Development of artificial intelligence (AI) algorithms to improve cancer treatment is taking a big flight through new collaborations and funding. AI solutions can assist medical specialists finding and applying the right treatment based on all complex information acquired from patients and have the potential to guide medical interventions accurately to the location of tumours without damaging surrounding healthy tissue. One of the collaborations is the AI for Oncology lab, a joint effort by the Netherlands Cancer Institute (NKI) and UvA, in which expertise in cancer research and AI technology blend together. The domains are represented by UvA's Clarisa Sánchez (IvI) and NKI's Jonas Teuwen and Jan-Jakob Sonke. A second collaboration, funded by RVO, is the Partnership for Online Personalized AI-driven Adaptive RT lab between NKI, UvA and Elektra. The lab, under the supervision of directors Efstratios Gavves (IvI) and Sonke, focusses on new AI strategies for further improvement of precision radiotherapy: personalising treatment by improving the quality of imaging used during treatment, predicting and accounting for changes in the patient's anatomy over time and automatically adapting radiation delivery. Last but not least, Innovation Fund Noord Holland financed UvA spin-off ELLOGON.AI, founded by Gavves and Evangelos Kanoulas (IvI), with a loan of 297,000 euros for the development of AI technology for the diagnosis of cancer immunotherapy. With this financing ELLOGON.AI takes an important step in improving the survival rates for cancer patients.

SUBSTANTIAL UNCERTAINTIES IN COVID-19 SIMULATIONS

While in a physical experiment error bars are often included in the measured values, predictions from a computer model often lack this measure of uncertainty, despite their use in high-level decision making. According to an international study, computer modelling to forecast COVID-19 mortality contains substantial uncertainties in its predictions. The study, in which Daan Crommelin (UvA/CWI) and Peter Coveney (IvI) participated, used the VECMA toolkit to couple an uncertainty quantification technique to the epidemiological CovidSim model. For models with a high number of parameters like CovidSim, it is difficult to study the effect uncertainties in the input parameters have on uncertainties in the output. The new method determines and focusses on parameters that affect the output uncertainties the most, resulting in better probabilistic predictions. This proved very effective. Out of 940 parameters in CovidSim, half of the overall variation in results was down to just three: the disease's latency period, delay in self-isolation after infection and the effectiveness of social distancing. The latter two can be influenced by governmental policies, which can greatly contain the disease's spread. The findings were published in *Nature Computational Science*.

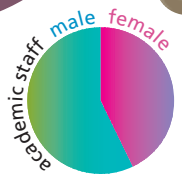
Swammerdam Institute for Life Sciences

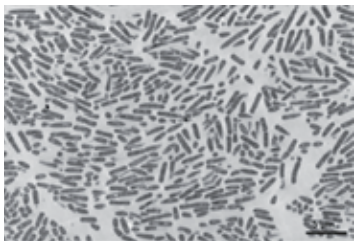
Research at SILS spans the biological processes in humans, animals, plants and micro-organisms. The exchange of information and extension of research across disciplinary boundaries are key to how we work.



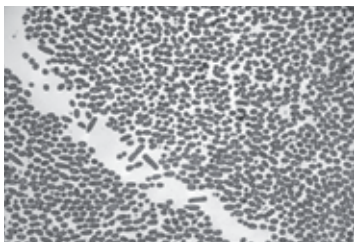
people **247**
FTEs **238.6**

*of which 80% technical support staff





New flat embedding



Widely used pellet embedding

New mechanism of antibiotic tetracycline

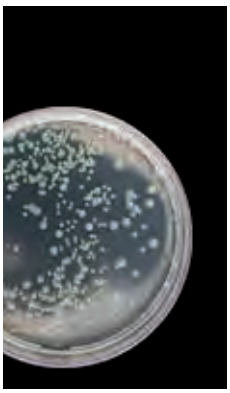
While researching ways to optimise a preparation technique to more efficiently study bacteria via transmission electron microscopy, a team led by Michaela Wenzel and Leendert Hamoen discovered a new mechanism of tetracycline. This widely used antibiotic effectively blocks ribosomes and prohibits growth in a wide range of bacteria. The researchers monitored *Bacillus subtilis* reacting to tetracycline so they could assess the potential of a new sample preparation technique in which bacteria are embedded on a flat surface. This enabled microscopic observation of longitudinally cut cells. They unexpectedly found that in addition to blocking ribosomes, tetracycline causes deformations in bacteria membranes due to incorrect localisation of proteins. This dual antibacterial activity might be the reason that resistance against tetracycline occurs relatively slowly. Suggested further research includes developing tetracyclines with enhanced membrane effects to fight multi-resistant bacterial strains more effectively. The findings were published in *Communications Biology*.

Age Smilde received Herman Wold Gold Medal 2021

On 7 September 2021 at the SSC17 conference in Denmark, Age Smilde was awarded the 15th Herman Wold medal in Gold from the Swedish Chemical Society, 'for his relentless inquisitiveness to the development and proliferation of Chemometrics, combined with a sincere dedication to build bridges across disciplines'. The prestigious Herman Wold medal is awarded biannually to individuals who have contributed significantly to the development and proliferation of Chemometrics and its expanded synonyms in machine learning and multivariate statistics within data driven life sciences.

Biologists find gene that creates extra vacuoles in plant cells

In 2017 Ronald Koes and Francesca Quattrocchio discovered that some plant cells do not just contain a single large central vacuole, but also several smaller ones. Following up on these 'vacuolinos', they discovered that in petunia cells the RAB5a gene plays a crucial role in their formation. Switching off the gene ensured that cells no longer contain the small vesicles, while overexpression lead to larger ones. Interestingly, the size and number of the vacuolinos generated by the RAB5 gene determine characteristics such as the colour and shape of the flower petals. With these first insights into the function of vacuolinos, Koes and Quattrocchio may have found a fundamental biological mechanism, as the RAB5a gene is present in many plant species. The findings were published in *Cell reports*.



Promising ebselen-derived inhibitors of COVID-19 identified

A research team led by Ewelina Węglarz-Tomczak and Stanley Brul provided evidence that modified derivatives of the compound ebselen – a drug already in use against several neurological disorders – may serve as promising prospective drug against COVID-19. The enzyme called papain-like protease (PL^{pro}) in the virus, fools host antiviral innate immune response by altering host-cell proteins. In their research, the team showed that very low levels of ebselen can already effectively inhibit activity of PL^{pro} in a fast and irreversible way. When further testing ebselen derivatives, they identified four molecules that act as strong inhibitors against PL^{pro} from CoV2. These are highly promising findings in the research into and possible development of anti-COVID-19 therapy. The discovery was published in *Scientific Reports*.

Credit: Prometeus

Book release: Cyriel Pennartz on the relationship between brain and mind

'This is not a book for the faint of heart – it is for doubters, tinkerers, worriers, trackers and other people curious about what's going on up there in their heads,' says Cyriel Pennartz on his new scientific book *De code van het bewustzijn* (The code of consciousness).
The issue of consciousness, especially sensory consciousness, has a central role in Pennartz's new release: how is our brain – this remarkable tissue literally crackling with electrical activity – able to let us experience the world with its wealth of qualities as 'just the usual'? Pennartz shows that 'experience' and 'consciousness' are not superfluous concepts and according to him, studying them is not an impassable road. In fact, over the past thirty years, studies of patients, computer simulations and the electrical behaviour of brain cells have paved the way for thorough research into brain mechanisms of consciousness.

In *De code van het bewustzijn*, Pennartz takes the reader on an inspiring quest for one of the greatest scientific challenges of the twenty-first century: understanding the relationship between brain and mind.

Credit: Paulo Brando

Large grant for UvA research in Caribbean

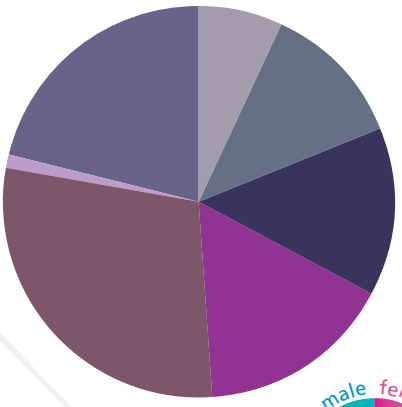
The Minister of Education, Culture and Science announced that more than 7 million euros was awarded to two projects within the NWO programme Caribbean Research: a Multidisciplinary Approach. One project is *SEALINK*, chaired by Mark Vermeij, which aims to create the first comprehensive understanding of ocean pollution and coral reef health in the Dutch Caribbean. The second project is *Island(er)s at the Helm*, chaired by Francio Guadeloupe, which aims to co-create sustainable and inclusive strategies for social adaptation to certain climatic challenges in the region. These projects focus on issues that are of great societal and scientific importance for the Caribbean region and facilitate transfer of knowledge via education and outreach. This is the first time that NWO has funded programmes of this size in the Dutch Caribbean.

Measuring bird migration in ARTIS

Judy Shamoun-Baranes, Rotem Kadan-Zilber and Leonardo Porcacchia installed a BirdScan radar in ARTIS Amsterdam Royal Zoo. The radar is part of a demonstration site to educate visitors of the zoo on remotely monitoring biodiversity and records bird migration. Running 24/7, the radar detects altitude, direction and speed of birds, insects and bats, automatically classifying them based on wing beat pattern. By researching seasonal patterns in bird migration, it is possible to measure the increase and decrease in biomass and investigate whether environmental and anthropogenic conditions influence migration. This demonstration site is part of the national research project ARISE, which sets up an infrastructure to identify and monitor all multicellular biodiversity in the Netherlands within five to ten years. In the future more types of sensors will be placed in different spots in the Netherlands.

Institute for Biodiversity and Ecosystem Dynamics

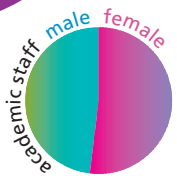
IBED aims to increase our understanding of the diversity and dynamics of ecosystems, from the molecular and genetic level to entire ecosystems. How do organisms interact with each other and with their non-biological environment?



- Full professor **7%**
- Associate professor **12%**
- Assistant professor **14%**
- Postdoc **16%**
- PhD candidate **29%**
- Lecturer **1%**
- Support and management **21%**

people **148**

FTEs **134.5**



Pesticides do not reduce arthropod pest densities when natural enemies are present

When natural enemies of arthropod pests of crops are present, pesticide applications often do not result in a decrease of average pest densities, according to new research by Arne Janssen and Paul van Rijn. Despite mounting concern for their side effects and development of resistance in pests, chemical pesticides remain the main agents for control of arthropod pests of agricultural crops. However, pesticide applications often lead to an increase in pest densities some period after the initial reduction of the pest. 'This will even occur when pesticides are applied repeatedly,' explains Van Rijn. 'A possible explanation for this is that pests suffer directly from pesticides, but at the same time, they indirectly benefit because the densities of their natural enemies are also reduced.' The study shows that the presence of natural enemies of pests often makes the use of chemical pest control superfluous. 'Moreover, natural pest control will result in more sustainable agriculture than the application of synthetic pesticides, with their well-known disadvantages,' concludes van Rijn. The findings were published in *Ecology Letters*.

Geert Timmermans appointed Honorary Fellow

Geert Timmermans, urban ecologist with the municipality of Amsterdam, has been appointed Honorary Fellow at IBED. He was the first to receive an Honorary Fellow appointment within the Faculty of Science. IBED scientific director Prof. Annemarie van Wezel: 'With this appointment, we hope to promote the development of a nature-inclusive city through collaborative projects between IBED and the municipality of Amsterdam.'

Impact of deforestation on Amazon biodiversity

Crystal McMichael was part of a research team that provided the first quantitative assessment of how environmental policies on deforestation, along with forest fires and drought, impact and threaten Amazonian biodiversity. With records of more than 14,500 plant and vertebrate species the team created biodiversity maps of the region, overlaying them with forest fire and deforestation observations over the past two decades. They found that since 2001, fires affected 95% of Amazonian species and as many as 85% of species listed as threatened in the region. They also found close associations between forest policy, fire-impacted forest area and biodiversity. Results of the study, as published in *Nature*, underscore the critical role of policy enforcement in the preservation of biodiversity in the Amazon, which supports around 40% of the world's remaining tropical forests and plays a vital role in regulating Earth's climate by storing scrubbing and storing carbon from the atmosphere.

Credit: Paul van Rijn

Green

Valorisation theme

SEA BUTTERFLIES ALREADY STRUGGLE IN ACIDIFYING SOUTHERN OCEAN

Due to increasing concentrations of atmospheric carbon dioxide caused by anthropogenic (human) activities, the Southern Ocean will acidify in the coming decades. This process affects shell growth in sea butterflies, useful biological indicators of ocean acidification and an abundant prey at the base of Southern Ocean food chains. In a new study, scientists from Naturalis Biodiversity Center, UvA and NIOZ show that sea butterflies already have difficulty growing their shells in present-day Southern Ocean conditions. PhD candidate Lisette Mekkes was involved in the research. She comments: 'Imagine that a highly abundant sea butterfly, *Limacina retroversa*, were to disappear from this region; that would have major implications for the local sea life that depends on them for food, and also for the rate of calcium carbonate export from surface waters to the deep sea.' These findings raise the alarming question of how much longer sea butterflies will be able to build their shells as acidification continues.

AMAZON APPROACHES CATASTROPHIC POTENTIAL TIPPING POINT

The first-of-its-kind Amazon Assessment Report detailing the natural emergency unfolding in the Amazon basin was presented on 12 November 2021 at the COP26 conference in Glasgow. The report warns that the Amazon is approaching a catastrophic potential tipping point. Carina Hoorn, associate professor at UvA's Institute for Biodiversity and Ecosystem Dynamics, is the lead author of the report's first chapter and co-author of its second. The Amazon rainforests emerged over 60 million years ago and have slowly adapted to climate and landscape changes. 'That is how geology works – slowly,' says Hoorn. 'But the ecosystem might not survive the unprecedented rate of change caused by human action. We need to raise awareness of the risks of losing the forest. And we need to further investigate the consequences of deforestation, e.g. increased erosion and climate change.'

TRACKING BIODIVERSITY FROM SPACE

An international expert group has drawn up a priority list of biodiversity metrics that can be observed from space. The research, co-authored by Daniel Kissling, has now been published in *Nature Ecology & Evolution*. Satellite remote sensing is an ideal tool for monitoring biodiversity changes from local to global levels, but to date there has been little coordination between the work of ecologists and remote sensing specialists. 'The priority list of remote sensing biodiversity products can improve monitoring of geospatial biodiversity patterns, and coordination and communication between networks of observers,' explains Kissling. Specific workflows are now also being developed in order to obtain essential biodiversity variables from remote sensing and channel investment towards specific technologies. Light detection and ranging (LiDAR), for example, is potentially an extremely powerful tool for retrieving variables that capture the three-dimensional (3D) structure of ecosystems and animal habitats.

THREE PROJECTS AWARDED FUNDING UNDER 'NEW CHEMISTRY FOR A SUSTAINABLE FUTURE' PROGRAMME

HIMS has received 1.2 million euros to fund research by three PhD students in the fields of catalysis and computational chemistry under a programme launched by ARC CBBC, the Dutch national chemistry research centre that investigates chemical building blocks for novel sustainable energy and materials. Two PhD students will work on photoredox catalysis projects under the supervision of Bas de Bruin and Joost Reek. Their aim is to develop new chemistry for future chemical applications with an improved redox economy, making use of novel direct functionalisation protocols and 'green' electrons provided by low-cost sources of electrical energy. The third PhD student, supervised by Peter Bolhuis, will use advanced computational quantum mechanical modelling (DFT) to unravel the electrochemical CO_2 conversion process. This work will contribute to direct use of renewable electricity, which will likely dominate energy supply in sustainable long-term scenarios.

IN SEARCH OF CATALYSTS FOR OPTIMAL CO_2 CONVERSION USING DATA SCIENCE

As part of its mission to foster interdisciplinary research, the UvA Data Science Centre made funding available for an interdisciplinary PhD project in Inverse Design. The researchers involved – computational chemist Bernd Ensing (HIMS, AI4Science Lab), catalysis engineer Shiju Raveendran (HIMS, Catalysis Engineering) and machine learning experts Max Welling and Jan-Willem van de Meent (IvI, AMLAB) – will use novel machine learning approaches (e.g. deep generative modelling and deep probabilistic programming) to infer optimal catalyst materials and process conditions given a set of desired chemical and process properties. The aim of this collaboration between HIMS and IvI is to develop catalytic materials that allow the use of CO_2 as a building block for high value-added chemicals and fuels, instead of treating it as waste.

IMPORTANT STEP TOWARDS FULL CIRCULARITY OF THE SUSPHOS PROCESS

A group of HIMS researchers took an important step towards full circularity of phosphate recycling in the SusPhos process. SusPhos, a promising UvA startup, recovers phosphates from wastewater for high-value applications such as flame retardants in a process developed by Bas de Jong, Marissa de Boer and Chris Slootweg four years ago. That process uses struvite, a mineral which – in addition to phosphate and ammonium – also contains magnesium. After focusing on recovering phosphate and ammonium initially, researchers have now turned their attention to recovering magnesium in a project financed by a 'Gouden KIEM' grant from the Dutch Research Council (NWO) and ChemistryNL. Their recent laboratory results indicate that it should be possible to reuse the recovered magnesium in functional products with high market potential. If this proves possible at industrial scale, the process could potentially become 100% circular.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INTERVIEW
BOB VAN DER ZWAAN, PROFESSOR OF SUSTAINABLE ENERGY TECHNOLOGY

CLIMATE TARGETS •

Collaboration and optimism are essential for the energy transition

'There's no alternative for optimism,' says Professor Bob van der Zwaan. In his view, optimism is the only way the climate targets of the Paris Agreement can be achieved. 'It's getting harder and harder, but it's still possible.'

Van der Zwaan has been working to make the planet a better place ever since he first started out in the world of science. He does not just talk about changes; he does everything he can to make sure they actually happen. 'Climate change is one of the greatest challenges of our time. I feel it's my duty to play my part in helping to solve it,' says the scientist, who is affiliated to the Van 't Hoff Institute for Molecular Sciences.

Van der Zwaan is helping to fight climate change in two ways: He spends just under half of his time as professor of Sustainable Energy Technology at UvA and spends the rest working for the TNO Energy Transition innovation institute. This combination works perfectly for Van der Zwaan. At UvA, his research is more fundamental, while at the Netherlands Organisation for Applied Sciences (TNO), he looks at how this research can be applied.

Renewable energy

In the '90s, Van der Zwaan was interested, among other things, in the role that nuclear energy can play in the energy transition. In his view, this is now no longer a realistic option for many countries. Instead, the UvA professor's main focus is thus other sources of energy.

'Renewable wind and solar power has now become so cheap – and prices are still falling – that, here in the Netherlands, we must invest heavily in these sources,' says Van der Zwaan.

His current research therefore focusses primarily on renewable energy that, in his view, offers the best chance of helping us meet the Paris climate targets. He looks, for example, at the costs and cost reductions of individual energy technologies such as wind and solar power. Van der Zwaan is also researching how, together, these two sources of energy can meet our energy demand in all sectors of the global economy.

Through his modelling studies of energy systems, he contributes to the major international reports of the Intergovernmental Panel on Climate Change (IPCC), which set out energy and climate change scenarios for this century every seven years.

From reduction to negative emissions

'We can only see a short distance ahead, but we can see plenty there that needs to be done,' is how world-renowned mathematician Alan Turing put it. The same applies to the current energy transition. In the meantime, however, Van der Zwaan and his colleagues are already working on the phase in which it is no longer only about rapidly reducing emissions of greenhouse gases, which is the main goal at the moment. Instead, they already now put emphasis on how to achieve negative emissions after 2050.

'In 30 years, according to the Paris Agreement, CO_2 emissions must be negative. This means that we as a society are entering another phase,' explains Van der Zwaan. 'We are focusing on the question of how we can achieve these negative emissions. In other words, it's no longer just about preventing emissions. It's about how we can remove greenhouse gases, particularly carbon dioxide, from the atmosphere.'

Multidisciplinary approach

Working closely with other disciplines is key in climate research, says the professor: 'If we are to be in a position to tackle the major climate issues that we are facing, we have to think beyond our own disciplines. There's a huge amount of work to be done, by all of us, and the most important thing is that we do it together. The point is that there are obstacles on every possible level: from technology and costs to legal and organisational aspects.'

Van der Zwaan is promoting this multi-disciplinary approach both within UvA and externally. For example, from his base at the Faculty of Science, he launched the seminar series 'Future of Energy', in close collaboration with UvA's Institute for Advanced Study (IAS). In early 2022, the UvA-wide Research Priority Area ENLENS was launched on the basis of this series. Here, scientists from a variety of disciplines conduct research into the energy system and the energy transition in the context of the Sustainable Development Goals (SDGs).

Inspiration

Teaching is at least as important to Van der Zwaan as his research. After all, climate change is an issue that affects our future generations. In addition to teaching at UvA, he teaches at Johns Hopkins University in Bologna.

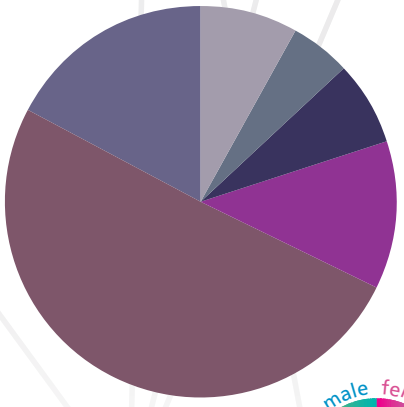
'I find teaching young people hugely inspiring. They are so motivated and engaged. These students really want to help the planet, because they know there's no alternative. I try, wherever I can, to tell them a positive story, without being dishonest about the negative aspects.'

Because what applies to our climate crisis also applies to his students: 'There's no alternative for optimism.' ■


there is
no alternative
for optimism

Van ‘t Hoff Institute for Molecular Sciences

The Van ‘t Hoff Institute for Molecular Sciences performs internationally renowned chemistry research, curiosity-driven as well as application-driven, within four recognisable themes. Computational Chemistry, Analytical Chemistry, Synthesis & Catalysis and Molecular Photonics.



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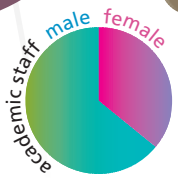
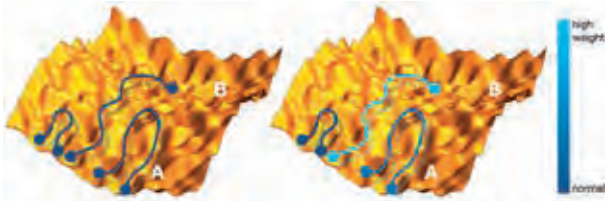
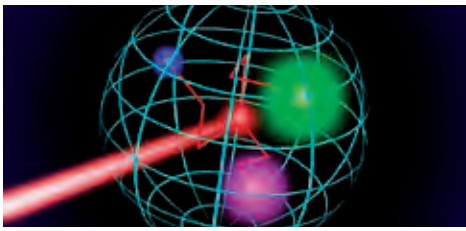






Artistic representation of near-infrared laser light entering a nanostructure

Rate constants as kinetic constraints in molecular dynamics simulations

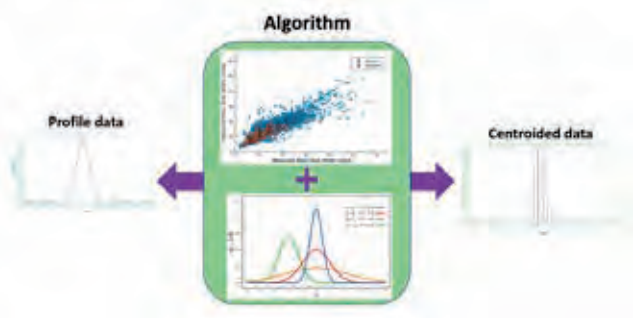
Biomolecular structures (proteins or DNA) are usually resolved with crystallography or cryo-electronmicroscopy. This is often combined with molecular simulations that can predict atomistic structure and dynamics, albeit with an approximate description of atomic interactions. Statistical methods can increase their accuracy by incorporating experimental information. Besides structures of molecular states, their populations and their interconversion rates are of interest, but hard to predict correctly. Incorporating knowledge of experimental rates into the simulations could further fine-tune the models. Research by Faidon Brotzakis, Michele Vendruscolo and Peter Bolhuis introduced a method of imposing known rate constants as constraints in molecular dynamics simulations, based on maximum-entropy principles for an ensemble of dynamical trajectories.
The method reweights each path to match the calculated and experimental interconversion rates of a molecular transition, while minimally perturbing the prior path distribution. This kinetically corrected trajectory ensemble leads to improved structure, kinetics and thermodynamics, as well mechanistic insights that may not be readily evident from the experiments. The findings were published in *Proceedings of the National Academy of Sciences*.

A robust novel methodology for the synthesis of complex natural products

Researchers of the Synthetic Organic Chemistry group presented a new methodology for the divergent total synthesis of yaequinolone-related natural products. Yaequinolones are biologically active molecules with antibiotic properties and insecticidal activities that are isolated from marine and plant fungi. The group, led by Tati Fernández-Ibáñez, developed a novel, comprehensive approach based on late-stage C-H functionalisation of a common intermediate to synthesise no less than ten yaequinolone-related natural products, for the first time ever. Key to the success of the late-stage C-H functionalisation was the use of an active catalyst based on palladium, developed by the same group. Wen-Liang Jia, who obtained his PhD in March 2021, made a major contribution to the research. The findings were published in *Journal of Organic Chemistry*.

Quantitatively understanding defects in phosphors from a nano perspective

Researchers led by Hong Zhang provided insight into the microscopic dynamics of energy transfer and conversion in doped phosphors. Using dedicated nanostructures and computer modelling they were able to quantitatively determine the mechanism of interaction between hydroxyl impurities and luminescence centres inside lanthanide-doped phosphors. These impurities can reduce the non-linear ‘upconversion’ performance of lanthanide-doped phosphors – where they emit one photon upon absorption of several photons of lower energy – up to three orders of magnitude. The team’s findings, published in *Light: Science and Applications*, contribute to the development of novel materials that can e.g. be used to shift the near-infrared light of an economic continuous-wave milliwatt laser towards visible frequencies. Potential applications are in high-density data storage and photo-induced therapy.



Enhancing the power of Analytical Chemistry using data science

In the research of the Analytical Chemistry group, data science continues to move to the forefront. Several recent publications highlight the development of methods and new applications that couple analytical technology with data science methods. A particular highlight is a paper of Saer Samanipour and Bob Pirok in cooperation with researchers at the University of Queensland and the Norwegian Institute for Water Research. The paper focusses on processing high-resolution mass spectral data and describes a novel machine-learning approach for the seamless interconversion of centroided (compressed) data and mass peak profile data. The researchers developed algorithms and incorporated these in the open-source and open-access Cent2Prof software package. Compared to existing algorithms, it reduces the rates of false detection and enhances the characterization accuracy. The findings were published in *Analytical Chemistry*.

Outreach & Diversity

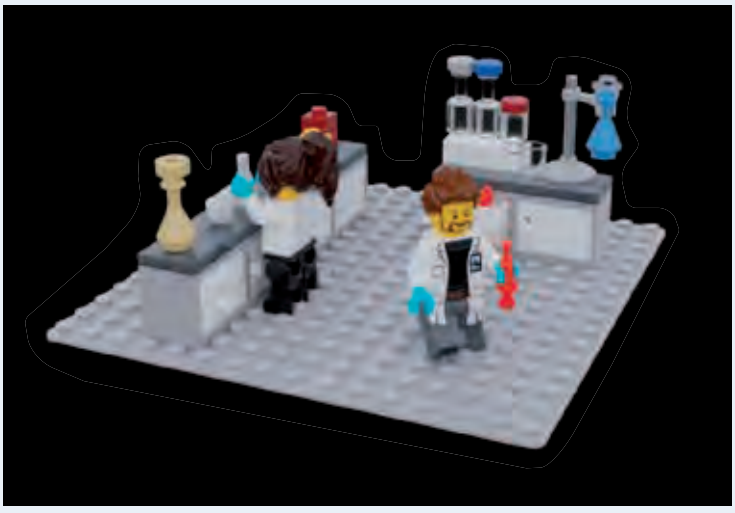
YONI SCHIRRIS WINS THREE MINUTE THESIS PITCH

Yoni Schirris, PhD candidate at the UvA Informatics Institute and Netherlands Cancer Institute, won the UvA 3MT (Three Minute Thesis) pitch and represented our university in the international finals.

Science communication

SYNTHESIS OF NEW HETEROGENEOUS CATALYSTS EXPLAINED WITH LEGO ANIMATION

Ilse Denekamp, HIMS PhD student, studies heterogeneous catalysis – a way to make materials with controllable properties using catalysts and reactants in differing phases. She recently translated her PhD research into a one-minute video using a Lego animation, music and voice-over. Her promotor Gadi Rothenberg views short animations as an important tool in science communication: 'Today, communication between disciplines and cultures is the key to successful collaboration. Animations like this one emphasise the creative aspects of science on the one hand and the importance of solving technological and social problems on the other.'



2 FACULTY PROJECTS 'VALUED' FOR SCIENTIFIC COMMUNICATIONS

The Ministry of Education, Culture and Science awarded €10,000 to each of the two projects of UvA's Faculty of Science involved with outreach and scientific communications. The faculty is pleased with these awards for efforts involving a podcast about astronomy and the study of inclusive artificial intelligence (AI). The podcast goes under the name of '100 Years of Pancakes!' – a reference to the Anton Pannekoek (Pancake) Instituut. The podcast is hosted by astronomer, author (The Planet Hunters) and familiar media presence Lucas Ellerbroek and aims to interest the public at large in all things astronomical. The second awarded effort is the CIVIC AI lab, which focusses on the application of AI in the fields of education, welfare, environment, mobility and health. While AI offers great possibilities, it also carries distinct disadvantages. For example, image recognition systems that are trained using images of people with lighter skin tones are less accurate when recognising those with darker skin tones. The CIVIC AI lab examines examples of such friction so that AI promotes equality and delivers fair opportunities in the future, overcoming its negative side effects. The lab also serves as an information resource about new technologies and their ethical and inclusive use.

Diversity

Sisters in Science. From left to right: Mimi den Uijl, Lotte Schreuders, Noor Abdulhussain.

SISTERS IN SCIENCE WIN NWO DIVERSITY INITIATIVE AWARD

Three analytical chemists at UvA, Mimi den Uijl, Noor Abdulhussain and Lotte Schreuders, attract huge interest with their Instagram account @SistersinScience_NL.
As youngsters, the Sisters all wrestled with the same stereotypes and had no idea what a career in science involved, let alone whether a scientist could actually be like them in any way. Driven by the belief that science can only become more accessible through transparency and highly visible role models, they set out to transform the ivory tower of advanced research and university teaching into something completely understandable and appealing. They use their Instagram to show young people from all kinds of backgrounds what they do in their daily lives, the place they work at and the fun they have as junior scientists. Their efforts won them the Dutch Research Council's Diversity and Inclusion Initiative Award, worth 50,000 euros. The Sisters intend to use the funds to professionalise their platform further, and reach and inspire their target group even more effectively.

Science education

FIRST AID FOR PROFILE PAPER (START-UP) PROBLEMS

Each year, the UvA and the VU receive countless requests from secondary school students preparing for their final profile papers. The pleas range from 'I have no inspiration' to 'Can I experiment in your lab?' and come in scattered across the entire faculty. The universities' efforts to help students on their way, however, were upended by corona pandemic. In response, the Bètapartners network – an ongoing collaboration supporting science education – came up with profielwerkstuk.nl. This website offers help to pupils in any phase of their papers, even expert help. 'The great thing is,' adds Bart Groeneveld, project manager, 'we can now serve far more students.' The cooperation has now expanded beyond science subjects to include the humanities and social and behavioural sciences. Charlotte Clarijs, the project leader: 'Ultimately, we hope that profielwerkstuk.nl will be the website that students first look at before they start on their profile paper. The first reactions have been extremely positive.'

FACULTY RESEARCHERS SUPERVISE FINALISTS IN SCHOOL CHEMISTRY COMPETITION

Imagination at Work is a national chemistry competition. Pupils work together with scientists and experts to research topics as sustainability, food, climate, energy and health. Final presentations are in the form of an essay contest. This year's win went to Canisius College (Nijmegen) pupils Cas Revenberg and Thijn Koopman, who investigated the capture of CO_2 using porous materials under the supervision of Stefania Grecea and Andreea Gheorghe (HIMS). Jury president Margot Verwei of Avans University of Applied Sciences praised their clear presentation of climate change and global warming and their ability to explain the technical aspects of their subject understandably. Other contributions included presentations on 'sustainable energy' and 'waste as a raw material' by students from respectively Jan Arentsz in Alkmaar, under the supervision of Chris Slootweg and Steven Beijer, and Rijnlands Lyceum Sassenheim, under the supervision of Grecea and Suzanne Reus. Students received a cheque of 500 euros as a contribution to their studies.

PUBLICATION OF DIVERSITY AND INCLUSION POLICY DOCUMENT

UvA's Faculty of Science published a Diversity and Inclusion Policy document, which sets out its ambitions for the next three years under four strategic objectives. Roughly summarised, those objectives are 'access to a university education for all, whatever the student's background', 'collaboration in diverse teams and settings', 'recruiting, appointing and retaining staff from diverse backgrounds' and 'promoting good practices and knowledge exchange'. Promoting diversity and inclusion at the Faculty of Science has been the focus of explicit attention for some time now. The new policy document is designed to consolidate the paths and initiatives that already exist by providing a clear focus.

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