University of Amsterdam
Faculty of Science

2020 IN REVIEW

research

education

valorisation


UNIVERSITEIT VAN AMSTERDAM
904

Dear reader,

Based on the contents of this year's annual review, you might not guess that 2020 was a more challenging year than ever. This is the most packed magazine we've ever had before; a testament to the adaptability and perseverance we have all showed as the COVID-19 pandemic threw up one obstacle after another.

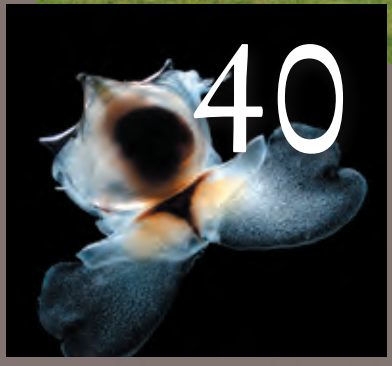
Which isn't to say it was easy. Undoubtedly, throughout the year, many of us have had moments where we struggled. Working from home, making the switch to online teaching, sometimes while managing childcare, dealing with our own health concerns or that of loved ones, and missing what is essentially unmissable: connection with others. The classic stereotype of scientists as socially isolated creatures who prefer to hide behind stacks and stacks of papers and books could not be further from the truth. As scientists we passionately engage with the world around us, eager as we are to make meaningful contributions to society.

This is the passion that you see on display in this magazine. Read for example the interview with Sennay Ghebreab (page 58), associate professor of socially-intelligent AI. As scientific director of the Civic AI Lab, he works together with VU Amsterdam colleagues, the City of Amsterdam and the Ministry of the Interior and Kingdom Relations to exploit AI in promoting equal opportunities. Or read the interview with quantum information researcher Michael Walter (page 50) who works on solving complex optimization problems with quantum computers. Together with colleague Maris Ozols, he leads school children on a 'quantum quest', inspiring the next generation of much needed quantum researchers (see page 68). Likewise, Emily Burdfield-Steel, who studies the impact of urbanisation on moths, has developed an interactive game using Pokémon cards to explain evolution to school children (page 36).

Making meaningful contributions to society through science, is also what drives many of our students today. As Geert Bakker, student in the Future Planet Studies Bachelor's programme puts it in conversation with IIS director Lucy Wenting (page 10): 'Many students - myself included - recognise the importance of reflecting on complex societal problems during our time at university.'
As for our students, as dean of the Faculty of Science I'm very aware that the past year also placed a large burden on them. Keeping up motivation while being largely cut-off from meaningful connection with your teachers and your fellow students, is not an easy feat.
On pages 22 and 23 you can read how some of our students coped.
'Teaching only makes sense if learning takes place,' said Alex de Koter on the occasion of his election as Faculty of Science Lecturer of the Year (see page 15), adding: 'So you have to constantly try and find out what a student thinks and does. You have to be in continuous dialogue.' At the time of writing, as restrictions are once again being eased and the vaccination rate is rising, we are hoping that the new academic year will see the return of students to our Science Park campus at a normal scale, allowing that dialogue to become continuous rather than 'on and off' once again.

Peter van Tienderen
Dean of the Faculty of Science
June 2021

CONTENT



Organisation

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Research & valorisation

Research institutes

INTERVIEWS

2021-2026: CONNECTING SCIENCE IN A CHANGING WORLD

In 2020, the Faculty of Science management team began drawing up the strategic plan for the period 2021-2026. Entitled 'Connecting science in a changing world', the plan outlines topics of expected relevance to the Faculty while also taking into account the UvA's own strategic plan.

FACULTY OF SCIENCE CELEBRATES 20 YEARS

In 2020, the Faculty of Science celebrated its 20th anniversary. Before becoming the UvA institution we know today, its different labs and disciplines had been scattered around Amsterdam. In the mid-1990s, a report entitled 'New roads in science' identified the potential of uniting the disciplines. By the turn of the millennium, the UvA joined forces with the City of Amsterdam and the Netherlands Organisation for Scientific Research (NWO) to develop Amsterdam Science Park. In 2000, the UvA's faculties of biology, chemistry and mathematics, informatics, physics and astronomy merged to become the Faculty of Science. Two decades later, the student body has grown from 2,000 to over 7,000. Numbers of international students and female students have both nearly quintupled. And last but not least, the budget has increased from €64 million to €178 million.

MARISKA ENNEKING DEPARTS FACULTY OF SCIENCE

Director of personnel and administration Mariska Enneking left the Faculty of Science on 1 January 2021. In her farewell message, she commemorated her 19-year career at the UvA as a period during which 'I worked with very nice colleagues, with never a dull moment, and in which I learned a lot.' She has since begun a new job, serving as director of operations of the Faculty of Technology at the Amsterdam University of Applied Sciences (HvA). Dean Peter van Tienderen praised Enneking for keeping personnel 'on track, while also having eye for the human side of things'.

Enneking's departure prompted a change of the governance structure, which is now in line with other UvA faculties. In the new structure, the management team will continue as a group of three, with Dean Van Tienderen, Vice-Dean Lex Kaper and Chris Marcelis as director of operations. Marcelis took over Enneking's portfolios, with day-to-day responsibilities being delegated to the current department head of Personnel and Organisation and a secretary to the board in a newly created role.

From left to right: Peter van Tienderen, Chris Marcelis and Lex Kaper.

September 2020: replacement of the nitrogen tanks resulted in some spectacular images. Photo: Wim van der Meijden.

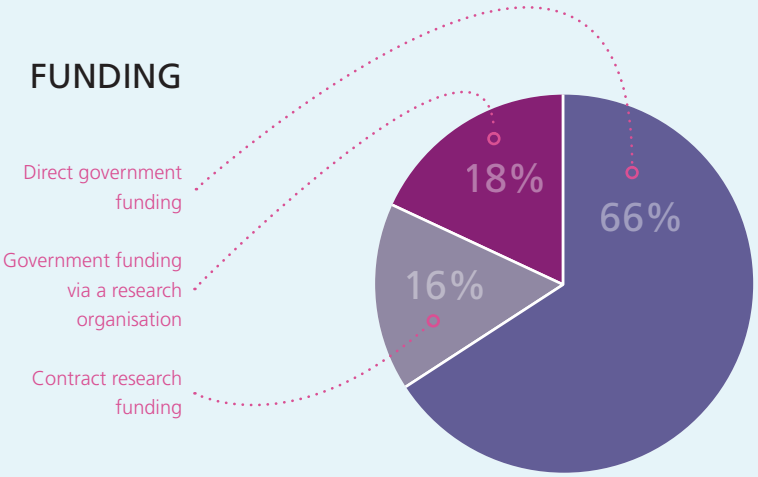
NEW APPOINTMENT AND PROMOTION CRITERIA

In 2020, the Faculty of Science published new appointment and promotion criteria for permanent scientific staff. The updated criteria were the result of a comprehensive revision process. With the updated criteria, the Faculty aims to achieve a more balanced appreciation of achievements in the areas of research, teaching and leadership in hiring or promotion decisions. 'This had been a matter of concern for a while at our Faculty,' said Dean Peter van Tienderen. 'Success was too narrowly defined as success in terms of scientific output and acquired funding. Important achievements in the area of teaching innovation were insufficiently weighed in decisions regarding promotion. This was the situation despite the fact that we particularly value that relationship between research and teaching at the Faculty of Science.'

The criteria will be used by appointment advice committees and supervisors when assessing candidates for appointment or promotion. In the broader sense, the criteria are a tool for recruitment and selection of staff and can be used to determine career prospects for current staff.

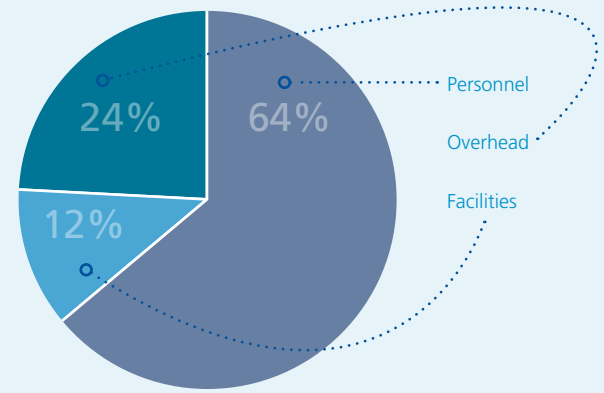
Funding & expenses

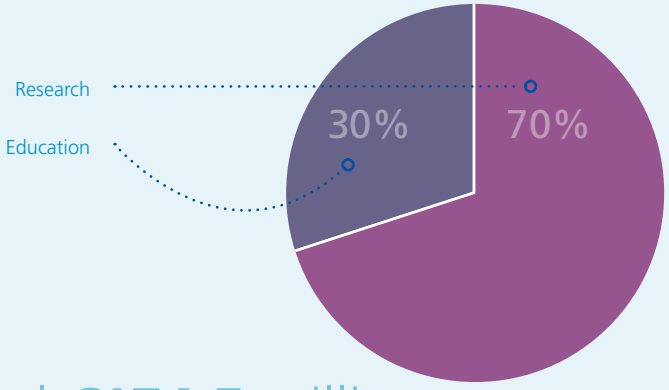
FUNDING



total **€183.1** million

EXPENSES





total **€174.5** million

Education

AT THE FACULTY OF SCIENCE

At our Amsterdam Science Park campus, we educate nearly 7,000 students in our research-based Bachelor's and Master's programmes. Students at the Faculty of Science are driven by different motivations. Some want to go deep into one subject, while others want to know how it all connects. Some become smitten with research and want to do it for a lifetime, while others are eager to apply all they have learned within a single field.

With our portfolio of specialised programmes and programmes that cross the boundaries of discipline, we offer a home to all of them. Sharing an unwavering curiosity and eagerness to learn, our students are part of a community of dedicated and talented peers and lecturers. These lecturers are themselves always eager to learn more, whether to develop their didactic skills or to find innovative teaching methods that help students to take charge of their own learning process.

Our aim remains clear: to inspire the next generation of scientists and set them on their own road to discovery.


@uva_science
Lex Kaper
(Vice-Dean,
Director of Education)

INTERVIEW
LUCY WENTING, DIRECTOR OF THE INSTITUTE OF INTERDISCIPLINARY STUDIES
GEERT BAKKER, STUDENT FUTURE PLANET STUDIES

Space for interdisciplinary experimentation

'We cannot solve our problems with the same thinking we used when we created them.' These words, often attributed to Albert Einstein, might very well be the motto of the Institute for Interdisciplinary Studies (IIS). The Institute's penchant for experimentation makes it the UvA's incubator for innovative inter-disciplinary education.

Take the Pressure Cooker: an intensive programme in which students spend three days getting to the bottom of challenges faced by social partners. Or the 'Pandemic' elective, which deals with pandemics in the past, present and future and was developed during the COVID-19 pandemic, enabling IIS to begin offering it to all UvA students last autumn.

There is no such thing as a failed experiment

IIS director Lucy Wenting sees it like this: 'Not all of our educational experiments succeed, of course, but the ones that fail teach us something as well. We need this opportunity to experiment since we are, above all, an institute that wants to address social issues and respond quickly to current themes. I feel privileged to have the chance to do this as an institute.
We are given the space to innovate and experiment with new courses, new minors and other forms of interdisciplinary education.'

This builds on the vision Karel van Dam, emeritus professor of Biochemistry at the UvA, had in mind when he founded I2O (the predecessor of today's IIS) in 1996. Van Dam was convinced that where disciplines intersect, innovation takes place. This is why he was eager to better connect the various disciplines within the faculties' education and research, and to teach students – from the outset – to consider complex societal challenges or scientific problems from different perspectives.

But back to 2021. Van Dam's dream has been a reality for years. Today, interdisciplinary DNA runs through the institute's veins, as evidenced by the two broad Bachelor's programmes offered: Future Planet Studies and Natural and Social Sciences. Students can also follow two Master's programmes – Brain and Cognitive Sciences and Forensic Science – and there are many different elective courses and honours programmes on offer for the entire UvA community. The institute also boasts an education lab where interdisciplinary innovation projects are devised and implemented together with faculties.

Complex social problems

The IIS connects the various facets of its teaching activities through an interdisciplinary approach and a consistent outward gaze. And that attracts enthusiastic students who feel engaged with society, like Geert Bakker, a second-year student in the IIS Bachelor Future Planet Studies. 'Many students - myself included - recognise the importance of considering and reflecting on complex social problems during our time at university.
Thanks to our interdisciplinary degree programme, we are aware of the tendency to view problems from a one-dimensional perspective. Take climate change, for example. This is more than just a problem of excess CO_2. In order to take control of climate change, and to really understand it, you have to realise that it's not only a technical problem, but a social one as well.'

Wenting notes: 'This complexity of problems is why IIS exists. Now, I'm not saying that every degree programme should be interdisciplinary. But I would like every student to be familiar with these complex issues.
I think it's important that students be given the opportunity to make a foray into other disciplines. That way we can train young professionals who are actively engaged with the world around them and are able to help think constructively about possible solutions.'

Social transitions

In the coming years, IIS will focus not only on interdisciplinary and transdisciplinary education, but on social transitions as well. To that end, the institute is working to realise even stronger connections between external stakeholders – such as municipalities, NGOs

and consulting firms – and the Bachelor's and Master's programmes, minors and other study programmes it offers. Co-creation will play a central role in those efforts.

Wenting elaborates: 'If we want to advance our society, I am convinced we will need knowledge about social transitions and how to achieve them through education and research. Take the internet, for example. It has developed incredibly quickly. But might that development have been too fast? Shouldn't we pause for a moment and, as a society, start anew and redesign it according to the values we hold dear?'

Creativity

Making that change will require creative thought. Robbert Dijkgraaf, former professor at the Faculty of Science and the current director of the Institute for Advanced Study (IAS) in Princeton (USA), once said, 'Creative scientists should be allowed their freedom.'

The IIS offers lecturers and academics from all UvA faculties that freedom to experiment with education. This is how the successful Bachelor's programme in Future Planet Studies was launched. The IIS also provides annual grants to lecturers for the development of new teaching methods and curricular content.

And students are naturally involved as well. For a few years now, the Create a Course Challenge has offered students the opportunity to submit ideas for new interdisciplinary courses. The best proposals are actually developed into elective courses by a number of education experts, working together with the students.
In 2020, the Challenge yielded 178 ideas. The five ideas that made it to the final round addressed topics such as digital warfare, crisis communication and queer culture in Amsterdam.

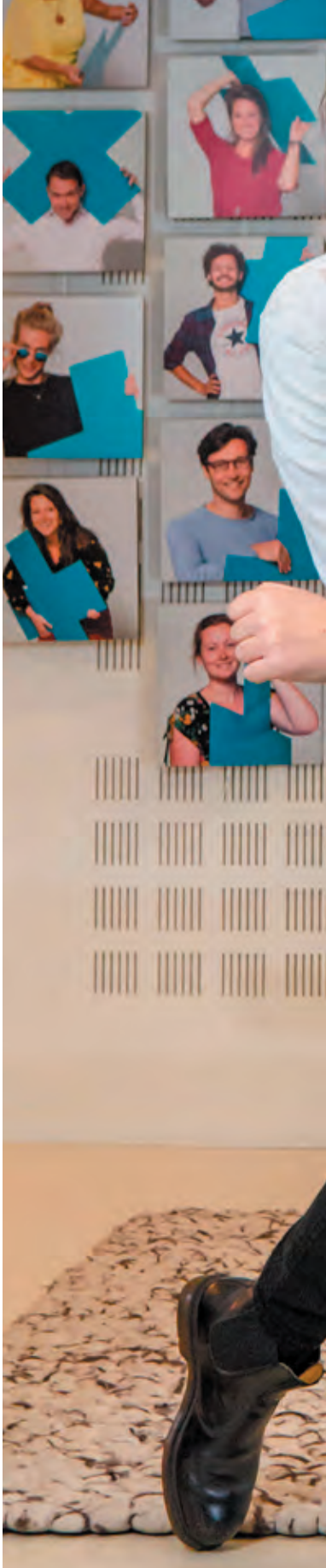
New Bachelor's programme

The IIS continues to innovate. The institute is currently collaborating with the Faculty of Science to structure the Makerspace for the new Science & Design Bachelor's programme.
In this programme, students from various disciplines will work together to design and develop materials. Social Data Science, another new interdisciplinary Bachelor's programme, is in the final stages of accreditation. This programme was set up by lecturers and researchers from the Faculty of Social and Behavioural Sciences, the Faculty of Science and the Faculty of Humanities. Right from the start, students will take part in digital innovation projects concerning topics such as sustainability, health, mobility and social equality.

'While the subject matter is obviously very interesting and topical, it's not necessarily easy. The great thing is that these lecturers, who work at different places at the UvA, become acquainted through their teaching activities. This is our way of using knowledge sharing to build a close-knit community,' concludes Wenting.

Inspired lecturers

And it is precisely these lecturers who are the indispensable foundation of the IIS. Because, as Bakker emphasises, good education relies on competent, enthusiastic lecturers. 'I have noticed – and continue to see – that these lecturers make a difference for many students. Which is vital, particularly in these times of online education. You can learn a lot from passionate lecturers who are experts in their field. That's why I enrolled at university in the first place. I want a glimpse into their knowledge because it offers me a basis for further exploring a given subject on my own,' Bakker concludes. ■



Lucy Wenting has been director of the Institute of Interdisciplinary Studies since 2010. She studied Philosophy and Political Science at the UvA and is specialised in leadership, strategy and curriculum development. **Geert Bakker** is a second-year student of Future Planet Studies.

University of Amsterdam
Institute of Inter
plinary Studies

Education highlights

Stanley Brul
Jacobijn Sandberg
Marcel Vreeswijk
Morten Strömme

COLLEGES OF SCIENCE, LIFE SCIENCES AND INFORMATICS GET DIRECTORS

The Faculty of Science appointed three directors of education to its three newly established distinct disciplinary colleges. Stanley Brul (SILS) became director of the College of Life Sciences. Jacobijn Sandberg (IvI) became director of the College of Informatics. Marcel Vreeswijk (IoP) became director of the College of Science.

Appointment of the new directors supports the colleges in making more strategic choices concerning their educational focus, resolving capacity issues and filling vacancies. Overall, the new organisational structure strengthens the relationship between teaching and research within the Faculty of Science and alignment of the programme portfolio with current research areas.

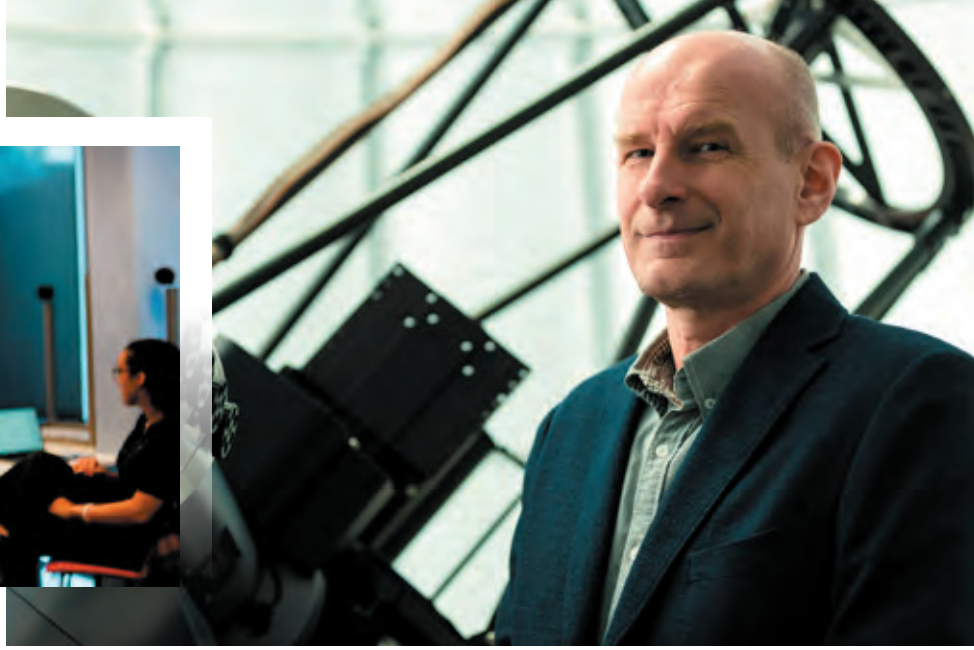
PROJECT LEADER FOR SCIENCE AND DESIGN BACHELOR'S PROGRAMME

A new Bachelor's programme in Science and Design is closer to becoming a reality thanks to appointment of Morten Strömme as project leader. This envisaged programme will train students in science, experimentation, modelling and design, all with the aim of solving societal challenges by applying and developing advanced technology.

Along with Chris Slootweg (HIMS) and Jacobijn Sandberg (IvI), Strömme is tasked with outlining and piloting crossover projects from different disciplines, establishing requirements for a makers lab and uniting stakeholders within the faculty and within Amsterdam Science Park, the city council and the University of Applied Sciences (HvA).

COMPUTER SCIENCE AT THE UVA AND IVI MAKE TOP WORLD RANKINGS

Computer science is included among eight disciplines at the UvA that made it to the top 100 in their field, according to the Times Higher Education (THE) World University Rankings by Subject 2020-2021. In the subject of computer science and information systems, the 2020 QS World University Rankings placed the Informatics Institute (IvI) at 45 worldwide. Within Europe, it holds the 12th place of all computer science departments.



Alex de Koter, Faculty Lecturer of the Year

FACULTY LAUNCHES UNIQUE LECTURER DEVELOPMENT PROGRAMME

The Faculty of Science appointed 19 new junior lecturers for a four-year period through its new Lecturer Development Programme. This unique programme – the Faculty of Science is the only UvA faculty to offer one – reserves 0.1 FTE of the lecturer's contract to their own personal and professional development.

In an online kick-off meeting, Vice-Dean Lex Kaper welcomed the brand-new lecturers. He explained that while teaching has traditionally been a task for researchers, thanks to the growing number of students enrolled at the Faculty of Science, 35 per cent of education is now being provided by lecturers who do not have a research appointment. 'This makes junior lecturers an important and essential part of the Faculty,' he said.

Kaper went on to say that the new Lecturer Development Programme was designed especially for this group. The programme enables lecturers to get training that hones their teaching skills and support in exploring their career prospects. The latter element anticipates the possibility that, when their four-year contracts end, not everyone will be able to transition into another position at the university.

The UvA's Teaching and Learning Centre is providing didactical training during the first three years of the programme on various issues, including creating a safe learning environment and motivating students. In addition, the lecturers can obtain their University Teaching Qualification (commonly known by the Dutch acronym BKO). Participants are also guided in time management, learn how to recognise their own unconscious biases and receive help from a coach if they encounter problems during their lectures.

Before the kick-off meeting concluded, the lecturers had the chance to talk in breakout sessions. 'I like teaching, but dealing with unmotivated students is something I always find challenging,' said one participant. 'It would be great to have some guidance on this.' Another lecturer noted she was eager to learn how to explain complex subjects: 'How can I come up with effective assignments to go along with them?' A third participant expressed wanting to work on achieving a good work-life balance.

ALEX DE KOTER VOTED FACULTY OF SCIENCE LECTURER OF THE YEAR

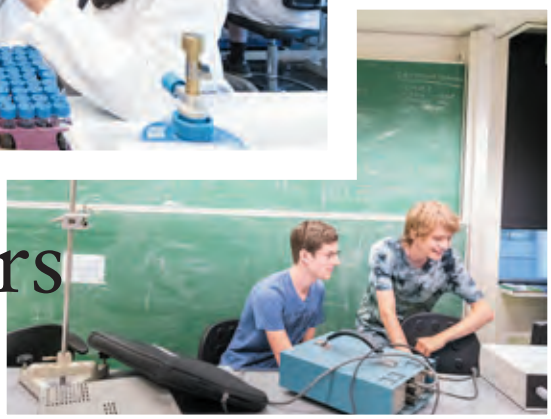
Receiving the most votes by students and staff within the Faculty of Science, Alex de Koter was named Faculty Lecturer of the Year. De Koter has worked at Anton Pannekoek Institute (API) since 1997, and was appointed professor of Astrophysics at the start of 2020. Students praised him for having good stories and knowing all his students by name. API colleagues called him 'a man with a great, genuine interest in what moves his students' who 'always tries to put himself in the other person's shoes'.

COMENIUS TEACHING FELLOW GRANT FOR ERWIN VAN VLIET

The Netherlands Initiative for Education Research (NRO) awarded a Comenius Teaching Fellow grant to Swammerdam Institute for Life Sciences (SILS) lecturer Erwin van Vliet for his IGuideME project. IGuideME is an app meant to encourage student engagement and facilitate feedback. Van Vliet sees the app as a possible answer to the problem of students being taught in large groups and rarely getting feedback until getting a summative assessment in the form of a mark.

ADVANCED UTQ CERTIFICATES

Certificates in Advanced University Teaching Quality – UTQ for short, though commonly known by the Dutch acronym SKO – went to six members of the Faculty of Science. This group included lecturers Ana Oprescu, Jan Pieter van der Schaar, Rob Schuurink, Arie Vonk, Evangelos Kanoulas and Valeria Krzhizhanovskaya. Throughout the Advanced UTQ programme, lecturers are meant to work on their own project within a curriculum, demonstrably applying what they have learned on the job. They also formulate a personal learning question to address during coaching and meetings.



Students as researchers

LAB CREATES 3D RECONSTRUCTIONS OF ARCHAEOLOGICAL OBJECTS

The Faculty of Science's Visualization Lab developed an augmented reality application that places 3D reconstructions of archaeological objects in a learning environment. The application is the fruit of work by student Sander Hansen, at the time pursuing the Bachelor's in Computer Science, and the 4D Research Lab within the Faculty of Humanities. 3D modelling makes fixed objects in museums interactive, offering a new approach for analysing data and a kind of virtual tangibility that can help pique students' curiosity.

AI STUDENTS FIND FATAL FLAW IN FAMOUS TRAVELING SALESMAN PROBLEM

A replication study by Informatics Institute (IvI) researcher Daan van den Berg and his three students Joeri Sleegers, Richard Olij and Gijs van Horn contested an influential 1991 study's finding that not all distance matrices are equally hard. This has implications for the traveling salesman problem, which involves finding the shortest tour along cities on a map. Their findings were published in June in Operations Research Perspectives. Their article title 'Where the really hard problems aren't' nods to the 1991 study's title 'Where the really hard problems are'.

GOOD YEAR FOR AI RESEARCH

It was a prolific year for UvA students working on artificial intelligence (AI), resulting in virtual conference presentations, publications and receipt of a Best Research Paper Award.

The EvoStar 2020 conference, organised by the Society for the Promotion of Evolutionary Computation in Europe and its Surroundings, published in its proceedings an extract from Joeri Sleegers' AI Master's thesis. It also published a part of Marleen de Jonge's Bachelor of Science thesis as a late breaking abstract.

ECTA 2020, the 12th International Joint Conference on Computational Intelligence, published additional papers by Sleegers and De Jonge. Sleegers won the Best Research Paper Award.

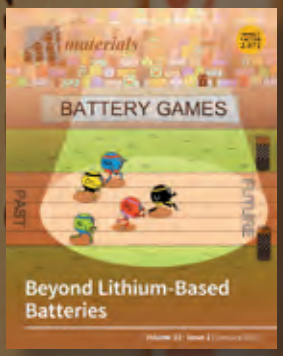
GECCO 2020, the Genetic and Evolutionary Computation Conference, gave Igor Pejic the opportunity to present the first half of his AI Master's thesis. GECCO also published a paper co-authored by AI Master's student Reitze Jansen, computational science Master's student Yannick Vinkesteijn and IvI researcher Daan van den Berg.

ICCC'20, the International Conference on Computational Creativity, published a paper co-authored by AI Master's students Redouane Dahmani and Arne Meijs and information studies Master's student Sven Boogmans with Van den Berg.

Publications & awards

HIMS STUDENTS PUBLISH ON LITHIUM-ION BATTERIES

As Master's students within the sustainable chemistry research priority area at the Van't Hoff Institute for Molecular Sciences (HIMS), Peter Jungbacker and Tess van Teijlingen studied the pros and cons of the most promising alternative materials for lithium-ion batteries. They co-authored an article published in January in *Materials*.



EAST-WEST SEED GRADUATION PRIZE FOR PLANT SCIENCES

Daniel Pérez Pinedo, an alumnus of the Master's in Biological Sciences, won the East-West Seed Graduation Prize for Plant Sciences. Worth €5,000, the award was for his thesis reconstructing paleovegetation composition in Myanmar across the Eocene-Oligocene Transition (EOT), a major global cooling event that took place about 33.9 million years ago. He worked under the supervision of IBED associate professor Carina Hoorn and PhD student Huasheng Huang.

UVA THESIS PRIZE TO AI ALUMNUS

Sindy Löwe, an alumnus of the Master's in AI, won the UvA Thesis Prize 2020. Her thesis described a new algorithm for training neuronal networks and gives a better explanation for the way cerebral neuronal networks learn. The jury found that Löwe demonstrated the ability to develop a ground-breaking, innovative idea at a high academic level in a scientifically sound manner. She is now a PhD student at the Informatics Institute (IvI).

YOUNG TALENT AWARD

Five UvA students received the Young Talent Award, worth €500 and issued by the Royal Holland Society of Sciences and Humanities (KHMW). The award recognises students who best perform within their class during their first year of study within an exact or technical science. This year's award winners are Emiel Wiedijk (for mathematics), Alex Hanrath (for physics), Emil Hodžić (for chemistry), Erik Buis (for computer science) and Mira Mioch (for biology).

LORENTZ GRADUATION AWARD FOR THEORETICAL PHYSICS ALUMNUS

Lotte Mertens, an alumnus of the Master's in Theoretical Physics, won the Lorentz Graduation Award for Theoretical Physics, issued annually by the Royal Holland Society of Sciences and Humanities (KHMW). Her prize-winning thesis studies the relation between quantum mechanics at the microscopic level and the measurements we make of it at much larger scales. Mertens is now a PhD student at the Institute of Physics (IoP).

ECHO AWARD

Marwa Ahmed, an alumnus of the Master's in Biomedical Sciences, won the ECHO Award 2020 in the category of science and technology. Ahmed is one of two UvA students who won this award, annually given to highly talented individuals of non-Western background who demonstrate outstanding social involvement.

Asked about the award, Ahmed said: 'I have had my doubts about initiatives like this in the past because I didn't know if I wanted to be treated in a different way because of my background, but those doubts are gone. I wish there was no need for initiatives like this. But as of now, it is simply necessary.'

INTERVIEW
PETER VAN TIENDEREN, DEAN OF THE FACULTY OF SCIENCE
HILAL DEMIREL, STUDENT ASSESSOR
MANISH JHINKOE-RAI, CHAIRPERSON OF THE FACULTY STUDENT COUNCIL (2020-2021)

20 years Faculty of Science

Two excavators are busy. A man with a helmet is coiling a cable. There's a strong wind, turning the otherwise quiet construction site at the Science Park into a sandstorm.

The new building may be the pride of the Faculty of Science, but there's not much to see right now, so Dean Peter van Tienderen and students Hilal Demirel and Manish Jhinkoe-Rai walk a little farther looking for a suitable spot for a photo. Around the corner, with a bit more shelter from the Science Park 904 building, it's off with their coats and time for a couple of quick photos.

THIS INTERVIEW WAS PUBLISHED ONLINE IN DECEMBER 2020 AS PART OF AN INTERVIEW SERIES MARKING THE FACULTY OF SCIENCE'S 20TH ANNIVERSARY

Taking photos inside isn't forbidden, but as Van Tienderen explains, the rule is that you have to wear a face mask when you're not in your workspace. We walk past the distinctive stairs in the centre of the building that connect the labs with the workspaces. Photographer Liesbeth Dingemans seizes her chance. Everyone smile! Only, well, those face masks ...

Van Tienderen, Demirel and Jhinkoe-Rai are pleased to be back at university. Van Tienderen says most of his meetings are now online. 'It works, but it's not as nice; you miss the casual contacts. You're not going to book a Zoom meeting just for a quick question. The advantage is that most people in my online meetings already know each other, which makes it easier to crack a joke and discuss things in a relaxed way. I think it must be very hard for new first-year students.'

Demirel picks up on that comment. 'I started this academic year with a major in Pedagogy. I didn't know anyone. It's really nice to be able to meet with a group for at least an hour every two weeks.' She also has one hour of contact time every fortnight: a seminar. Jhinkoe-Rai is less lucky; he doesn't have any in-person meetings at the moment. 'All of the student council meetings are online too. It's weird, different from normal, but you get used to it,' he says.

Drugs

They're slowly getting used to dealing with the COVID-19 pandemic and the associated protocols. Some practical problems are yet to be tackled. 'One of the challenges is to find a suitable work placement position for all students,' says Van Tienderen. 'Luckily, the faculty has good connections with the business community.'
Jhinkoe-Rai agrees. 'I've been to several companies for my The Analytical Chemist in Industry course. My final placement will be with the Amsterdam Police for my Master's thesis. I'm going to research substances that are not yet illegal, but are actually similar to certain types of drugs. Chemistry is everywhere.' When he starts talking about this research, Jhinkoe-Rai's eyes light up. 'I took a course with Arian van Asten, what a lecturer! He talks about his subject with such passion, every lecture is like watching an episode of NCIS. I'm really lucky to be able to do my research with the police.'

Dinosaurs

We keep walking through the building. Van Tienderen points out the recently constructed new study spaces, built above a number of large research areas. 'It will be a while before the new building is completed, but in the meantime, every square metre is being put to good use.'
There are a few students working. We don't want to bother them for long, so we walk towards the Science Lounge. It's a meeting room with a large table, which features a landscape with dinosaurs instead of a classic floral arrangement.

'It's funny, isn't it?' says Demirel. I'd love to sneak in a few more.' 'I don't like it,' Van Tienderen laughs. 'I'd be happy if you took it with you!'

During a short round of introductions, Demirel mentions she's a student assessor. What does that mean? 'The directors and the dean have a lot of contact with the student council, which represents students' interests. But there's still a gap between the student council and the board above it. As a student assessor, I'm trying to bridge the gap and reduce that distance. I attend board meetings and provide the student perspective.' Jhinkoe-Rai adds: 'There's a set protocol in the student council: if something happens, a file is created and the issue is discussed with the board.' Demirel says, 'For me, it's more like if there's something going on that doesn't have a file yet, I can easily discuss it with the dean.'

'That's very useful for me,' says Van Tienderen. 'We catch up every week and talk about what's happening. I can also have something read and ask how it comes across. Things that might make sense from my perspective don't necessarily make sense to students.' He quickly adds: 'Not that Hilal represents the whole world and all students, but it's nice to hear a student's perspective.'

Gender-inclusive streetwear

Van Tienderen considers student participation to be very important, in terms of policy and education, as well as more informal matters. 'Last year, the student council suggested we come up with something to promote diversity and inclusiveness. So we created the Grassroots Science4all Fund, for which students and staff in the Faculty of Science can submit proposals.' The money is used to organise activities that promote diversity. Some of the proposals that have received money so far include a knowledge evening for local children and their families, homework assistance for students from a lower socioeconomic background and a fashion show of gender-inclusive streetwear, made from an innovative new material. 'The idea for Grassroots Science4all came from students and has become very successful,' says Van Tienderen. 'It's a good initiative. Together, we can achieve things I wouldn't think of by myself.'

Twenty years of the Faculty of Science

How has the Faculty of Science changed over the past twenty years? The students look at each other and laugh; Jhinkoe-Rai was in nappies twenty years ago, and Demirel hadn't even been born yet. But Van Tienderen can tell us a thing or two; he started at the UvA in 2001. 'Back then, only Biology was at the Science Park. Everything was smaller; we had a small building, we all went to the canteen together, there was fish on Fridays, that sort of thing.' Van Tienderen thought things were good back then, but he's not really nostalgic. 'Now that other programmes have come to the Science Park, there's a lot more interaction between them. It's really made a world of difference.' Both students say they're happy with the campus at the Science Park. 'It's a nice place, it still feels quite small, at least compared to Utrecht,' says Jhinkoe-Rai, who did -his Bachelor's at Utrecht University.

Van Tienderen thinks the enormous growth of the faculty, from 2500 to 7000 students, might be the biggest change. Every degree programme has grown, and some new courses have been added. To accommodate all those students, new lecture rooms have been built and the library has been downsized. Isn't that a shame? Demirel says, 'I've never felt the need to go to the library to look anything up.' Jhinkoe-Rai agrees. 'I could do my studies without physical books.'

Van Tienderen can't help but laugh. 'Things were very different twenty years ago. Even more so when I started, forty years ago!' He had to go to the library to read articles. He had to look things up on microfiche: small, semi-transparent sheets of plastic, printed with tiny writing. You magnified the writing with a kind of overhead projector. Once you knew where the article was, you could request it. 'You would send an stamped envelope to an author, and you would get the article sent back by post, usually weeks later!' The students can't imagine what that was like. Demirel points out that this would require a totally different way of studying. 'You'd have to plan a lot more. I can go online the night before a lecture, and with the click of a button I have access to every scientific publication.'

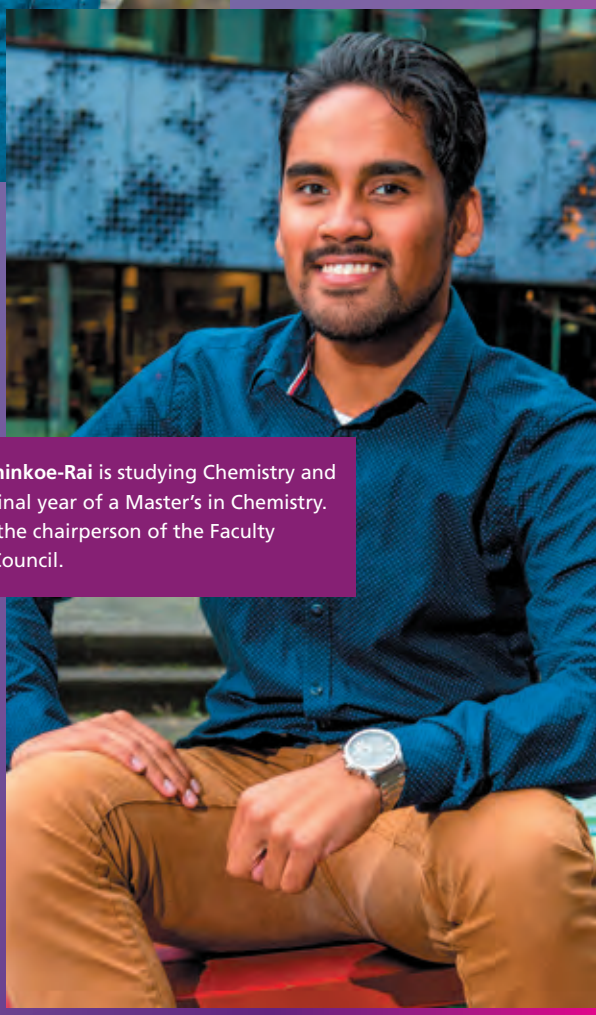
Collaboration

Van Tienderen says a lot has also changed in the area of research. 'You used to be personally involved in all aspects of the research, from setting up the experiment to taking the measurements, doing the analysis and writing articles. These days research is less of an individual endeavour; more collaboration is needed to produce the end product.' According to Van Tienderen, this requires new methods of teaching. 'Students have to learn different things, following the T model: not just in-depth knowledge, but the ability to cooperate with a broad range of people. Some degree programmes are now very specialised. It's good to remember that team performance is becoming increasingly important.'

Talking about the Faculty's past soon turns into a discussion about the future. Van Tienderen notes that today's students want to contribute to finding solutions to big questions, for example, in the field of climate and sustainability. 'One of the things we're working on is the new Science and Design programme. It's about translating our science into new organisms or new materials,' he says. 'You think of something, then design it. Transforming plants to make them more resistant, or developing new materials with highly predictable properties. Not just searching for the fundamentals, but also taking a new approach to searching, in terms of both depth and breadth.' Demirel and Jhinkoe-Rai find this development interesting, because they can see it happening around them: their fellow students want to contribute something, they want to solve concrete problems. Scientific research, applied in practice. Van Tienderen looks proud, saying: 'The students are the ones who ultimately have to do it.' ■

Hilal Demirel is a student assessor and second-year student in the Natural and Social Sciences Bachelor's. She is majoring in Pedagogical Sciences.

Peter van Tienderen studied Biology in Utrecht, obtained his PhD at NIOO-KNAW and did a postdoc in the United States. After several years of research in Wageningen, he was appointed professor of Experimental Plant Systems at the UvA in 2001. He was also director of IBED from 2005 to 2014. Van Tienderen has been Dean of the Faculty of Science since 2017.



Manish Jhinkoe-Rai is studying Chemistry and is in the final year of a Master's in Chemistry. He's also the chairperson of the Faculty Student Council.

Students on

Emma van Osch

Psychobiology

I haven't seen all of my friends for over a year now, and since I'm nearing graduation, I don't know that I still will.

Hats off to Erwin van Vliet and Taco Werkman. They taught neuropharmacology and pathophysiology, and did a great job despite the Coronavirus. And thanks to all the teachers for being willing to put their heads together with ours to best get through this situation!

Hidde Ferwerda

Biology

Right before the pandemic, I moved into a place with three other students. Since we all had to stay home, we got to know each other faster and better. I also had more time to play guitar, tend to my plants more consistently and build a vegetable garden.

André de Roos, Jasper Croll and Ben Martin created a very enjoyable and instructive quantitative biology course – with fun online *borrels* too.

Jetske Ribbers

Physics and Astronomy

This past year I had so much time to watch Netflix, I now have nothing to watch anymore, so I do other things, like reading, running and studying.

Student life no longer exists, and that's a major shame. After this year, I'll never again complain about how early I have to get up, how busy the train is, how heavy my bag is or how far it is to walk to Building G.

Rianne van Diest

Chemistry

I was able to finish my Bachelor's project, for which I was allowed to spend much time at Science Park.

Compliments to all the teachers for doing all they could during lockdown, such as creating open-book exams, so students wouldn't have to deal with complicated proctoring rules, and taking the time at a lecture's start to ask how everyone is. Programme director Sape Kinderman and study advisor Ambi Oosterhout put a lot of effort into supporting and helping too.

Lex Slort

Mathematics

It was a strange year, with many ups and downs for me, but I came out stronger than I went in. I started my own tutoring company, Bijlex. The business has grown fast, and is now a big part of my daily life.

As a lecturer, Guus Regts was really great to have, very cooperative, very solution-oriented and also would take every complaint or comment very seriously.

Maartje de Kroon
Biomedical Sciences
Before, I used to commute about an hour. Now before class, I could exercise almost every day. I thank Henriëtte Bout for the amazing conversion of our course to a Zoom version.

2020 was my first year as a student information officer. It feels special to help prospective students in their decision-making, and I'm looking forward to doing this in a large lecture hall filled with people instead of via screen!

Renske de Leeuw
Information Studies
2020 was mostly very boring, but I learned better how to deal with boredom. Just chatting with someone became a lot harder because everything feels so formal on Zoom.

Fortunately, I didn't have any educational setbacks and passed all my courses. I thank Hannie van Hooff for the refreshing classes online. Her experiments in cognitive psychology managed to keep everyone awake on the other side of the screens.

Emo Maat
Computer Science
This past year, through part-time studies in Philosophy I learned that writing a lot is really not my thing. I have since enrolled in Artificial Intelligence full-time. I missed walking around the UvA, seeing people, saying 'hello' and chatting. Nowadays, it's sitting at home and talking to, at most, five people weekly.

Leo Dorst is a legend and the teacher who struck me most, especially after he started talking fanatically about Lego.

Simon Stallinga
Artificial Intelligence
I have a nice group of friends within the university, which helped me in my courses and beyond. I also got two great university jobs, as a student information officer and as tutor.

It was probably not easy for the teachers either. So a big compliment to all lecturers who did their best to keep the classes interesting and interactive, despite the hurdle of online learning.

their 2020

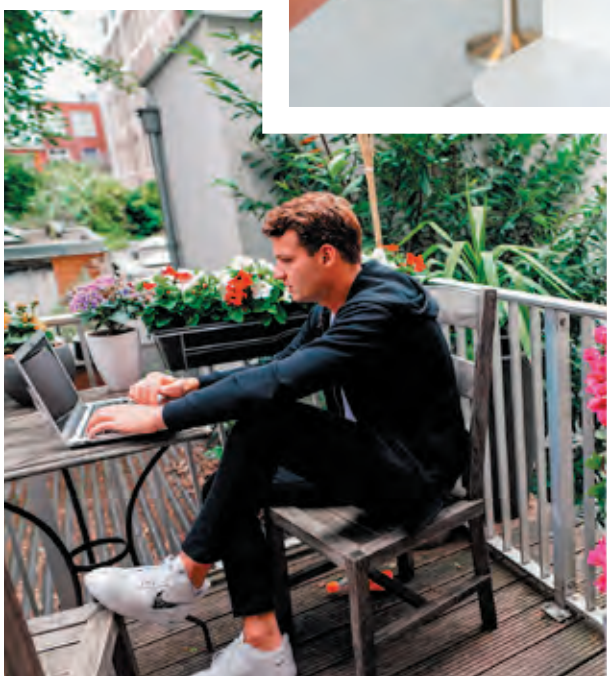
THE YEAR OF THE COVID-19 PANDEMIC

Coen van den Elsen
Natural and Social Sciences
Not having to be at university by 9 am, I got a lot more sleep! Pre-recorded lectures also allowed for more liberty in planning my week, although I much prefer 'the real thing'.

Jarik Guijt well led us and helped us deal with the pandemic. Study advisor Anna Holland also gave very good guidance. But as much as we all tried our best, online teaching just doesn't compare. Hopefully we can soon return to uni!

Teun Bastiaans
Future Planet Studies
Having to spend a lot of time in my room made me think a lot about everything, sometimes too much so. This gave me a better understanding of what is important and where I want to invest energy.

In 2020, I missed new perspectives and insights from others, which energises me and broadens my worldview. Donya Danesh, a workgroup teacher, was proactive in bringing a social dimension back into our online lectures.

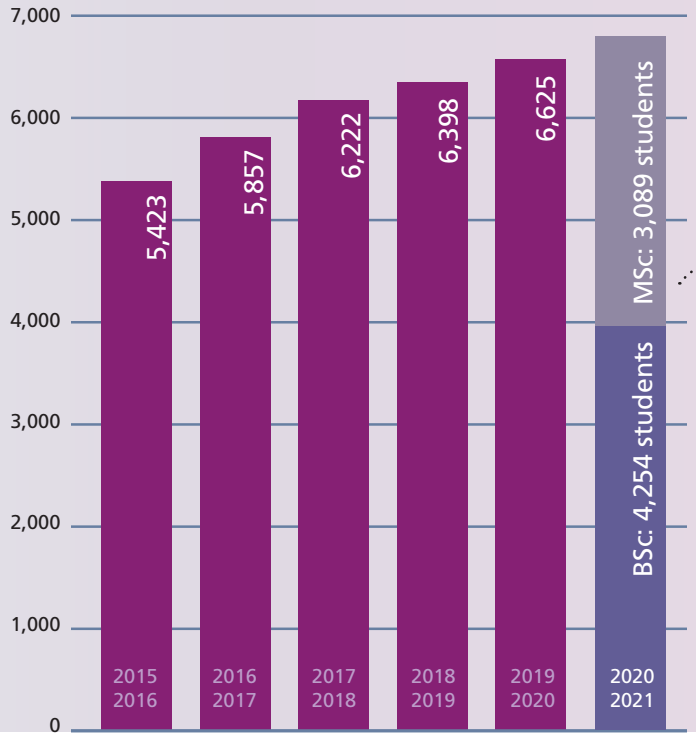


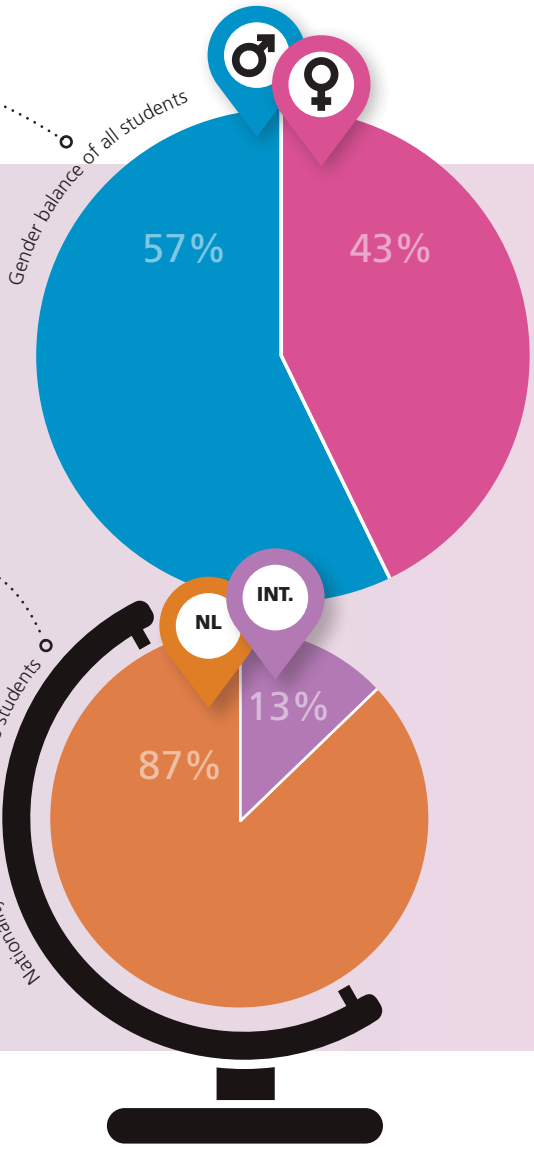
Students facts & figures

TOTAL STUDENTS 2020-2021

FULLTIME

6,861 students



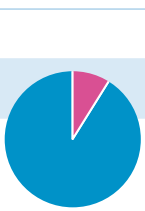


BACHELOR'S STUDENTS

FULLTIME | ALL PROGRAMMES TAUGHT IN DUTCH

ARTIFICIAL INTELLIGENCE

students	416	▼ 3%	109
first year enrolment*	122	▲ 24%	



25% female
75% male

* enrolment quota

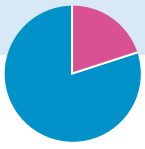
COMPUTER SCIENCE

students	376	▲ 1%	59
first year enrolment	110	▼ 19%	

9% female
91% male

INFORMATION SCIENCE

students	345	▲ 10%	57
first year enrolment	120	▲ 4%	



22% female
78% male

▲▼ compared to final figures of 2019-2020

BIOLOGY

students	185	▲ 9%	39	48% female
first year enrolment	59	▲ 9%		52% male

BIOMEDICAL SCIENCES

students	368	▲ 4%	82	65% female
first year enrolment*	132	▲ 14%		35% male

* enrolment quota

PSYCHOBIOLOGY

students	700	▲ 6%	142	80% female
first year enrolment*	241	▲ 9%		20% male

* enrolment quota

CHEMISTRY*

students	189	▲ 13%	22	37% female
first year enrolment	53	▲ 15%		63% male

* joint degree with VU Amsterdam

MATHEMATICS

students	228	▲ 3%	33	21% female
first year enrolment	70	▼ 14%		79% male

PHYSICS AND ASTRONOMY*

students	449	▲ 12%	67	20% female
first year enrolment	146	▲ 23%		80% male

* joint degree with VU Amsterdam

FUTURE PLANET STUDIES

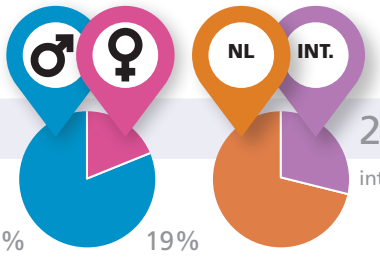
students	577	▶ 0%	125	55% female
first year enrolment	152	▼ 3%		45% male

NATURAL AND SOCIAL SCIENCES

students	421	▼ 2%	108	52% female
first year enrolment	121	▼ 16%		48% male

MASTER'S STUDENTS

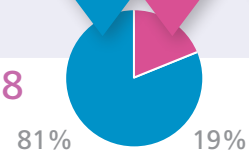
FULLTIME | ALL PROGRAMMES TAUGHT IN ENGLISH



ARTIFICIAL INTELLIGENCE

students	367	▼ 8%
first year enrolment	128	▲ 33%

138

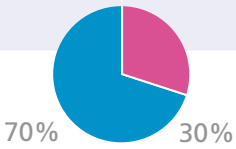


29% international

COMPUTATIONAL SCIENCE*

students	203	▲ 20%
first year enrolment	90	▲ 29%

32



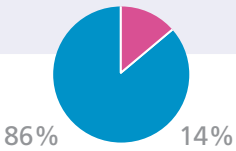
30% international

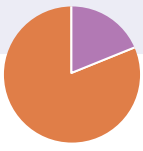
* joint degree with VU Amsterdam

COMPUTER SCIENCE*

students	83	▲ 28%
first year enrolment	12	▼ 29%

54





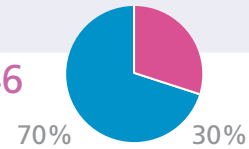
19% international

* joint degree with VU Amsterdam

INFORMATION STUDIES

students	247	▲ 7%
first year enrolment	192	▲ 36%

146

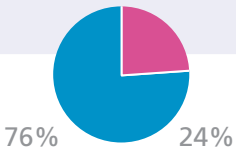


29% international

LOGIC

students	139	▲ 14%
first year enrolment	52	▲ 6%

22

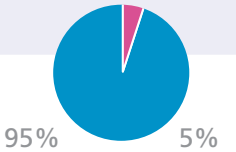


61% international

SOFTWARE ENGINEERING

students	64	▲ 56%
first year enrolment	39	▲ 117%

18

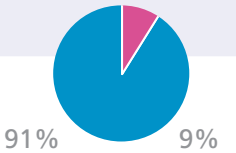


16% international

SECURITY & NETWORK ENGINEERING

students	35	▼ 22%
first year enrolment	17	▼ 43%

27

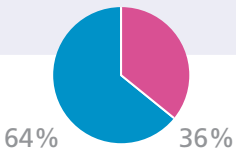


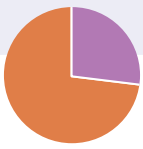
11% international

BIOINFORMATICS AND SYSTEMS BIOLOGY*

students	81	▲ 33%
first year enrolment	11	▼ 39%

33





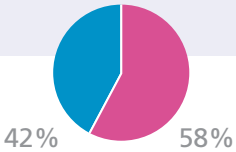
27% international

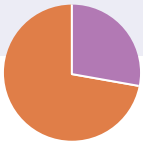
* joint degree with VU Amsterdam

BIOLOGICAL SCIENCES

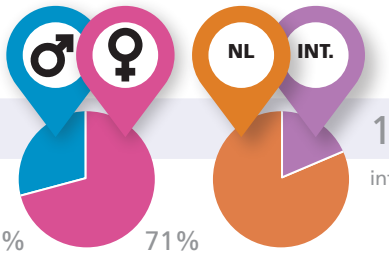
students	215	▲ 17%
first year enrolment	79	▲ 68%

42





25% international



BIOMEDICAL SCIENCES

students	495	▲ 5%
first year enrolment	154	▼ 12%

112 | 29% | 71% | 19% international

EARTH SCIENCES

students	89	▼ 3%
first year enrolment	23	▲ 5%

26 | 45% | 55% | 43% international

CHEMISTRY*

students	344	▲ 3%
first year enrolment	63	▲ 13%

108 | 56% | 44% | 17% international

* joint degree with VU Amsterdam

MATHEMATICAL PHYSICS

students	1	▼ 50%
first year enrolment	no new students allowed*	

1 | 100% | 0% international

* programme ends in 2021

MATHEMATICS

students	111	▲ 13%
first year enrolment	44	▲ 52%

25 | 82% | 18% | 21% international

PHYSICS AND ASTRONOMY*

students	352	▲ 4%
first year enrolment	135	▼ 1%

103 | 73% | 27% | 34% international

* joint degree with VU Amsterdam

STOCHASTICS AND FINANCIAL MATHEMATICS

students	37	▲ 61%
first year enrolment	20	▲ 67%

5 | 65% | 35% | 51% international

FORENSIC SCIENCE

students	91	▲ 3%
first year enrolment	31	▼ 16%

26 | 24% | 76% | 34% international

BRAIN AND COGNITIVE SCIENCE RESEARCH MASTER

students	135	▼ 1%
first year enrolment	49	▲ 29%

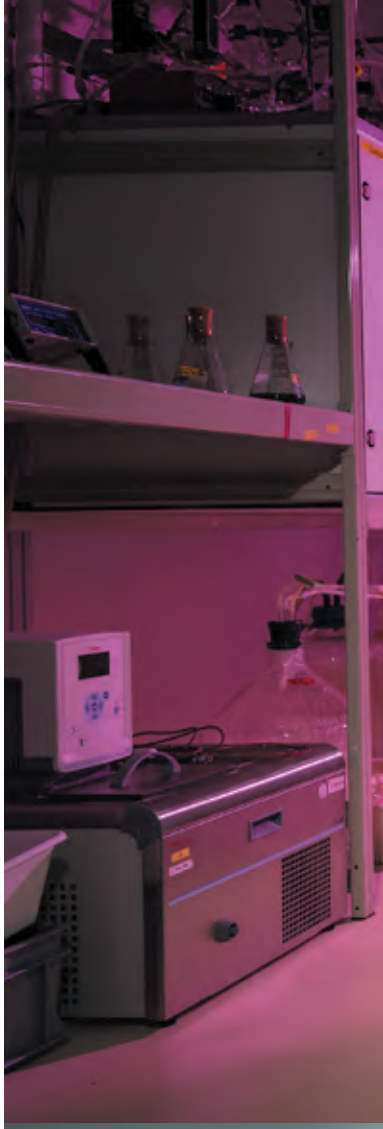
47 | 27% | 73% | 44% international

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. Our eight research institutes cover the full range, including astronomy, life, earth, physical, molecular, mathematical and information sciences. Whether our chosen instrument is a microscope or a telescope, whether we are unraveling the origins of life on Earth or shaping its future for generations to come, we share with each other a curiosity that knows no bounds.

But our interest goes beyond satisfying our own curiosity; we want our research to have impact. Collaboration is a given. We enthusiastically work with each other, with colleagues from neighbouring institutes at Amsterdam Science Park, with national and international peers and with partners from across industries and society at large. Our often fundamental research gets boosted through collaboration with partners that are experienced at applying science in society. Positioned at the beginning of the knowledge value chain, our research has the potential to lead to innovation and new products through further development in society and industry. The many examples in this magazine illustrate that road from curiosity to impact.



Grants 2020

Dutch Research Council

VENI

Dr Michelle Achlatis
IBED | Their day in the sun: the ancient collaboration between marine sponges and their photosynthetic symbionts
In marine sponges, symbiotic microbes harvest sunlight and feed the organism with sugars. Achiatis uncovers how sponges and microbes collaborate and evaluates their sun-driven biomass production on coral reefs.

Dr Antonija Oklopčić
API | How exoplanets lose their atmospheres
Planetary atmospheres change and evolve over time, and can even escape from their planets. Oklopčić is working on new tools to investigate how extrasolar planets lose their atmospheres.

Dr Felix Wierstra
KdVI | New algebraic structures to describe geometric shapes
Topology is the study of geometric shapes, and topologists try to describe such objects with algebraic structures. Wierstra's goal is to develop new multiplications that describe geometric objects.

Dr Jeroen Smid
ILLC | Because of this part...
The reasoning that an aeroplane can fly because it has wings is an example of a part-whole explanation. Smid analyses such non-causal explanations using the influential counterfactual analysis of causal explanations to improve understanding of explanations.

VIDI

Dr Efstratios Gavves
IvI | Finding time in videos
Video is everywhere, but today's AI struggles to understand time in videos, rendering it unsuitable for applications such as autonomous driving and guiding medical devices and treatments. Gavves researches novel algorithms that can find time in videos.

Dr Arno Kret
KdVI | Shimura varieties and the Langlands conjecture
The Langlands conjecture is one of the most important unsolved problems in mathematics, as it unifies the theories of algebraic equations and of automorphic forms. Kret seeks to solve new cases of this conjecture.

Dr Guus Regts
KdVI | Counting using complex dynamics
Network colourings are of fundamental importance in statistical physics, computer science and theoretical psychology. Regts uses techniques from complex dynamics and combinatorics to develop efficient algorithms for counting such colourings.

Dr Susanne Wilken
IBED |'Planimals' in changing oceans
Several marine microbes can grow as plants or animals. More plant-like, they increase ocean carbon storage; more animal-like, they release carbon back into the atmosphere. Wilken's study investigates how these mixotrophs – or 'planimals' – respond to ocean warming and acidification.

VICI

Dr Jason Hessels
API | Fast & furious astrophysics
Using a unique network of radio telescopes that span the globe, Hessels and his fellow astronomers aim to understand what powers the recently discovered fast radio bursts originating deep in extragalactic space.

Dr Christof Monz
IvI | Multi-parallel neural machine translation
Because current approaches in multilingual neural machine translation only accomplish interlingual representations under limited conditions, Monz proposes novel translation models that allow for the exploitation of multi-parallel corpora. This can result in better interlingual representations and translation quality.

RUBICON

Dr Horng Sheng Chia
IoP | Probing the dark universe with gravitational waves
Gravitational waves offer new possibilities for observing the dark side of our universe. Chia uses those emitted by binary black holes to explore the study of dark matter in new ways.

National research agenda

Dr Antonia Praetorius (IBED) examines microfibres released into Dutch waters. The project works with citizens to assess how real-world habits – which clothes are laundered at which settings – affect the release of microfibers, a major source of microplastics in the environment.

Dr Meike Wortel (SILS) researches the role of evolution in the infant gut microbiome. The project explores how important the evolution of fast-growing microorganisms is and whether they are replaced by strains from the environment.

Prof. Sander Woutersen (HIMS) investigates how nature uses molecules such as ATP to prevent protein aggregation in cells. This research helps in understanding the origins of life, but also preventing diseases caused by protein aggregation, such as Alzheimer's and Parkinson's.

The BioClock consortium studies how to keep the biological clock healthy in today's 24-hour society. The six-year programme explores the effects of shift work, integrating the biological clock into the educational system, cancer immunotherapy and flu vaccinations timing, chronotherapy for depression and light pollution's consequences for animals. **Dr Joram Mul (SILS)** is on a team investigating exercise's effects on metabolic health. **Prof. Astrid Groot** and **Dr Gerard Oostermeijer (IBED)** are involved in projects that mainly deal with the influence of light pollution on nature.

The Dutch Black Hole Consortium (DBHC) seeks to discover more about black holes using the Event Horizon Telescope. DBHC comprises participants from API, IOP and their joint initiative known as Gravitation AstroParticle Physics Amsterdam (GRAPPA). They include **Prof. Sera Markoff, Prof. Jan de Boer, Prof. Frank Linde, Prof. Ralph Wijers, Dr Alejandra Castro, Prof. Jeroen van Dongen, Prof. Erik Verlinde, Dr Alessandro Bertolini, Dr Sarah Caudill** and **Dr Samaya Nissanke**.

A consortium led by **Prof. Sander Bohté (SILS)** is bringing human principles into AI solutions to better integrate smart machines in society, such as drones and self-driving vehicles. Their research considers how the brain works to chart out human behaviours that guide autonomous agents. Also from SILS, consortium members **Dr Jorge Mejias** and **Prof. Cyriel Pennartz** are working on brain-inspired AI algorithms for safe mobility.

Coordinated by physicist **Prof. Auke Pieter Colijn (IoP)**, a consortium of knowledge institutions and public stakeholders is studying relic neutrinos. These neutrinos from the cosmos created one second after the Big Bang have never been observed. To do so, the consortium is developing an experiment to investigate the decay of heavy-hydrogen tritium. Fellow physicist **Dr Shin'ichiro Ando (IoP)** is also involved in the project.

With **Dr Jelle Zuidema (ILLC)** serving as secretary, a consortium of universities, businesses and other organisations is researching the black box of deep learning. Their examination considers how deep learning can be transparent and explainable for speech text and music applications.

ERC & EC grants

STARTING GRANT

Dr Efstratios Gavves | IvI
Visual AI uses algorithms to explain past visual observations, but its next generation of algorithms must be able to predict and prevent. Gavves focuses on the computational learning of temporality and the automatic interpretation of possible future visual sequences.

CONSOLIDATOR GRANT

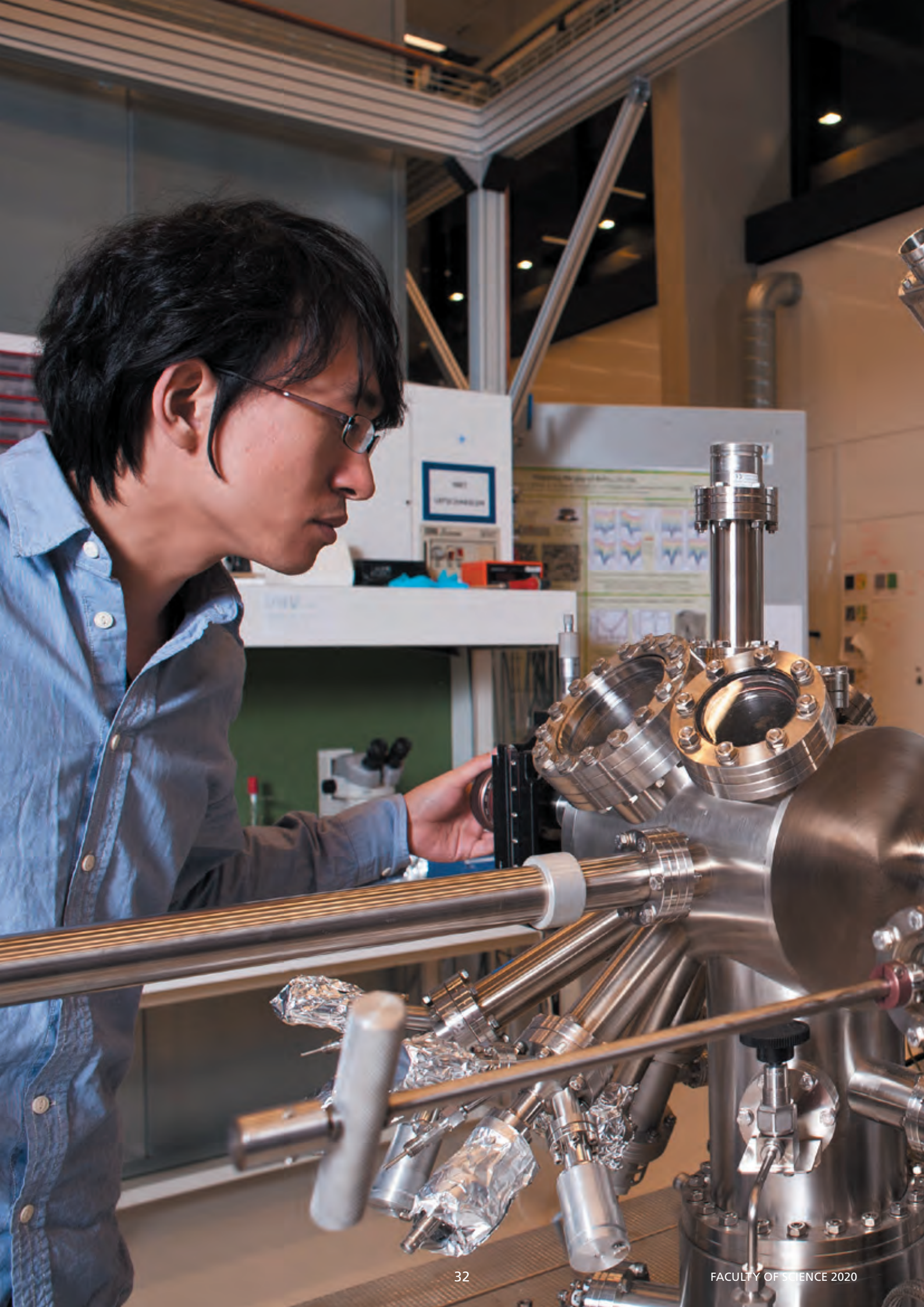
Dr Philipe Corboz | IoP
Studying quantum mechanical many-body systems is highly challenging, but data structures known as tensor networks are proving helpful. Corboz aims to develop the next generation of tensor network methods to tackle problems, such as high-temperature superconductivity and quantum spin liquids.

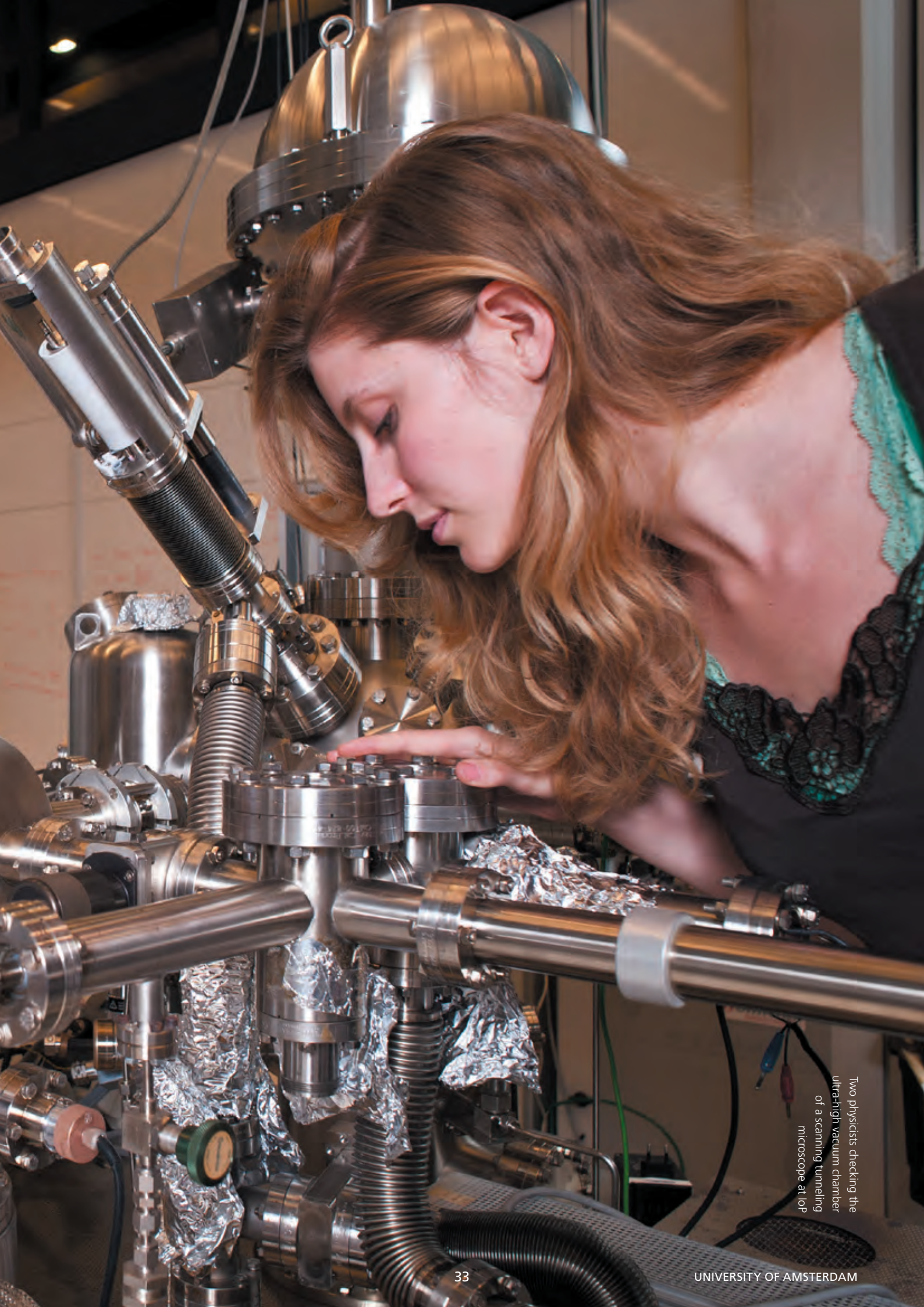
MARIE CURIE GLOBAL FELLOWSHIP

At **IBED, Dr Benjamin Mueller** researches DOM cycling through microbes and sponges. His project examines how changes in coral reef community composition affect the availability of produced dissolved organic matter, known as DOM, and its utilisation by planktonic microbes and sponges.

MARIE CURIE EUROPEAN FELLOWSHIP

At **IoP, Dr Rianne Lous** researches hybrid quantum systems in which ions are emerged in cold atomic gases. Her project probes the interactions between a charged impurity and a cold atomic bath.



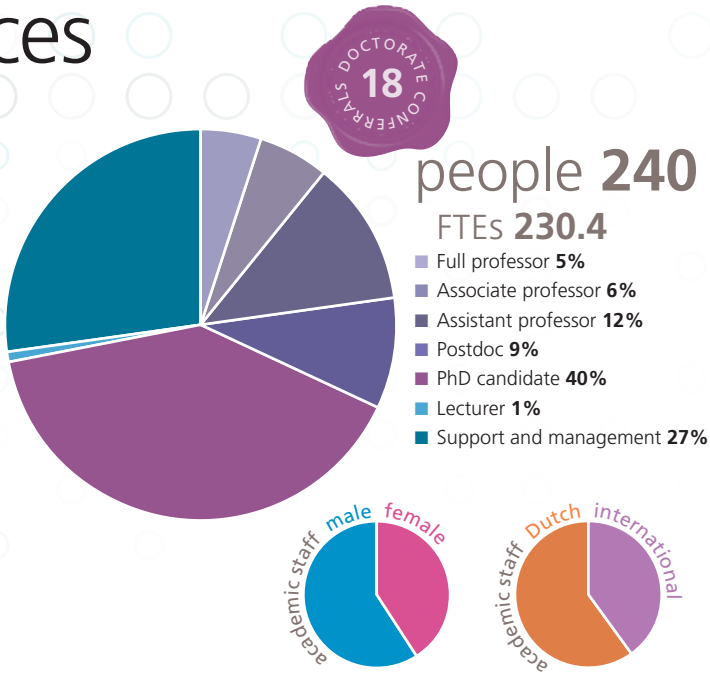


Two physicists checking the ultra-high vacuum chamber of a scanning tunneling microscope at IoP

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.

SILS team iGEM



Awards for team science, open science and synthetic biology

The Amsterdam Science Park Study Group won one of the first NWO Team Science Awards. To build a community of computational biologists and bioinformaticians, this group unites researchers from SILS and the Institute for Biodiversity and Ecosystem Dynamics (IBED). Team members collaborate on helping solve data analysis problems, sharing best working methods and honing their professional skills.

Joachim Goedhart, from the SILS research group Molecular Cytology, received an Open Science Use Case Award with co-researchers from Amsterdam UMC and Leiden UMC. Acknowledging work that makes research more accessible, transparent or reproducible, this award was for their development of a web tool for interactive data visualisation and data sharing.

SILS participated in the synthetic biology competition iGEM, short for International Genetically Engineered Machine, by hosting the Amsterdam team. Known as Forbidden FRUITS, the team won a silver medal for their proposed solution: a tool to design microbial production systems with stable, growth-coupled production.

Grants go to research on Parkinson's disease, food safety and COVID-19

Collaborations between SILS researchers and partners from various industries bore fruit this past year in the form of several grants.

Marten Smidt and Lars van der Heide received a proof-of-concept grant to continue work on identifying potential therapeutic targets in Parkinson's disease. Awarded by the Faculty of Sciences, a proof-of-concept grant provides the funding for a feasibility test that lets researchers determine whether an innovative idea or invention is ready for market. Smidt and Van der Heide focus on protein MCL1 role in the survival of dopamine neurons, which are selectively lost during the progression of Parkinson's disease. They want to strengthen MCL1 by identifying the protein E3 ubiquitin ligase that targets it for destruction. Inhibiting this ligase would prevent MCL1 degradation and boost survival of dopamine neurons, possibly halting the progressive decline of Parkinson's disease. Smidt and Van der Heide are founders of the pre-clinical research company Macrobian-Biotech, housed at SILS.

A second proof-of-concept grant went to Stanley Brul to test whether a method of mild temperature pasteurisation can completely kill microbial spores in food. This is especially relevant for food products, such as dairy, where high temperature is known to have a profound negative impact on flavour and composition of the food.

Brul was also co-recipient of a Physics2Market grant. He and fellow SILS researcher Ewelina Weglarz-Tomczak received the funding to test their idea of stopping COVID-19 from replicating by looking for molecules that inhibit an important coronavirus enzyme. As the research requires a special lab that allows experimentation with the real virus, they are working with Amsterdam UMC.

Ewelina Weglarz-Tomczak doing research on COVID-19

Bacteria made visible via microscopy. Photo: PxHere

Personal microbial health is a new research priority area

A new research priority area (RPA) at SILS aims to deepen understanding of the microbiome, a collection of microorganisms that live in a body. Shaped by genetic, immunological, cultural, socioeconomic, behavioural and environmental factors, the human microbiome is a major determinant of health. Plus, microbial misbalance affects the entire body. Tracking the microbiome-host interplay across contexts is therefore crucial for health and quality of life.

This new RPA on personal microbial health unites researchers focusing on epidemiological, translational or data modelling issues related to the gut or the oral microbiome. As a joint interdisciplinary network, it involves groups from SILS and the Informatics Institute (IvI), the UvA's Faculty of Social and Behavioural Sciences, the Academic Centre for Dentistry Amsterdam (ACTA) and Amsterdam UMC. The RPA links to those at the UvA that focus on urban mental health and systems biology and the project MiCROP, short for Microbial Imprinting for Crop Resilience.

Real-time imaging of bacteria in plants

Disease and pathogenic bacteria can afflict crops, leading to severe yield losses. A research group led by Harrold van den Burg worked with plant phenotyping technology company LemnaTec to develop a digital imaging system that tracks bacteria in living plants. Phenotyper, as the system is called, seeks to provide a better understanding of how pathogens invade a body through imaging the spread and growth of bioluminescent bacteria in plants.

To accommodate the phenotyping facility, the contained high-level biosafety compartment of the greenhouses had to be expanded. Researchers can now infect over 2,400 plants in a single experiment while automatically and unbiasedly scoring their disease severity.

'We are grateful for all help of our faculty and SILS that made this possible,' said Van den Burg.

INTERVIEW
EMILY BURDFIELD-STEEL, ASSISTANT PROFESSOR OF CHEMICAL ECOLOGY

Pokémon and a love of evolution

As a child, Satoshi Tajiri could often be found in the countryside around Tokyo. He felt more at home there than in the hustle and bustle of the Japanese metropolis. Among the trees, Tajiri hunted for insects, which he then added to his collection. When the flora and fauna surrounding Tokyo began to disappear at an increasing rate, Satoshi decided that he did not want to lose the pleasure of finding and collecting critters. He developed Pokémon, a computer and card game about fantasy creatures with an ability to evolve. Tajiri's world has much in common with that of IBED researcher Emily Burdfield-Steel: a love of insects, an interest in evolution and definitely Pokémon.

At IBED, the British-born assistant professor of Chemical Ecology is researching two types of social communication in insects: sexual communication and anti-predator communication.

How attract a male moth?

Briefly put, sexual communication is about how a particular female ensures the right male finds his way to her. And if you think that this is difficult enough for people, the process is at least as complicated among insects.

Burdfield-Steel's research centres on pheromones – a signalling substance that one individual emits to communicate with another – in two closely related species of moths found in North and Central America. 'This is a species of moth where the females know exactly how to attract males of their own species while simultaneously repelling males of other species,' she explains.

'Which is really quite clever! She uses different pheromone blends for different situations: one for when only potential dreamboats from her own species are around, and another blend that includes an extra substance which attracts the right male, but also repels the Mr Wrongs from the related species.'

But just how easy is it for moths of this species to create such a blend? One of the questions that Burdfield-Steel's analysis in the IBED lab seeks to answer is why the female moth does not simply use the blend with the additional substance every time.

Remarkable bug barf

In addition to sexual communication between insect species, Burdfield-Steel also researches anti-predator communication, particularly that which relies on colour and chemical protection.

For example: together with a fellow Australian researcher, she is examining the behaviour of the mountain katydid (*Acripeza reticulata*), which lives at high altitudes in Australia. The most remarkable thing about this species of grasshopper is that it 'vomits' toxins when it comes across a potential predator looking for a meal. The question Burdfield-Steel and her colleagues are asking is what cocktail of chemical ingredients makes this vomit so intense that it causes predators to flee.

And, as it happens, she has come to the right place at the Science Park – one of only a handful of labs equipped to analyse this grasshopper vomit. As Burdfield-Steel notes: 'The equipment is on hand, but so are the people who know exactly what they are doing.'

She found this out when, while still affiliated with a Finnish university, she attended a symposium in Groningen. There, Burdfield-Steel spoke with Astrid Groot, professor of Population & Evolutionary Biology, and learned about a system for interaction between species. She was immediately enthusiastic.

Emily Burdfield-Steel has been assistant professor of Chemical Ecology at IBED since 2019. She obtained a PhD in behavioural ecology and sexual selection at the University of St Andrews, Scotland, and subsequently held positions at the University of Jyväskylä, Finland, and Macquarie University, Australia.

Of Groot, Burdfield-Steel says: 'I was especially impressed by the level of expertise. Her group has a detailed understanding of the chemical composition of the pheromone blend these moths deploy. That made me interested in working with her. Which is why I'm glad that I was able to relocate to Amsterdam a few years ago. The department I work in is open in nature and there is a lot of interaction because my colleagues are interested in one another's work. The IBED also encourages us to work together, both within the institute and the Faculty and beyond.'

Insects and the city

In Amsterdam, Burdfield-Steel set up an interesting project that explores how urbanisation influences the social interaction between members of the same species, in this case a diurnal moth called the six-spot burnet. For example, how does air pollution affect the communication system of these moths? Moths living in rural areas have much less pollution to contend with. And how does that same pollution impact their communication with predators?

She explains: 'As humans, we create "green corridors" such as parks, even though we aren't certain whether particular organisms can survive there. Can these species survive in the city? Will they be able to find food? Will these green urban areas become a new habitat for them – or a trap? Will they be eaten by predators? There are so many different aspects to urbanisation and insect communication. Birds behave differently in urban areas than elsewhere, for instance. I have a system that enables me to study all kinds of communication in a holistic way. Since insects are indispensable to our survival, it is crucial that we learn more about them.'

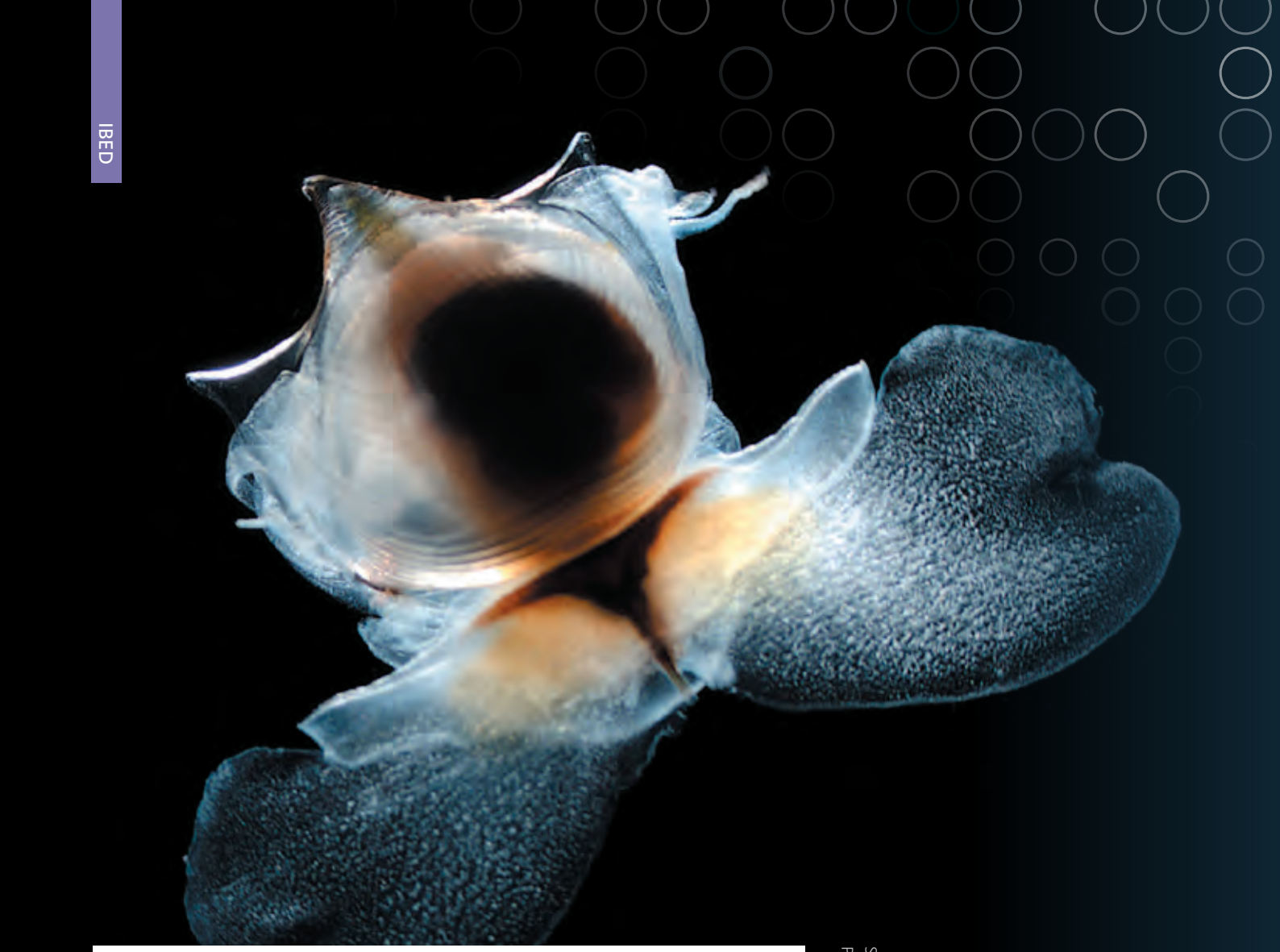
Attention to the world outdoors

The attentive reader is probably wondering when Pokémon will finally show up in this story. As it happens, the Japanese video and card game is one of the tools Burdfield-Steel uses to convey her enthusiasm for evolution and for science in general to a new generation. She does this by visiting primary and secondary schools.

'I think this is important because we need people who are scientifically literate, who have a basic understanding of how information should be interpreted,' she says. 'Science is not some mysterious thing; it helps you to understand the world around you. In my experience, the younger the children, the more open they are. Having worked with four and five year olds, I was impressed by how small children are both willing and able to understand quite difficult concepts. When they are young, they see no difference between fun and learning.'

To reach those children, and older people as well, Burdfield-Steel developed an interactive game in which she uses Pokémon cards to explain how evolution works. 'Children know absolutely everything about Pokémon. So I ask them to make an evolution tree using a set of cards. There's no such thing as a wrong answer because everyone has their own theory of how the creatures evolved. That makes it fun to see a group of children using the same cards to create some very different evolutionary trees. Sometimes they make a model based on a certain type of Pokémon, like a water type, and sometimes it's based on the number of legs and/or ears the Japanese characters have.'

In this way, Burdfield-Steel is actually doing the same thing Satoshi Tajiri did for many generations of children in the 1990s, and – with the advent of Pokémon GO – for adults in and outside Japan as well: getting them excited about evolution and small creatures. ■



Sea butterfly (*Cavolinia uncinata*)
Photo: Katja Peijnenburg.

Sea butterflies and sea angels are canaries in the coalmine for acidifying oceans

An international team of researchers showed that the two major groups of pteropods – sea butterflies and sea angels – have Cretaceous origins and thus must have survived previous global change events in history. Led by IBED researcher Katja Peijnenburg, the study was published in September in the *Proceedings of the National Academy of Sciences.*

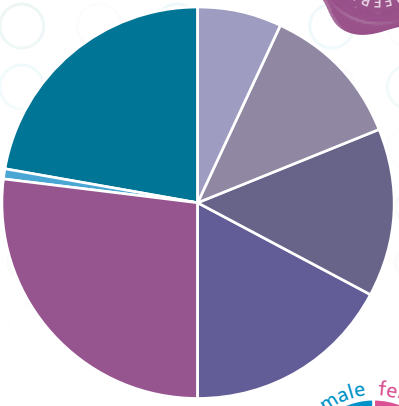
Pteropods, abundant aragonitic calcifying plankton, serve as canaries in the coalmine for our acidifying oceans. Their sensitivity to high CO_2 levels and limited fossil record have led to the common view that pteropods only became abundant after the Paleocene-Eocene Thermal Maximum, approximately 56 million years ago. These findings indicate that pelagic aragonitic calcifiers have shown remarkable resilience to perturbations in the Earth's carbon cycle over evolutionary timescales.

In the past, changes in ocean processes were responsible for fluctuations in atmospheric CO_2. Today it is the atmosphere that controls ocean chemistry, leading to an increasingly acidified ocean. We still do not know whether marine organisms, particularly those that calcify, have the evolutionary resilience to adapt fast enough to these changes.

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?

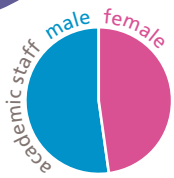
DOCTORATE CONFERRALS 19



people **144**

FTEs **130**

- Full professor **7%**
- Associate professor **12%**
- Assistant professor **14%**
- Postdoc **17%**
- PhD candidate **27%**
- Lecturer **1%**
- Support and management **22%**



Root microbiome can make crops more resilient to climate change

Spend more time researching the interaction of food crops with their root microbiome, urges IBED professor Franciska de Vries in an article published in April in *Science.* De Vries and her co-authors argue that this knowledge is essential for protecting crops from the effects of drought and thus making them more resilient to climate change.

Although the soil microbiome's response to drought has received more scientific attention over the past few years, most research has focused on non-food crops. Yet, explains De Vries, who was the article's first author and led the team: 'As our climate is changing, the need for food crops that are more resilient to different types of stress is increasing. If we have more knowledge about the way the root microbiome can help plants during stress, or recover from it, we can use this to protect crop yields.'

In their article, the biologists highlight promising research directions, such as how plants influence their microbiome through root exudate, the carbon-rich fluid excreted by plant roots on which micro-organisms feed. In her new research programme, De Vries is investigating whether grasses can change the composition of their root exudate under the influence of drought, thereby increasing the activity of their microbiome. If so, this might nudge the micro-organisms into releasing more essential nutrients from the soil, which in turn helps the grasses recover from the drought.

Photo: Shutterstock

For mandrills, timing is everything

Mandrills have the cognitive ability to track intervals of several days, a team of researchers led by IBED's Karline Janmaat discovered. The results of the research were published in November in *Animal Cognition.*

'We knew that primates can learn short time intervals, but there was still very little evidence that they could keep track of intervals of several days,' says Janmaat. The team introduced carrots and grapes to mandrills at ARTIS Amsterdam Royal Zoo and hid the foods every two and five days, respectively, at fixed locations. Observing each mandrill's daily location choices for 113 days, they found that the animals had learned the carrots' two-day interval after about 30 days. The mandrills failed, however, at tracking grapes, seemingly needing more time to learn their five-day interval. It was previously assumed that only humans possessed cognitive mechanisms that enable learning time intervals of several days.

A juvenile mandrill in ARTIS. Photo: ARTIS, Colin Eusman.

Unique species in island-like systems

Mountains and islands have undergone a highly dynamic past changing much of their isolated character that we see today. An international research team, which includes IBED island biogeography expert Kenneth Rijsdijk, published these findings in July in *Global Ecology and Biogeography.*

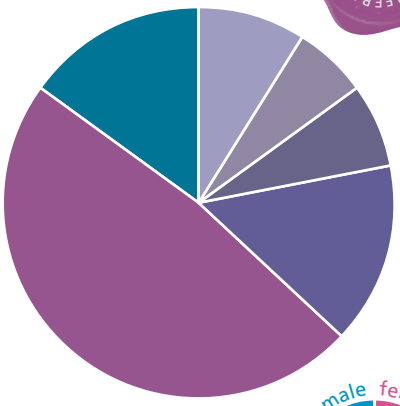
Isolated patches of habitat in mountains can be found on mountaintops, in high-elevation valleys groups and as groups of isolated mountains in a desert. These groups have been called 'sky islands' due to their insularity and high number of endemic species. The researchers asked how such sky islands compare to true islands and in how far isolation was a main driver of endemism. They elaborate on the importance of understanding that islands began with a certain level of isolation and then endured a dynamic trajectory of shifting isolation.

Sky islands in the Andes mountains in Colombia Photo: Suzette Flantua (UvA)

Van 't Hoff Institute for Molecular Sciences

The Van 't Hoff Institute for Molecular Sciences (HIMS) performs internationally renowned chemistry research, curiosity-driven as well as application-driven, within four recognisable themes: Computational and Analytical Chemistry, Synthesis & Catalysis, and Molecular Photonics.

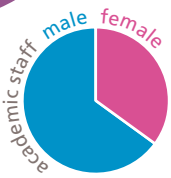
DOCTORATE CONFERRALS 27



people **164**

FTEs **157.9**

- Full professor **9%**
- Associate professor **6%**
- Assistant professor **7%**
- Postdoc **15%**
- PhD candidate **48%**
- Support and management **15%**



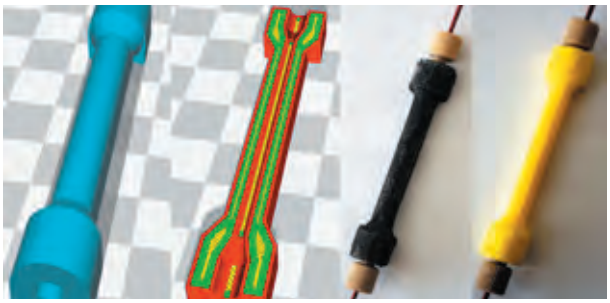
Promising sustainable synthesis of medium-sized cyclic molecules

Metalloradical catalysis is at the heart of a novel synthesis path for medium-sized ring compounds. This finding was described in an article published by HIMS researchers Minghui Zhou, Marianne Lankelma, Jarl Ivar van der Vlugt and Bas de Bruin in April in *Angewandte Chemie*. The reaction enables synthesis of a variety of novel eight-membered ring compounds from a broad substrate scope. It features mild reaction conditions and enables asymmetric synthesis and scale-up, thus providing a powerful strategy for the synthesis of pharmaceutical molecules and novel chemicals with medium-sized cyclic structures. The results confirm the potential of the metalloradical catalysis concept developed by De Bruin, which is further characterised by good functional group tolerance, satisfying yields and avoiding unwanted by-products.

Finding a novel path for sustainable synthesis of ring compounds required quite some chemistry gymnastics. Image: Bas de Bruin/HIMS

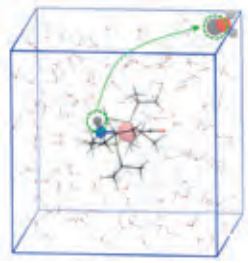
Successful 3D printing for separation of small molecules

The HIMS group in analytical chemistry gained a unique position in 3D printing in the analytical sciences domain. HIMS researcher Suhas Nawada invented a hybrid form of stereolithography that enables – for the first-time – customisation of separations devices. The work led to a patent application. Based on this work, Nawada and fellow HIMS researchers Noor Abdulhussain, Marta Passamonti and Peter Schoenmaker co-authored an article demonstrating the technology's application in analytical chemistry. Published in July in *J. Chromatography A*, the article demonstrated that 3D-printed channels can successfully separate small molecules. It shows, moreover, how 3D-print technology enables the in-house fabrication of low-waste, custom-made columns that can be used in an array of applications and for a far lower cost than traditional industry supplied columns.



From left to right: CAD model of the printed housing; travel path of the extruder; printed housing of glass-reinforced polypropylene; and printed housing of standard polypropylene. Image: HIMS

Major insight into molecular catalyst for solar energy conversion



Transfer of a proton from a molecular catalyst into solution. The Computational Chemistry researchers established the probability of such deprotonation by means of advanced first-principle molecular simulations. Image: HIMS

Researchers from the HIMS computational chemistry group provided crucial insight into a type of catalyst that could contribute to a future sustainable energy supply. Nitish Govindarajan, Hugo Beks and Evert Jan Meijer performed advanced first-principle molecular simulations of a ruthenium-based catalyst for methanol dehydrogenation. Their article published in December in *ACS Catalysis* reveals how the de-protonation probability varies by many orders of magnitude along the catalytic cycle. These findings demonstrate the importance of controlling the acidity of molecular dehydrogenation catalysts. Methanol dehydrogenation holds potential as part of a future sustainable energy system, in which electricity from wind and sun is used to produce chemical fuels, such as methanol. Regeneration of electricity from methanol is enabled through methanol dehydrogenation, yielding molecular hydrogen.

Patent for molecular heaters that could increase crop yield

An idea of Wybren Jan Buma, who leads the HIMS molecular photonics group, resulted in a patent for a novel class of molecules that can raise plant temperature, thus letting plants grow at lower environmental temperatures. This could extend their growth season and facilitate speed breeding programmes for new crop varieties.

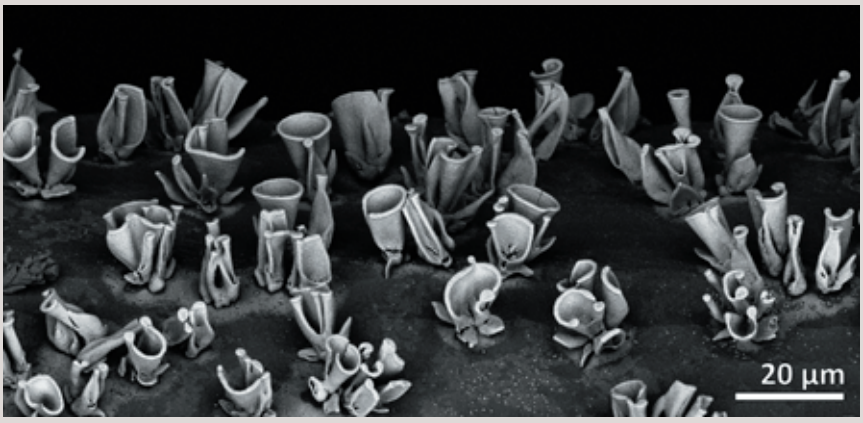
The molecular heaters work similarly to the molecules of sunscreen lotion, which absorb UV photons, transform their energy into molecular vibrations and convert harmful light into harmless heat. Having developed advanced laser spectroscopic techniques for elucidating the photodynamics of these molecules, Buma set out to broaden his research scope. He teamed up with plant cell biologist Teun Munnik of the Swammerdam Institute for Life Sciences (SILS) to explore the notion of applying the molecular heating phenomenon to plants. They focused on natural molecules, such as *sinapoyl malate*, that certain plants already produce for UV protection. They also studied different molecular variants to optimise their heat-generating effect and then demonstrated that application of the molecules indeed increases plant leaf temperature and induces increased amounts of biomass.

The molecular heaters are the subject of further study in the European Union's BoostCrop project. Buma and Munnik envision large-scale application of their molecular heaters in mixtures with surfactants and wetting agents or combinations thereof. This would optimise their application on plants. Another line of development is to chemically adjust the molecular heaters so they better stick to plant surfaces. The researchers seek partners to further develop feasible applications of the molecular heaters. Preliminary exchanges with key players have already suggested there is a high level of interest in the field of crop protection and development.

High-resolution laser spectroscopy and supersonic expansions provide key insight and optimize the energy conversion processes that are at the basis of molecular heaters. Photo: Ivar Pel

It's all circular

The transition to a sustainable, circular economy is one of the most important developments in society today. The Faculty of Science has much to offer in addressing this challenge, from expertise in developing alternative energy sources and reusable materials to finding environmentally friendly ways of crop protection.



Field of flower-like nanocomposite architectures. Image: AMOLF

HARD CHEMICAL CONVERSION BY SOFT MATTER

Converting CO_2 to value-added products is a much-desired chemical transformation, considering the link with climate change. However, this is not an easy task. Making CO_2 reactive and selective to desired products requires appropriate reaction conditions and suitable catalysts. Dr Maria Ronda-Lloret from the Catalysis Engineering group (HIMS) and Dr Hans Hendrikse from the Self-Organizing Matter group (AMOLF) have reported on a new type of material active for CO_2 conversion. Under the supervision of Dr Shiju Raveendran (Catalysis Engineering) and Dr Wim Noorduin (Self-Organizing Matter), they synthesised nickel-based coral-like architectures (figure). Not only are they beautiful, but they are also active in converting CO_2 and butane, a natural gas component, to syngas at relatively low temperatures. Several chemicals, such as hydrocarbons or alcohols can be further made from syngas. The results were published in the journal Advanced Materials and highlighted in Nature and Nature Reviews Materials.

FROM 'STICKY MESS' TO CARBON-NEGATIVE PLANT-BASED CHAIR

'Such a thing doesn't exist,' HIMS chemists Gadi Rothenberg and Albert Alberts repeatedly heard when they discovered a 100% bio-plastic polymer in 2010. Although their experiment failed multiple times at first, Rothenberg and Alberts immediately knew they had something special in their hands when 'what we were left with was a viscous mass; I also call it "sticky mess",' recalled Rothenberg.

A decade later, in collaboration with furniture manufacturer VepaDrentea, they created an entirely plant-based chair. 'Most furniture is held together by glues containing toxic chemicals. This chair isn't, making it completely sustainable and safe for the environment,' said Rothenberg. Hemp serves as the raw material for the seat, which is favourable because the plant grows without fertilisers or pesticides all over the Netherlands, requires little water, is strong and absorbs a lot of CO_2. The chair's production thus has a negative carbon footprint.

Photo: VepaDrentea

GREEN TALENTS AWARD TO IOP PHD CANDIDATE

Emma Mamisoa Nomena, a PhD candidate at the Institute of Physics (IoP), won a 2020 Green Talents award for her work on developing bio-based materials using cellulose. Her research focuses on decoupling plastics from fossil fuel resources and enabling a circular economy. The jury of German scientists selected 25 up-and-coming researchers, from among 589 applicants across 87 countries, on the basis of scientific excellence and innovation potential. Winners get the opportunity to complete a fully funded research stay of up to three months at a German institution of their choice in 2021.

FIRST NWO STAIRWAY TO IMPACT AWARD AND RABO SUSTAINABLE INNOVATION AWARD TO HIMS CHEMIST

Chris Slootweg received the NWO's very first Stairway to Impact Award, consisting of €50,000. The Van 't Hoff Institute for Molecular Sciences (HIMS) chemist developed a process to recover phosphate from waste streams, such as sewage, and upcycle it for high-end industrial applications. Resulting offshoot company SusPhos won the Rabo Sustainable Innovation Award 2020 in the circular economy and climate category, for which it received €20,000.

Artist impression of FRB 180916.J0158+65, also known as R3. Image: Danielle Futselaar

API helps collect clues in the unsolved mystery of fast radio bursts

The origin of brief, highly intense flashes known as fast radio bursts (FRB) remains a mystery to astronomers. They last only a thousandth of a second, but hundreds have already been detected. Still, the exact source is known for only four FRBs.

An international team of researchers, including API's Jason Hessels and PhD student Kenzie Nimmo, observed an FRB originating from a spiral galaxy similar to our own. This FRB is the closest ever localised and identified in an environment radically different to that of previous bursts. The team published their findings in two articles last year in *Nature*. Using one of the world's biggest optical telescopes, the eight-metre Gemini North on Mauna Kea in Hawaii, the astronomers established that the bursts originated from galaxy SDSS J015800.28+654253.0—500 million light years away from Earth.

'The location found is totally different from the previously located repeating FRBs, but also different from all other previously studied FRBs,' explained Nimmo. 'The differences between repeating and non-repeating fast radio bursts are thus less clear and we now think that these events may not be linked to a particular type of galaxy or environment. It may be that FRBs are produced in a wide variety of locations across the universe and just require some specific conditions to be noticeable.'

The first article, published in January, describes the FRB's precise location in a nearby spiral galaxy. In the second article, published in June, the researchers report that an FRB source becomes active about every 16 days, but does not burst with the regularity of a clock, nor is every active period equally long or violent. Nimmo suspects that this FRB is part of a binary star system, noting: 'The interaction with another star could then explain the repetition and the erratic eruptions.'

The team is now set on studying other repetitive FRBs to compare the violence of their bursts.

Team including Sera Markoff discover black hole's shadow wobbles

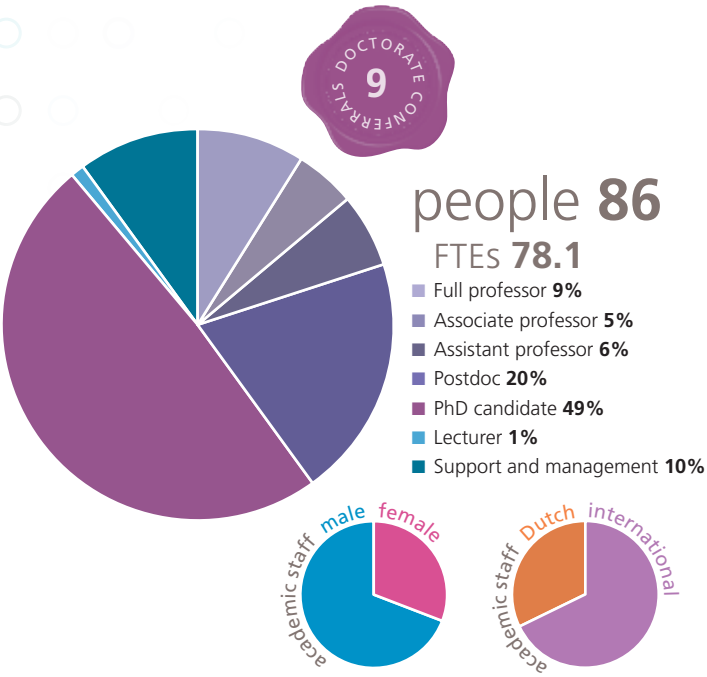
The Event Horizon Telescope team that published the first images of black hole M87* also discovered that its shadow has been wobbling over the years. The findings of the team, which includes Sera Markoff (API) and PhD student Koushik Chatterjee, were published in September in *The Astrophysical Journal.*

While the researchers found the diameter of M87*'s shadow consistent with predictions for black holes of 6.5 billion solar masses based on Einstein's general theory of relativity, they unexpectedly discovered that the crescent-shaped ring of hot plasma around the hole wobbles. This provided them a first glimpse of a dynamic accretion structure this close to the event horizon of a black hole, where gravity is extremely high.

Image: Event Horizon Telescope

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.

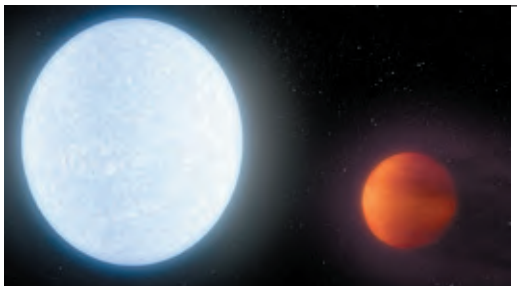


NWO Diversity Initiative Award to Sera Markoff and Communication Award to IAU100

Altair, a project introducing primary schoolchildren to astronomy and physics, received the first NWO Diversity Initiative Award. API's Sera Markoff, who launched Altair, plans to put the € 50,000 prize towards launching Altair+ to develop activities for secondary school pupils from a wide range of communities and ethnic backgrounds.

IAU100, an international astronomy outreach project that aims to reach diverse audiences and countries where people have limited access to scientific knowledge, was the first recipient of the NWO Communication Award. The € 10,000 prize is intended to support scientific communications in a new project associated with the International Astronomical Union.

Sera Markoff



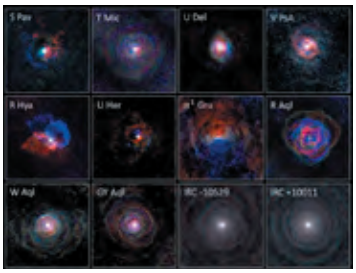
Artist impression of exoplanet KELT-9b (right) and its host star KELT-9 (image: NASA/JPL-Caltech)

Lorenzo Pino leads study observing iron in exoplanetary atmosphere

An international team for the first time directly demonstrated the presence of iron in an exoplanet's atmosphere through discovering emission lines of uncharged iron atoms in its light spectrum. The observation was complicated as the exoplanet, KELT-9b, is outshined by its host star, KELT-9. Both bodies are located approximately 620 light years from Earth. The study's lead author is API astronomer Lorenzo Pino. He compared looking for the exoplanet's light in the glare of its host star with seeing a firefly near a lamppost, noting: 'A few years ago we saw the shadow of the firefly, or in our case, the shadow of the exoplanet. We've now looked at the exoplanet directly.'

Team including Alex de Koter capture stellar winds in unprecedented detail

Astronomers from Belgium and the Netherlands, including the API's Alex de Koter, published an explanation for the mesmerising shapes of planetary nebulae in September in *Science*. Their discovery is based on an extraordinary set of observations of stellar winds around ageing stars. Contrary to common consensus, the team found that these winds are not spherical, but have a shape similar to that of planetary nebulae. The astronomers could even identify different categories of shapes, including disks, spirals and cones. The team concluded that interaction with an accompanying star or exoplanet shapes both the stellar winds and planetary nebulae.



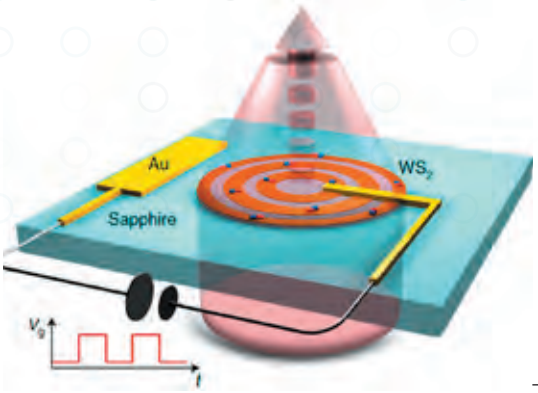
Gallery of stellar winds around cool ageing stars, showing a variety of morphologies, including disks, cones and spirals. The blue colour represents material that is coming towards you; red is material that is moving away from you.

Eva Laplace wins ET Outreach Award for software on star evolution

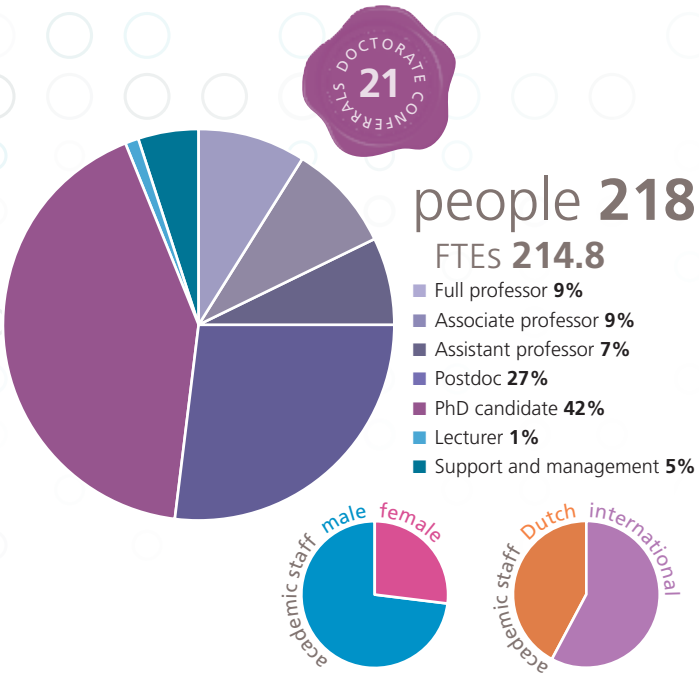
For developing a tool to better understand the lives of stars, PhD candidate Eva Laplace won the ET Outreach Award of the Royal Holland Society of Sciences and Humanities (KHMW). Called TULIPS, the software is meant to help astronomers and non-astronomers alike see a star's size, colour, changing composition and interior processes. It also makes stars easier to compare with each other. The annual € 5,000 prize is issued to young astronomers who have a good idea for engaging with a large audience.

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.



Schematic drawing of an atomically-thin lens (orange rings) on glass (blue) that effectively focuses light above the surface. The focusing mechanism can be turned on and off using a small electrical voltage. Image: Nature Photonics / UvA / Van de Groep.



An atom-thick lens with an on/off switch

Led by IoP's Jorik van de Groep, physicists from the UvA and Stanford University constructed a new ultra-thin lens that can be turned on and off. The team of researchers published their findings in April in *Nature Photonics*.

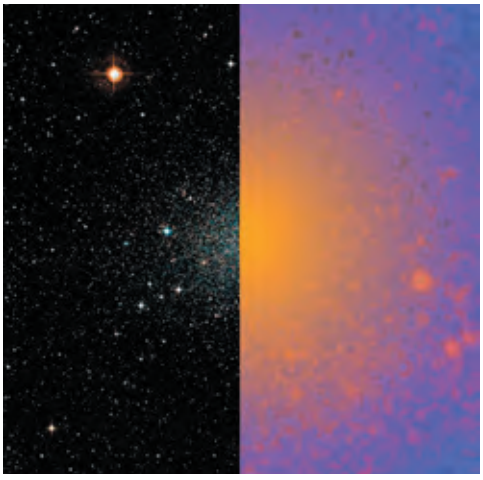
The lens is made from tungsten disulphide, which is a mere single layer of atoms thick. Light interacts very strongly with this semi-conducting material, shaping it to act as a lens. However, application of a small electrical voltage changes its properties, so previously focused light passes through the material essentially unhindered. This turns the lens off. Insights from this tuneable optical research can inspire future designs and applications, for example, in augmented and virtual reality.

Dark matter proves even more elusive

Dark matter is harder to detect than previously expected, according to a new study by a group of scientists including IoP's Shin'ichiro Ando. The results, which were published in September in *Physical Review D*, strongly call for revising a key search strategy for discovering dark matter particles and the quest for Physics beyond the Standard Model (BSM).

Combining theoretical and observational methods, the scientists carried out the first end-to-end analysis that models dwarf galaxies. As Ando summarised: 'Our method starts at the Big Bang, follows the evolution of dark matter and the growth of galaxies across cosmic time, and uses this as the basis to understand how dark matter might be distributed within the individual dwarf galaxies we see in the sky today.'

Full of dark matter but little else, dwarf galaxies have provided nearly pristine laboratories to search for dark matter's telltale sign – gamma ray signals that might arise from dark matter annihilating within a galaxy – and to do so without the complication of other astronomical phenomena. Yet, the research concluded that the annihilation signal is much weaker than earlier estimates. Simply put: dark matter is more difficult to detect using dwarf galaxies than previously thought.



An optical image of the Sculptor dwarf spheroidal galaxy (left) alongside an illustration of the gamma-ray signal that might arise from dark matter annihilating within the galaxy (right). Image: Giuseppe Donatiello and NASA/DOE/Fermi LAT Collaboration.

New Sector Plan appointments

IoP began filling new group leader positions enabled by the Dutch government's science and technology sector plan known as Bèta en Techniek. The plan's funding has allowed IoP to bolster its research priority areas in gravitation and astroparticle physics – GRAPPA, for short; quantum matter and quantum information; and soft matter. The latter two research areas are pursued in collaboration with the Korteweg-de Vries Institute for Mathematics (KdVI), the Informatics Institute (IvI) and the Van't Hoff Institute for Molecular Sciences (HIMS).

Those who were first appointed included Sara Jabbari-Farouji (computational soft matter), Mikhail Isachenkov (mathematical quantum physics, with KdVI), Tina Pollmann (experimental astroparticle physics) and Jory Sonneveld (detector development for particle tracking). Other new group leaders who started in 2020 include Flavia de Almeida Dias (MacGillavry fellow in experimental high-energy physics) and Arghavan Safavi-Naini (quantum many-body theory and quantum simulation).

Image: NIAID

Major COVID-19 findings led by Daniel Bonn

The COVID-19 pandemic spurred a lot of attention-generating research by IoP's Daniel Bonn and colleagues. Physicists Bonn, Stefan Kooij and Cees van Rijn were part of a team finding that small cough droplets, potentially containing virus particles, can float in the air in a room for many minutes, especially when it is poorly ventilated. Good ventilation in shared spaces, such as public transportation and nursing homes, is therefore crucial to slowing down the spread of the coronavirus. The results were published in May in *The Lancet*.

In a separate article published in September in *Indoor Air*, IoP physicists Bonn and Van Rijn co-wrote about their research that aerosols, viewed as a way of transmitting the SARS-CoV-2 virus that causes COVID-19, can persist for periods of 10 to 20 minutes inside an elevator during normal operation. To reduce risks, the researchers recommend leaving elevator doors open for longer and wearing an adequate facemask in the confined space of an elevator.

In October, *Physics of Fluids* published an article co-authored by Bonn, Kooij, Van Rijn and Scott H. Smith on SARS-CoV-2's transmission via inhalation of aerosols. The researchers found that aerosols can float in the air for many minutes and in confined, poorly ventilated settings where continuous coughing, speaking and sneezing occur. Especially contagious people produce almost 20 times as many aerosols as normal persons.

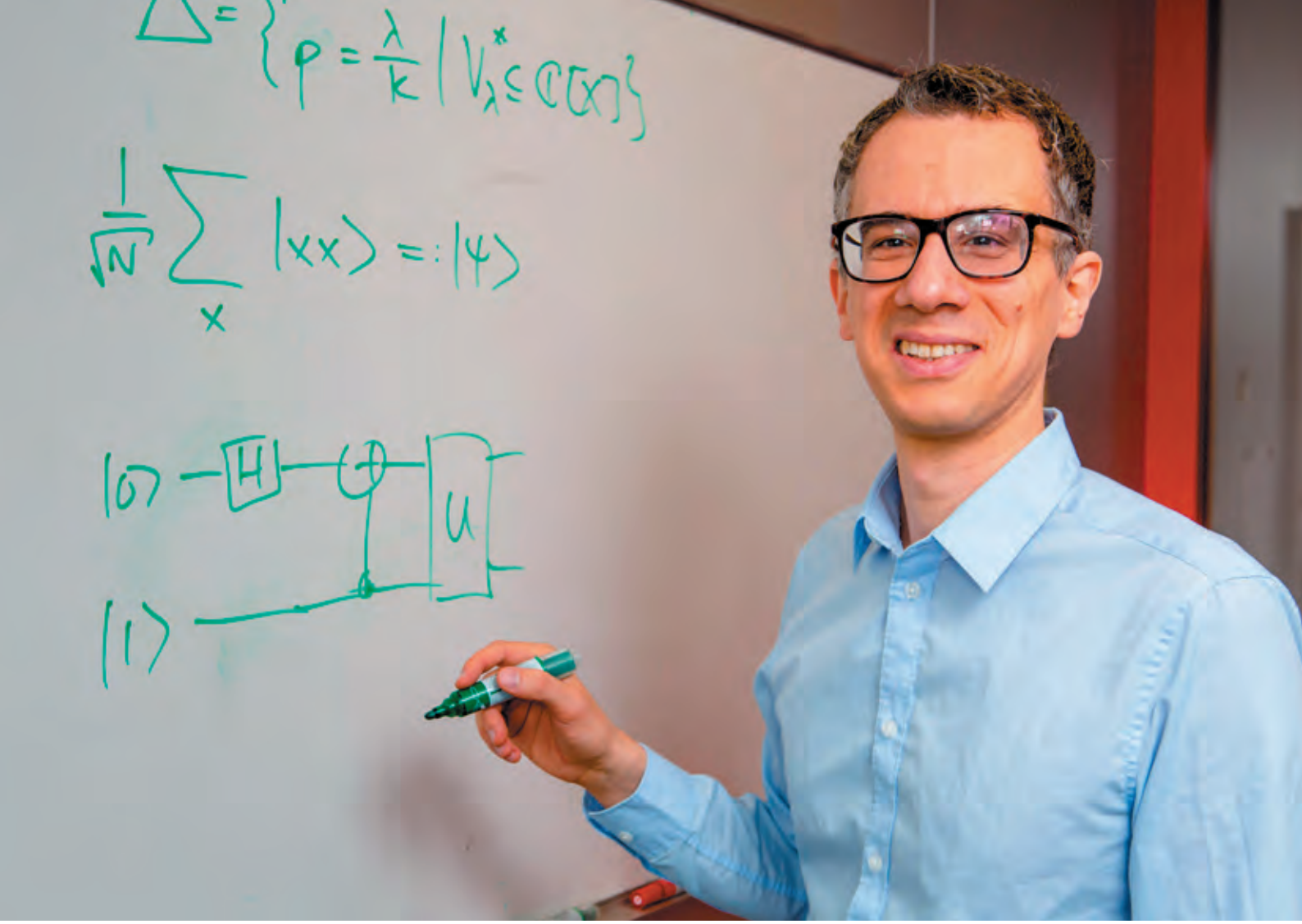
Photo: NPO

Bonn was also a founding committee member of the newly launched Pandemic Science forum. Pandemic Science identifies itself as a community of scientists responding to the need for swift and independent multidisciplinary peer-reviewed research most relevant to fighting the COVID-19 pandemic. It aims to provide assessments that can be used by pandemic policy advisors, governments and the public at large.

INTERVIEW
MICHAEL WALTER, ASSISTANT PROFESSOR OF QUANTUM INFORMATION THEORY

‘I feel like we are part of something bigger’

Within a few years, or at least in this decade, it should happen. The first working quantum computer will become a reality. When it does, it will be a breakthrough comparable to the arrival of the internet. A quantum computer can do calculations that today’s ordinary computers can only dream of. Big and small questions in fields such as chemistry, biology and medical science should then be much easier to solve. But before we get to that point, there is a lot of research left to be done.



One of the places where this research is being conducted is at Science Park, at the Faculty of Science. There, assistant professor Michael Walter works within the Korteweg-de Vries Institute for Mathematics (KdVI), the Institute of Physics (IoP) and the Institute for Logic, Language and Computation (ILLC). He is also a senior researcher at QuSoft, the research centre for quantum software.
After studying mathematics and computer science in Germany, he obtained his doctorate in physics from ETH Zürich, with a thesis on quantum information.

That was in 2014. At the time, quantum information was already attracting a fair amount of attention. Today, in 2021, the whole world knows what quantum computers are and we eagerly await the arrival of these supercomputers. Walter's field of research is booming.

'This is a very exciting experience for all of us,' says Walter. 'I am very curious to see where quantum computers will take us. We already know that they can prove valuable in a wide range of applications. I feel like we are part of something bigger, something with which we can really make a difference. Through my research, I'm trying to find out which calculations these new computers can accelerate, and how. This means that I want to find new algorithms and gain insight into the complexity of quantum computations. I hope this knowledge can have an impact on our society.'

Quantum entanglement and optimisation

Walter's research falls within quantum information theory, with some topics being more mathematical and others more physics-orientated in nature.

For example, he explores the phenomenon of quantum entanglement. Entanglement is when multiple quantum mechanical particles are 'linked' to one another, although they may be very far apart, and adopt each other's properties. If one particle changes, in other words, the properties of the other particle(s) change with it.

Walter elaborates: 'For me, entanglement is the common thread that unites all my research. It is responsible for the speed of quantum algorithms and the power of quantum networks. This motivates us to better understand its mathematical structure. But there are also indications that entanglement can help us understand how spacetime can emerge from quantum mechanics. These are all things I research with my students and colleagues.'

From the mathematical angle, he also explores another exciting area of research: quantum optimisation. In doing so, he aims to answer questions such as: how can quantum algorithms help speed up optimisation tasks in quantum

computers? What is possible and what is not?

Walter says: 'Optimisation is incredibly important. Think, for instance, of maximising throughput in a factory or optimising the distribution of vaccines. Many mathematical problems can be formulated in the language of optimisation. This offers a wealth of possibilities. Quantum algorithms can have a major impact in this area.'

Theory versus practice

What is unique about Walter's research is not only that it moves between three different disciplines – mathematics, computer science and physics – but also that he is focusing on both fundamental and applied science. Walter recently received an Early Career Award from the Royal Netherlands Academy of Arts and Sciences (KNAW) for his interdisciplinary research.

'At its core, my research is fundamental,' he says. 'But some of it is more applied. I'm happy to be doing both. The fundamental kind, supplemented by research that lets me touch the "real" world. I work on a variety of projects in which I frequently collaborate with other universities, institutes and companies, too. In terms of mathematics and computer science, for example, I collaborate closely with colleagues of Berlin and Princeton, while on the physics side, I have on-going collaborations with Berkeley and Caltech. All those projects are different but related.'

It's no coincidence that Walter ended up at the Faculty of Science. In the field of quantum computer science, there is almost no better place to be in Europe than the Science Park. 'Amsterdam is certainly one of the strongest places when it comes to quantum computer science – not only in Europe, but worldwide. There are many excellent colleagues to work with at the UvA. And with the CWI next door, you have even more people close by to exchange thoughts with and challenge your ideas.'

Teaching

In addition to his research, Walter also devotes attention to future generations of quantum researchers. He teaches the introductory course in Information Theory for a number of Bachelor's programmes and Quantum Information Theory for the Master's programmes. 'While preparing lessons can certainly be time-consuming, it is well worth it. Especially when you see the students become enthusiastic about the topic.' At KdVI, he is working with colleagues to set up a new specialisation in Discrete Mathematics and Quantum Information.

Walter has also started working with an even younger batch of students: 'We've developed an online course about quantum computing for secondary school students called "Quantum Quest". I think it's very important to reach this group and get them excited about this field. Simply put, we'll be needing a lot of new people in the future.'

The online lessons are not easy. The students spend a month working on various quantum computing problems. They get to hear a few lectures as well. 'The online course is extremely successful. It teaches secondary-school students to program for quantum computers. Precisely because it's a bit more difficult – the course material is nearly at the Bachelor's level – they feel challenged and find it interesting to do.'

Moving forward together

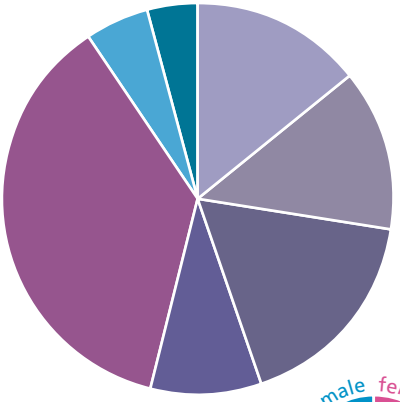
That new generation is vital. There is still quite a bit of work to be done to create a working quantum computer. Within the Netherlands, effective collaboration is a key facilitator. Walter elaborates: 'Each university has its own strength, which we use to strengthen each other. The experimentalists are excited because they are well on their way to building a quantum computer. This, in turn, greatly motivates us theoreticians to find surprising new algorithms.' ■

Michael Walter is assistant professor of Mathematics and Theoretical Physics at the University of Amsterdam and senior researcher at QuSoft. He received a Diploma (2010) from the University of Göttingen and a PhD (2014) from ETH Zürich. Before joining QuSoft, he was a postdoctoral research fellow at Stanford University.

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.

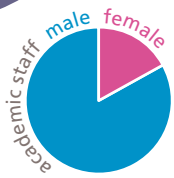
Wifi in the city



people **73**

FTEs **68.9**

- Full professor **14%**
- Associate professor **13%**
- Assistant professor **17%**
- Postdoc **9%**
- PhD candidate **36%**
- Lecturer **5%**
- Support and management **4%**



NETWORKS consortium gets EU grant

The NETWORKS consortium, of which KdVI is a member, received a €1.5 million grant under the European Union's Horizon 2020 programme. The grant allows this collective of mathematicians and computer scientists from the UvA, Eindhoven University of Technology, Leiden University and the Centre for Mathematics and Computer Science (CWI) to expand its activities. One way it has decided to do so is by opening positions for fourteen additional PhD students.

The NETWORKS programme aims to better understand complex, volatile networks, such as those involving energy and communication, in order to achieve optimisation and smarter management. Its work includes the development of new stochastic models and algorithms, focusing on large-scale networks. The ultimate goal is to create more reliable models of these networks and better optimise and manage their processes.

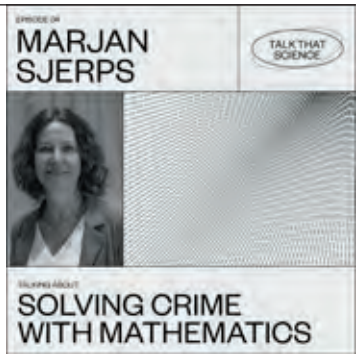
Winter e-Course in Mathematics enrolment exceeds expectations

From February to April, high school pupils and higher education students with a deficiency in maths attended the KdVI Winter e-Course in Mathematics. KdVI lecturers Andre Heck, Marthe Schut and Gideon Jager digitised the traditional course materials of the annual in-class summer course and added an online forum as well as chat sessions for support and guidance. Nearly 120 participants started the course, far exceeding the expected 50 registrations. Seventy-two participants passed the exam.

Two awards for Michael Walter

Double laurels went to Michael Walter, a mathematician and theoretical physicist working at KdVI (as well as IoP and ILLC). He received an NWO KLEIN grant for his project on taming tensors, which takes an optimisation approach to computational invariant theory. A KNAW Early Career Award acknowledged his work as a young talented researcher in the Netherlands with an innovative research idea.

Walter's project, which involves one PhD student, sets out to develop novel algorithms for solving puzzles much more efficiently than was previously thought possible. This has important applications for tensors – large arrays of high-dimensional data that are ubiquitous in machine learning and quantum computing but notoriously difficult to work with – and promises to shed new light on fundamental questions about the speed limits of computation. To illustrate, intuition tells us that it should be easier to scramble a solved Rubik's Cube than to solve a scrambled one. Computer scientists recently discovered tantalising evidence that, for a broad and important class of puzzles with continuous symmetries, that intuition may well be mistaken.

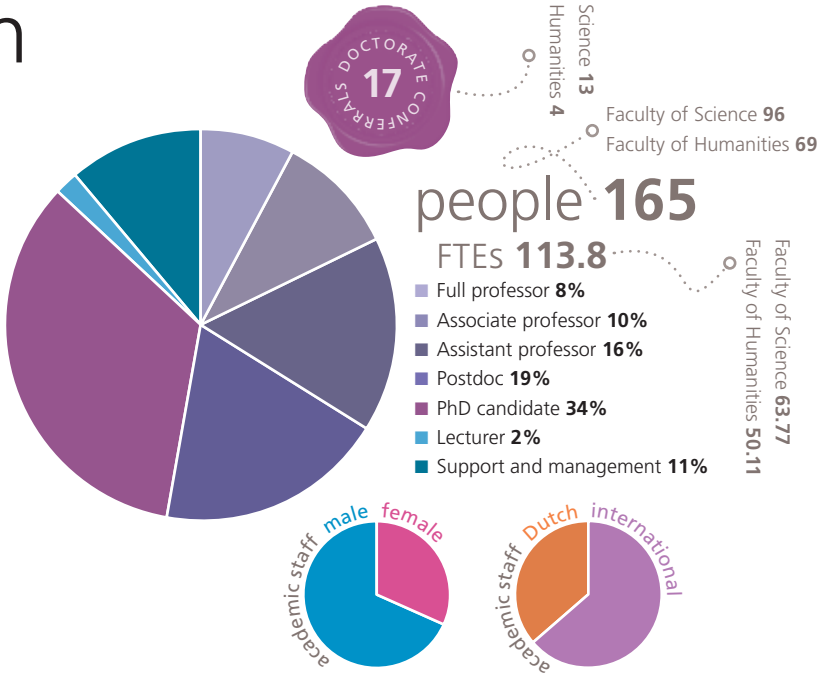


Marjan Sjerps guests on podcast 'Talk That Science'

KdVI professor Marjan Sjerps appeared on the podcast 'Talk That Science' in an episode on maths against crime. Sjerps discussed how her work as a forensic statistician and how calculations in probability calculation can be used to measure the strength of a piece of evidence.

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.



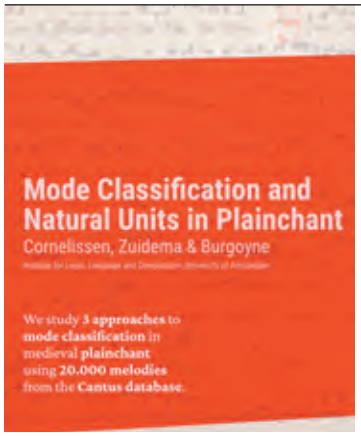
SignLab Amsterdam helps Dutch Deaf get COVID-19 healthcare

SignLab Amsterdam, which is led by ILLC researcher Floris Roelofsen, helped develop a tool to improve information exchange between hearing healthcare workers and Deaf patients in the COVID-19 era. While communication between the two groups has long posed challenges, restrictions during the pandemic have made it even harder. Facemasks are mandatory in many settings, rendering lip-reading impossible. Plus, safety restrictions can limit access to sign language interpreters. Using animated avatars and videos, the researchers translated common questions and statements in diagnosing and treating COVID-19 from Dutch to Dutch Sign Language. The project was awarded funding under the COVID-19 Programme of ZonMW, a Dutch organisation for health research and healthcare innovation.

Corona fast track grant for Giovanni Colavizza

Giovanni Colavizza was awarded an NWO Corona: Fast track data grant for his project entitled Collecting systematic survey data on scientists' information-seeking and information-spreading behaviour in a time of crisis. The funding was issued to support research being conducted at the height of the COVID-19 pandemic, and specifically on issues, other than medical and healthcare issues, that arise in society during the crisis.

Image: Bas Cornelissen



Harry Buhrman joins KNAW

ILLC professor Harry Buhrman became a member of the Royal Netherlands Academy of Arts and Sciences (KNAW). A quantum researcher, Buhrman leads the algorithms and complexity research group at CWI, the national research institute for mathematics and computer science. He is also director and founder of research institute QuSoft, which focuses on the development of quantum software and applications of quantum computers and quantum networks. The membership honours his exceptional scientific achievements in research focusing on the interface of computer science, mathematics and physics. Buhrman gained international fame for his work on quantum communication and quantum lower bounds.

Best papers

For their exceptional papers, various ILLC researchers received recognition at international conferences, all of which were held virtually this past year.

ILLC PhD student Bas Cornelissen was awarded for a paper co-authored with ILLC researchers Willem Zuidema and John Ashley Burgoyne. Entitled 'Mode Classification and Natural Units in Plainchant', the paper was awarded by the ISMIR 2020, a conference held by the International Society for Music Information Retrieval.

ILLC PhD student Bryan Eikema was awarded for a paper co-authored with his thesis advisor, ILLC researcher Wilker Aziz. Entitled 'MAP Decoding All You Need? The Inadequacy of the Mode in Neural Machine Translation', the paper was awarded at COLING'2020, the 28th International Conference on Computational Linguistics.

Jana Sotáková, a PhD student co-advised by ILLC researcher Christian Schaffner, was awarded for the paper she co-authored called 'Breaking the Decisional Diffie-Hellman Problem for Class Group Actions Using Genus Theory'. Her recognition came at CRYPTO 2020, the 40th Annual International Cryptology Conference.

Ahmed Nait Aicha with a resident of physical rehabilitation centre Naarderheem
Photo: Ahmed Nait Aicha

Algorithms to promote safe and sound aging

Researcher Ahmed Nait Aicha defended his PhD, describing how sensor monitoring can detect changes in the ways independently living older adults perform daily activities without pain or injury – that is, their functional health. His work proposes and assesses methods to track functional health by applying machine-learning algorithms to raw sensor data for detecting visits, measuring walking velocity and predicting fall risk. Early detection of a decline in physical condition can ensure timely intervention. Ambient technology, Nait Aicha explains, does not require making expensive home modifications because it is built into everyday devices, such as smartphones, motion-sensor lamps and smart thermostats.

New labs and launches

January marked the official opening of the AI for Medical Imaging lab (AIM Lab), a collaboration between the UvA and the Inception Institute of Artificial Intelligence (IIAI) in the United Arab Emirates. At the opening ceremony, scientific co-director Cees Snoek emphasised that lab partnerships drive AI innovation, talent development and ecosystem growth.

Also becoming fully operational, the AI4Science Lab held a kick-off workshop in July. The event celebrated the appointment of five PhD students. Aiming to solve scientific data problems with modern machine learning approaches, the lab is a joint initiative of six of the eight research institutes in the Faculty of Science and is connected to the Amsterdam Machine Learning Lab (AMLab).

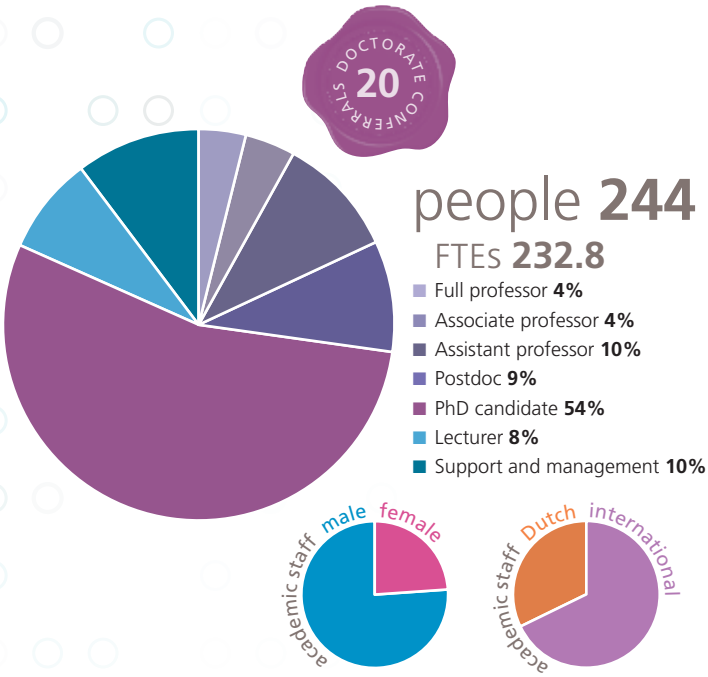
September saw the start of Amsterdam's European Laboratory for Learning and Intelligent Systems (ELLIS). The pan-European initiative works to build a stronger machine learning and AI research community. Of the 30 ELLIS units in Europe, three are in the Netherlands. A financial contribution by the UvA helped make ELLIS Amsterdam possible.

In October, the QUVA Deep Vision Lab marked its first five years of operation and announced another five years' worth of funding. The QUVA Deep Vision Lab combines fundamental research conducted at IvI with applied research undertaken by tech company Qualcomm. So far, the partners have produced world-class research while investing in new talent.

Last year, the UvA and the Netherlands Cancer Institute (NKI) agreed to launch a new lab to treat cancer more effectively with the aid of AI. Clarisa Sánchez Gutiérrez's appointment at IvI as professor of AI and Health is especially relevant here. One of her priorities is to build a multidisciplinary research group that bridges the Faculty of Science, Amsterdam AMC and parties, such as the NKI, in efforts to put socially responsible AI solutions into clinical use.

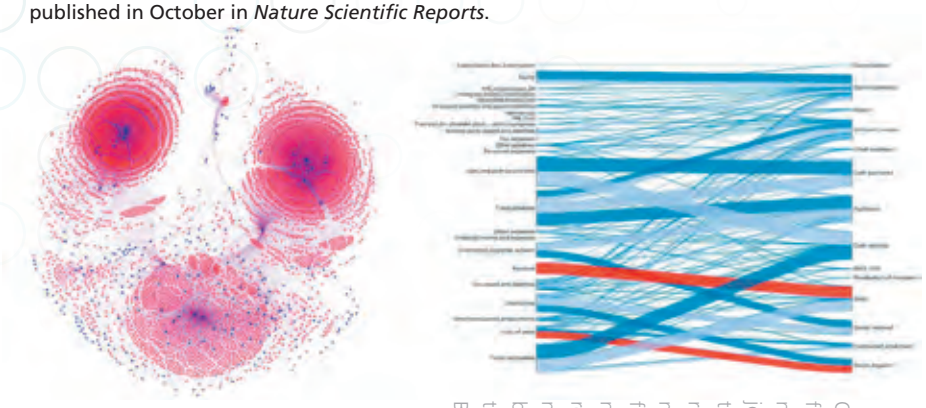
Informatics Institute

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.



PhDs apply computational models to pricing and risk management

Two IvI PhD students worked on developing data-driven methods to estimate contagion effects and incorporated them into computational models for pricing and risk management. The subject was timely since the COVID-19 pandemic has yet again illustrated that distress initially affecting a small part of the economy can spread to the entire system. Ioannis Anagnostou co-authored an article proposing a method to enhance credit portfolio models, which was published in March in the *Journal of Credit Risk*. Marcel Boersma co-authored an article about reducing the complexity of financial networks, which was published in October in *Nature Scientific Reports*.



On the left is the financial statements network extracted from journal entry data for three companies; on the right is the high-level monetary flows obtained from the detailed network on the left. The red flows show the profit margin relationship between (partial) flows in the network. Image: Boersma et al. 2020

AI Technology for People publishes *New Scientist* special edition

To highlight the importance of AI to a broader public, the Amsterdam coalition AI Technology for People put together a special edition of popular science magazine *New Scientist*. This autumn 2020 issue showcases AI research and innovation across the Amsterdam region and features contributions by IvI researchers, such as Cees Snoek, Maarten de Rijke and Marcel Worring. Topics include customised searching, how AI can be used to improve cancer treatments and the importance of ensuring that algorithms do not perpetuate social inequality and discrimination.
The magazine opens with an endorsement note from Amsterdam mayor Femke Halsema. 'Life without artificial intelligence (AI) is no longer conceivable in 2020,' she writes. 'Not for a city like Amsterdam, but not for me either.'

Image: New Scientist/Pascal Tieman

Grants for computing and AI

Grants went to various IvI researchers. These include Andy Pimental, chair of the Parallel Computing Systems, whose APROPOS and ADMORPH projects received funding through the EU Horizon2020 programme. Paola Grosso was awarded an NWO for the project UPIN, which seeks a solution to an ever-growing problem: that it is becoming more and more opaque for internet users to understand and control how their data is processed and routed.
A new research collaboration that includes Rick Quax received a €1 million Regional Information and Expertise Center (RIEC) grant for a project to develop novel methods to analyse organised crime through a complexity approach.

INTERVIEW
SENNAY GHEBREAB, ASSOCIATE PROFESSOR OF SOCIALLY-INTELLIGENT AI

Fighting inequality with the help of artificial intelligence

From an early age, Sennay Ghebreab, associate professor of Socially-Intelligent AI, has had a desire to help people. At first, he wanted to become a physician. Years later, the researcher from UvA's Informatics Institute discovered that he could do things differently, maybe even at a grander scale. Ghebreab now uses artificial intelligence (AI) as a power tool to overcome the many faces of inequality.

'We human beings are limited in that we can only focus on a limited number of things. AI, on the other hand, can examine and compare thousands of things at once. That's why we need to apply this technology to analyse complex issues such as social justice and climate change,' says Ghebreab.

To solve those big problems, you have to be prepared to think and act more broadly. 'I have always been interdisciplinary to some extent: at the medical faculty, in social sciences and, of course, at the Faculty of Science. This has given me the vocabulary to talk to people from different disciplines, and it has given me a broader perspective as well.'

Focus on a new generation

Ghebreab has spent the last decade imparting that emphasis on interdisciplinarity to his students. 'Sometime around 2010, I decided to stop putting my energy into my own research and to invest it in the next generation instead. Questions I have dealt with in my teaching include: how does the brain process information? Where do we see pattern recognition reflected? And how does AI cope with pattern recognition and bias? How does this work in social networks? At first, my students really struggled to integrate all these interdisciplinary techniques and perspectives. After a few years, though, they began to make the connection. It was great to see that happen.'

After several years of teaching pattern recognition and bias, Ghebreab wanted to inform the world outside the university about the dark side of AI technology, too. An opportunity to do so presented itself in 2015. Google launched an app that categorised black people as monkeys. Apparently, the algorithm had been 'trained' to function in a racist way.

Ghebreab elaborates: 'The app received a lot of public attention worldwide. How could algorithms possibly discriminate? Machines can't be racist, can they? I seized that moment to launch the public debate here as well, via a spoken column entitled "What computers can teach us about discrimination".'

Social cooperation in the Civic AI Lab

For the past 10 years, Ghebreab has been largely occupied with pointing out the dangers of AI. Those days are over for him. Now, he is focusing more on the potential opportunities of AI. He founded the Civic AI Lab, where he is the scientific director, for that very purpose. The lab is a public-public cooperation between three Amsterdam parties – the municipality, VU Amsterdam and the UvA – and the Ministry of the Interior and Kingdom Relations.

Ghebreab says: 'My goal is to use the lab to develop AI technology in order to expose the likelihood of inequality in the city on the one hand, while promoting equal opportunities on the other. Within

the lab, we have jointly defined a number of research topics we want explore on behalf of the city: education, mobility, health, well-being and environmental factors.'

Within the project on well-being, PhD students are working with the Municipal Health Service to study obesity. Many factors play a role in this wicked problem, including individuals' home situations and the degree to which they are active. Despite a wealth of available data, it is not clear why obesity is more prevalent in some neighbourhoods than others. Using AI, the researchers hope to answer questions such as: how does a disparity in obesity rates arise? What is the reason for this uneven distribution? What does that say about obesity and what is the best way to tackle it?

'In the education project, we use AI to look at how government money is being distributed to students and schools,' says Ghebreab. 'The question is: why does inequality only seem to be increasing? What is causing this? Are the funds being distributed in such a way that the money goes where it needs to go?'

Migration and AI

Ghebreab is also working on another interesting project within the VU Institute for Societal Resilience.
As a guest researcher, he has been working for years to improve the participation processes for newcomers in the Netherlands. Like we said, Ghebreab wants to help people. With the help of AI technology, he tackles migration-related issues such as the placement of refugees in the country of arrival.

'Currently, the Immigration and Naturalisation Service (IND) and the Central Agency for the Reception of Asylum Seekers (COA) determine placement based on the person's identity and where there is room – but there is a much better way to do this,' he says. 'Using an algorithm developed at Stanford, we can examine how to place each refugee in the location that will be most beneficial to them and the reception centre that hosts them. With the help of AI, it's possible to recognise patterns within previous placements of families and individuals. Who ended up where? And was the placement a success or not? These patterns are then used to place an individual where their chances of employment, or education, are greatest. It's actually a very simple matchmaking system that is already proving effective in the United States and Switzerland.'

Critical remarks

This is an incredibly eventful time for the field of AI. In less than two years, the Innovation Centre for AI (ICAI) has grown into a national ecosystem of public-private and public-public AI labs. Last year, nine knowledge institutes in Amsterdam joined forces in the coalition known as AI Technology for People. And at the national level, the NL AI Coalition has established ELSA (ethical, legal, social aspects) labs.

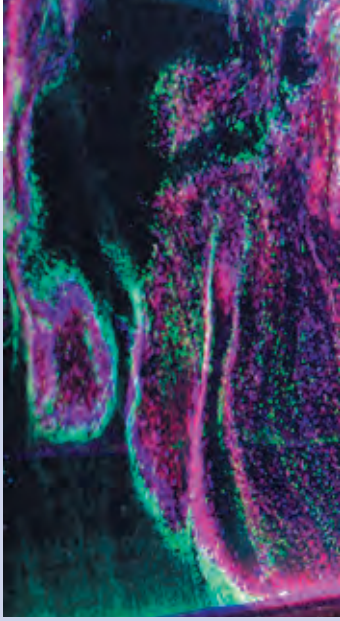
While Ghebreab is pleased with this development, he also sees a downside. 'Everyone, at all levels, is suddenly staking their own AI claim. But we should also appreciate the scientists who have been working on it for ages. Try to complement each other's efforts instead of trying to annex one another's territory. If we don't work together, it will only delay the development of good AI.'

This is one of the critical comments Ghebreab offers regarding the current focus on Artificial Intelligence.
'I see institutions, organisations, governments and companies – both inside and outside the university – starting to work with AI themselves. This gives rise to problems such as a discriminating algorithm. I am certain that, if they had done more through co-creation, we would have had fewer problems – like that whole thing with the childcare benefits scandal.'

He is also critical of AI-related education in the Netherlands.
'In other countries, there is much more emphasis on teaching children about AI, including in secondary schools. By starting this kind of education early, you can make sure that different layers – demographic groups – are exposed to it. It is important that people from all layers of society have a chance to contribute to AI, especially if we want it to be fair.' ■

Sennay Ghebreab is associate professor of Socially-Intelligent AI, programme director for the Information Studies Master's programme, and scientific director of the Civic-AI Lab.
He obtained his PhD at IvI's Intelligent Sensory Information Systems group, and returned to the institute in 2020, after spending several years at the UvA's Psychology Institute and as department head of social sciences at Amsterdam University College.

The art of science

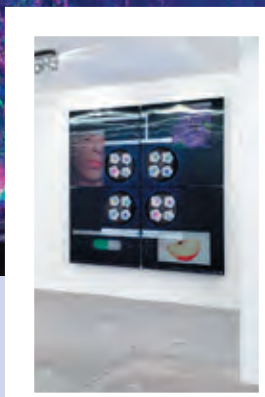


WATER SAMPLES ILLUMINATE SCHOOLCHILDREN – AND AMSTERDAM ARTWORK

In November, 650 primary schoolchildren collected jars of water from ditches, canals and ponds all around Amsterdam. Together with UvA biologists, they tested their water samples, using special equipment in a lab workshop. Students learned about the influence of light on oxygen content in water and learned just how indispensable it is for the production life in the city. Afterwards, they contributed their jars to 'The Water We Breathe', an artwork representing the levels of oxygen in Amsterdam's water that was displayed as part of the Amsterdam Light Festival.

Intreeweek 2020 at Science Park

Installation 'To be rebuilt with the materials of your time'. Photo: Christian Herren



Former artwork Hydrogeny by Gelfand and Domnitch

MOLECULAR GENETICIST FRANCESCA QUATROCCHIO AND ARTIST REANIMATE LAB PETUNIAS

Swammerdam Institute for Life Sciences (SILS) molecular geneticist Francesca Quatrocchio collaborated with visual artist Christian Herren in an art installation called 'To be rebuilt with the materials of your time'. The installation uses LED fans and lenticular prints to animate 120 watercolour paintings of bright-coloured lab-bred flowers that UvA biologists have been researching. The installation 'evokes the tradition of floral still-lifes and is contextualised within the gap between reality and representation, art and science,' the artist wrote in an Instagram post.

QUANTUM CLOCK RESEARCH FEATURES IN SCIENCE-ART COLLABORATION

Florian Schreck's research on quantum clocks and ultracold atoms was one of 13 projects selected for the Studiotopia initiative, linking art with science and culture with research. A professor at the Institute of Physics (IoP), Schreck combines complex systems of lasers, optics, electronics, mechanical components, vacuum chambers and software to laser-cool atoms to almost absolute zero. Using these atoms as very precise pendula, Schreck aims to build new quantum clocks that are not only more precise, but smaller and more transportable for real-world situations. Studiotopia pairs scientists and artists over a 17-month period, encouraging idea exchange on themes relevant to the UN Sustainable Development Goals.

PHYSICISTS WIN FIRST NWO COMMUNICATION AWARD FOR FORMULA MURALS

The very first NWO ENW Communication Award issued went to Leiden Wall Formulas project co-creators Ivo van Vulpen, a lecturer at the Institute of Physics (IoP), and fellow physicist Sense Jan van der Molen from Leiden University. The €10,000 prize recognises scientists who can translate their research to reach wider audiences. Together with the artist collective TEGEN-BEELD, Van Vulpen and Van der Molen create huge murals of physics formulas. Their first mural, featuring Einstein's field equation, appeared on a museum wall in 2015, a century after publication of the theory itself. All in Leiden, eight murals currently exist.

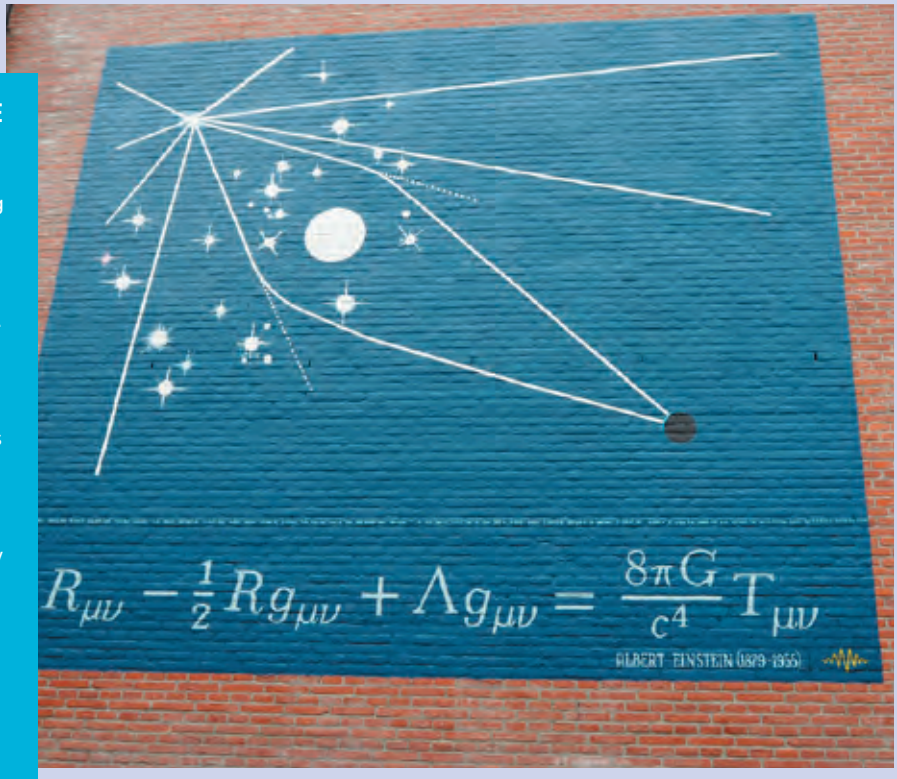
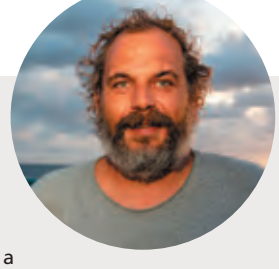


Photo: Project Muurformules, stichting TEGENBEELD

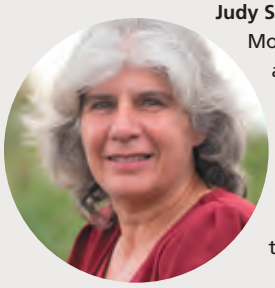
MEGA-PARTYGOERS MOVE LIKE OUR FORAGING ANCESTORS

Dance event visitors in large sporting venues move in ways that resemble foraging patterns of our human hunter-gatherer ancestors, found Informatics Institute (IvI) researchers. Philip Rutten, Michael H. Lees, Sander Klous and Peter M.A. Sloot used anonymised data to track movements of mobile phone-carriers at a 2017 performance by DJ Armin van Buuren in an Amsterdam football stadium. While the thousands of partygoers were clearly not just seeking food, drinks or mating partners, their movements exhibited properties typical of a pattern commonly observed in animal foraging. An article on the study went online in October and was published in February 2021 in *Physica A*.

Joris Mooij was appointed professor of Mathematical Statistics. His research focuses on causality. In his role as professor, he is continuing exploration into the subject with the goal of enabling reliable automated large-scale estimation of causal models from data to predict effects of interventions on systems. Mooij also teaches classes on statistics and data science.



Mark Vermeij was appointed professor of Tropical Marine Ecology. Vermeij's work on coral reef systems focuses on the evolutionary and ecological dynamics of benthic marine organisms. He also has a part-time appointment as research and deputy director at CARMABI marine research station in Curaçao. In his role as professor, Vermeij continues his focus on understanding to what degree organismal relationships contribute to the organisation and structure of coral reef communities.



Judy Shamoun-Baranes was appointed professor of Animal Movement Ecology. Shamoun-Baranes' research measures and analyses the movement patterns of animals in the wild in order to understand how animals respond to change. She is currently focused on birds' flight behaviour. Her teaching has an emphasis on human-animal interactions, biodiversity, environment and ecology. She also coordinates the European Network for the Radar Surveillance of Animal Movement (ENRAM).

Professor

Han Peters was appointed professor of Analysis. His research focuses on dynamic systems over the complex numbers, particularly in multiple variables. In an important breakthrough with co-authors from France in 2016, Peters demonstrated the existence of so-called wandering components. In his role as professor, he is investigating applications of complex dynamic systems in statistical physics.

Noushine Shahidzadeh was appointed professor of Crystallization in Porous Media. The aim of her research is to understand and control crystallisation and apply it to different fields where physical chemistry questions remain unresolved, such as the preservation and conservation of cultural heritage and artworks, civil engineering and the food industry. In her role as professor, Shahidzadeh continues working on inter-disciplinary projects in fundamental porous media research and research applied to other fields.

Marcel Worring was appointed professor of Multimedia Analytics. Worring researches access to large-scale multimedia data sources, using an approach that links automatic data analysis to interactive visualisations. In his role as professor, he is continuing research into intelligent technologies and their application across fields. Worring is co-founder of the Innovation Center for Artificial Intelligence (ICAI) and serves as scientific director of the Dutch National Police Lab AI and the AI for Medical Imaging Lab.

Full professors

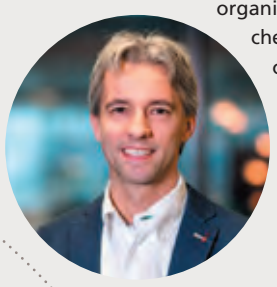
Marcel Vreeswijk was appointed professor of Experimental Physics of Top Quarks. His research is on quarks and leptons. The top quarks he studies are exceptionally heavy particles with measurable properties that provide insights into numerous fundamental interactions. With a global team, Vreeswijk is focused on working on the development of a new detector component at Nikhef, the Dutch National Institute for Subatomic Physics.

appointments 2020

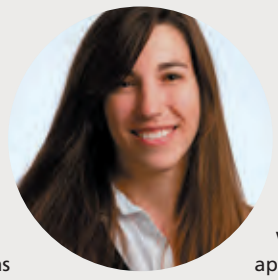
JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER

Joanna Ellis-Monaghan was appointed professor of Discrete Mathematics. Her theoretical research focuses on algebraic combinatorics, while her applied research uses and develops tools from discrete mathematics, topology, knot theory and computation. In her role as professor, Ellis-Monaghan continues work on an international initiative to develop a unified theory of graph polynomials. She also teaches courses in theoretical and applied discrete mathematics.

Titia Sijen was named professor by special appointment of Forensic Human Biology, a position established on behalf of criminalistics foundation Stichting Leerstoel Criminalistiek and facilitated by the Netherlands Forensic Institute (NFI). She is combining her work as professor with her position as team leader and senior scientific researcher at the NFI. Sijen has played a leading role in developing, validating and implementing various investigation methods.



Timothy Noël was appointed professor of Flow Chemistry. The aim of his research is to use cutting-edge technology to do chemistry faster, better and more safely, with the ultimate outcome of providing solutions to long-time problems in chemical synthesis. In his role as professor, Noël is teaching courses in organic synthesis, flow chemistry and catalysis.



Clarisa Sánchez Gutiérrez was appointed professor of AI and Health. She specialises in the development of automated solutions for medical image interpretation. In her role as professor, Sánchez Gutiérrez continues work focusing on the development and clinical implementation of socially responsible AI innovations in healthcare. She teaches in the fields of AI, computer science and information studies.

Willem Renema was appointed professor by special appointment of Marine Palaeobiodiversity, a position established on behalf of the Naturalis Biodiversity Center Foundation. He is combining his work as professor with his position as research leader of Marine Biodiversity at Naturalis. Renema is an expert in biogeography, paleoecology, coral reefs and marine biodiversity, and his focuses is on the origins and biodiversity of coral reefs in the Indo-Pacific.

Andy Pimentel was appointed professor of Embedded Computer Systems. In his research, Pimentel frequently works with external parties, such as the semiconductor company ASML. He leads five research projects funded by NWO and the European Union's Horizon 2020 programme. Pimentel teaches computer organisation, parallel system architectures and the programming and design of embedded computer systems.

Professors by special appointment

DIVERSITY & INCLUSION AT
THE FACULTY OF SCIENCE

Science4all

EVERYBODY MATTERS AND EVERYBODY IS NEEDED

The Faculty of Science published a Diversity and Inclusion Policy, outlining the ambitions in this area for the next three years. Naturally, we aim to ensure an inclusive learning and working environment in which students and employees feel at home. When everybody feels safe and well established we create the best possible conditions for talent to flourish. This also means that the Faculty of Science wishes to become more attractive to potential talent that is currently under-represented, such as young prospective students from migrant backgrounds and women talented in the natural sciences. A diverse and inclusive environment enables optimum development of all available talent and reaps the substantial benefits provided by a wide range of perspectives and opinions. This boosts the quality of research and teaching and amplifies our social impact.

We want to focus on accessibility and study success for students for whom studying at the university is not self-evident, collaboration in diversely composed teams, recruitment, selection, appointment, promotion and retention of employees with a diverse background, and identification and encouragement of good practices and knowledge exchange.

'Diversity and inclusion are everybody's responsibility,' says Dean Peter van Tienderen in the explanatory notes to the new policy document. The policy document was drafted with input from education directors, research directors, heads of faculty offices and the faculty diversity officer and was submitted online to all faculty staff and students. 'It isn't just a question of what the management thinks or does. The countless ordinary interactions that take place every day have a massive influence on whether people feel at home at the Faculty of Science, so we adopt the following policy: everybody matters and everybody is needed.'

FACES OF SCIENCE PARK

The debut Faces of Science Park event took place in February 2020. The event invited all staff members and students of the Faculty of Science and Science Park to participate in debates, lectures and workshops on the theme of 'Diversity and Inclusion in Science'. Organised by the Faculty's Diversity Officer and Diversity Sounding Board, the day encouraged attendees to join conversations about how to enhance diversity and better include the Amsterdam Science Park community in work being undertaken.

FACULTY LAUNCHES DIVERSITY JOURNAL CLUB

Encouraged by many discussions on diversity and inclusion in science that were held on campus over the summer, the Faculty of Science's Diversity Office and Diversity Sounding Board started the 2020-2021 academic year with a monthly Diversity Journal Club, open to all members of the community.

The Diversity Journal Club encourages open dialogues about diversity and inclusion in the context of science, such as how these issues play out in research and education. A first discussion point centred around the essay 'How Diversity Makes Us Smarter' by Katherine W. Phillips published in *Scientific American* in 2014. After a brief response to the article by Faculty Diversity Officer Machiel Keestra, participants could share their thoughts with each other.

WIF LAUNCHES STUDENT CHAPTER

Women in the Faculty (WiF) – a platform around since 2007 to support female scientists at the Faculty of Science – added a student chapter in May. WiF Students serves the interests of female students at the UvA specialising in science, technology, engineering and mathematics. The chapter was founded by five students from the computer science, artificial intelligence and biomedical sciences study programmes.

GRASSROOTS SCIENCE4ALL 2020 GRANTS AWARDED TO SIX PROJECTS

Amounting to funding between €500 and €5,000 per project, Grassroots Science4all grants went to six winners in 2020. Staff and students were called to apply for financial support for projects intended to improve diversity and inclusion at the Faculty of Science.

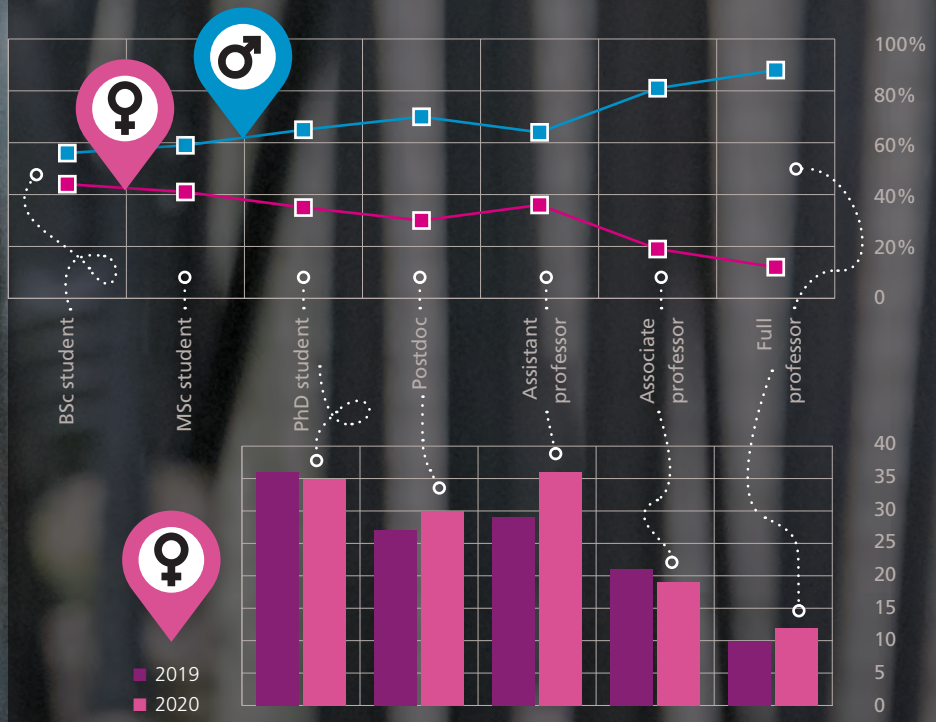
Gender balance facts & figures

The winning project topics include:

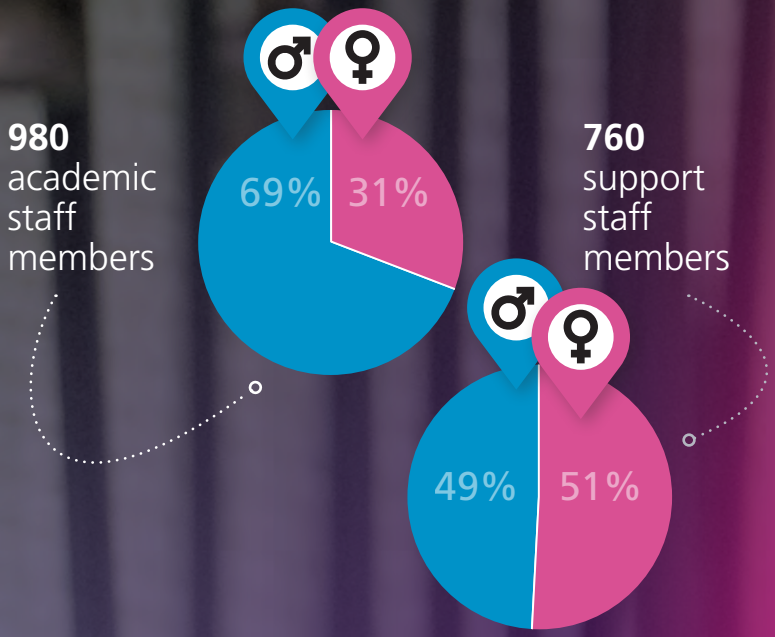
- Boosting Bachelor's students of a non-Western background at the Faculty and sparking interest in beta sciences in schoolchildren from underrepresented or disadvantaged communities
- Providing solutions to resolve inequalities in education due to the COVID-19 pandemic
- Awareness-raising on to diversity, or lack thereof, in science
- Helping first-generation students transition to college by spotlighting Faculty students as role models
- Preparing to host the Women in Data Science Amsterdam event in 2021
- Presenting a scientific interpretation on intersectionality within the natural sciences. In 2019, this project's applicants received the same grant, with which they presented a clothing line with garments that were made from a method of fermenting tea and also served as a snack for the public

INVIGORATING CONVERSATIONS

The Faculty Diversity Office noted in their annual report that the pandemic and Black Lives Matter demonstrations contributed to 'invigorating conversations and expectations regarding diversity and inclusion at the Faculty of Science' and that 'many conversations with staff and students about these events showed that many feel very engaged and concerned' about diversity, inclusion and equity, while often being surprised to learn about the uncommon obstacles and challenges that some of their fellow community members are facing.'



Improving the gender balance among scientific staff at the Faculty of Science continues to have our full attention. In 2018, we implemented several policy changes with this aim. Since then, the number of female full professors more than doubled, and the overall percentage of women in senior academic positions increased from 17.8% to 23.4%. The increase is partly due to successful recruitment in the context of the MacGillavry programme. When recruiting for the Science and Technology sector plan positions, we were able to fill 52% of the positions with female researchers.



A head start

Through various outreach initiatives the Faculty of Science helps schoolchildren of all ages to get acquainted with science and to prepare them for their own academic pursuits.

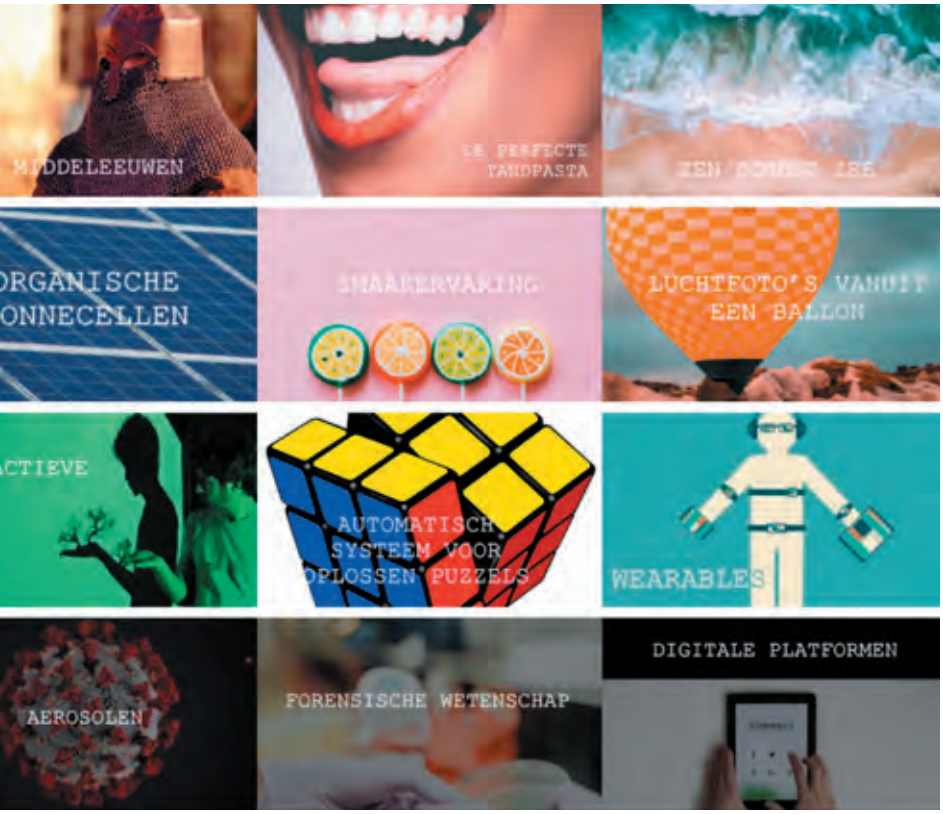
UVA LEADS HIGH-SCHOOLERS ON A QUANTUM QUEST

Maris Ozols and Michael Walter (KdVI, ILLC, IoP) who also work as researchers at Dutch research centre for quantum software QuSoft, led another edition of 'The Quantum Quest'. Since 2018, the course has guided high school students through the basics of quantum mechanics, computers and software.
For the 2019-2020 academic year, over 100 Dutch high school students, 15 teachers and 20 international students were selected to participate. The online course was taught in Dutch and English, and participants used quantum simulator Quirky, which conveniently runs on a web browser.

SUMMER SCIENCE ACTIVITIES AT VRIJLAND

Spotting a new planet, building robots and solving crime like a forensic detective: children experienced all of this in 2020 at VrIJland, an outdoor playground and workspace in the eastern islands of Amsterdam. Over the summer, seven to 12 year olds from diverse backgrounds attended weekly science workshops led by UvA students. Parents were welcome to join too, and jumped in every now and then to watch an impressive chemistry experiment, gaze at the stars or help their child with a challenging puzzle. Some participants were so enthusiastic that they wanted to follow the same workshop twice.

Photo: Freepik-sdecoret



A COVID-19-PROOF PLATFORM TO SUPPORT SECONDARY SCHOOL RESEARCHERS

How do I formulate a good research question? How do I to set up a sound experiment? How do I find trustworthy sources? These questions are typical of those that might arise when pupils in their final year of secondary school in the Netherlands work on an intense final research project known in Dutch as a *'profielwerkstuk'*.

To help this group during the COVID-19 pandemic, staff of the UvA, the VU Amsterdam and educational network Bètapartners created the website www.profielwerkstuk.nl. Through it, pupils can find tools, resources and other forms of help when researching scientific subjects. If they have questions that are not answered on the site, a pupil can contact a university student or lecturer with expertise in the subject. In joining forces, both universities hope to support as many students as possible as well as link with more universities in the future.

STUDENT IMPACT CENTRE CHAMPIONS EQUAL OPPORTUNITIES (AND 180 HOURS OF WEEKLY HOMEWORK)

The newly established Student Impact Centre (SIC) aims to support Faculty of Science students in being more involved in society through promoting or funding existing or new initiatives, which can be led by the Faculty or students themselves. By encouraging science, technology, engineering and mathematics students 'who seek to make a meaningful contribution to society on top of their studies,' said SIC project coordinator Moataz Rageb, SIC hopes to help 'them apply their understanding of science and any other talents they may have in a meaningful way while they are still at university.'

One of SIC's main points of focus is on equal opportunities in the education system. In this spirit, one outreach initiative is StudieHub, supported by the non-profit organisation Diversity Talks. StudieHub enables UvA students to give free homework help to upper secondary school pupils from low-income families. Besides homework guidance, the UvA students provide pupils with an early introduction to higher education and serve as role models who can answer questions about their studies and lives as students.

Homework supervision traditionally takes place at the Amsterdam East location of Cybersoek. This organisation, which was established in 2001, has several spots offering a place for walk-ins to get cost-free digital support and lessons. At Cybersoek – its name comes from the Arabic word for 'market' – the pupils can schedule to come by three days a week, finding a quiet location with necessary facilities for their work. Most participants are members of the first generation in their families to pursue this education. Under StudieHub's guidance, they can work on boosting their self-reliance, setting goals and working independently and on a team.

Over the past year, StudieHub provided its services digitally and on location in accordance with COVID-19 restrictions measures. During this period, UvA students, in collaboration with six surrounding secondary schools, helped some 80 pupils with homework guidance. With over 15 UvA students involved in the supervision, about 180 hours of homework guidance took place per week at StudieHub. The reported pass rate of the pupils was 95% last year. StudieHub has since found it has a surplus of motivated students and high school pupils, but a shortage of space to meet their needs. To this end, there are ambitions to open a second location, discussions about which have begun with various Amsterdam city officials and social partners.

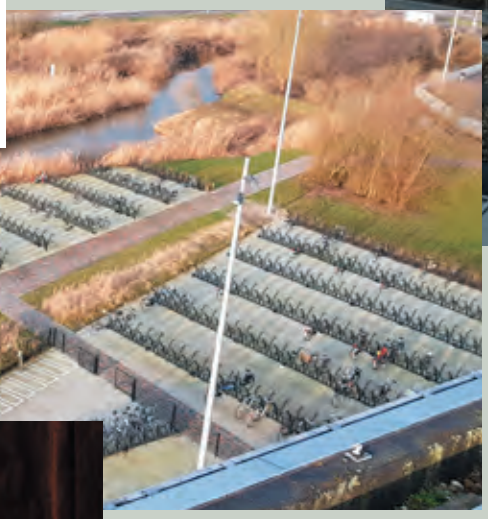
Doing our bit

With the COVID-19 pandemic forcing most of us to work, study and socialise from home, 2020's figures in energy consumption, mobility and waste hardly compare with those of before. Still, the Faculty of Science kept up diverse efforts to reduce its negative impacts on the environment at present and in the decades to come.

STREAMLINING WASTE STREAMS AT SCIENCE PARK

Students helped pilot a project to determine how to best sway people's correct waste-separating behaviour. Its preliminary results show that in public spaces at Science Park, waste is best divided into five categories: organic; paper; coffee cups; PMD (plastic, metal and drink packaging); and non-recyclable waste. The pilot's results are intended to be part of input to devise a waste tender for the UvA in 2021.

Since the end of 2019, the skylight above the central hall of Science Park 904 has consisted of glass plates with integrated solar cell technology in 70% of its surface. Because 2020 had more hours of sunshine than an average year, the skylight delivered more than the expected annual yield of 27,000 kWh of electricity.



MEASURES TO REDUCE ENERGY USE AT THE FACULTY OF SCIENCE

- The sunblinds at Science Park 904 became temperature-responsive, shutting at night to keep heat in and staying open even in cold weather if sunny.
- Buildings E and F got equipped with local electric boilers for hot tap water, reducing gas consumption.
- A newly implemented energy performance contract with the Faculty's maintenance service provider ensures oversight and responsibility of priorities, such as energy transition.

MORE ROOM FOR BICYCLES

Construction of LAB42 required moving out the old bicycle parking facility. But bigger and better, a new one has come in its place. There is now room for 1,600 bicycles. Both single and double-sided racks were installed, along with eight four-socketed charging stations for electric bikes. Part of the facility is reserved for scooters, cargo bikes, motorcycles and other special two-wheelers. Staff and students who want to park in a locked area can do so by using their UvA ID card to gain access through a gate. This expansion honours the Faculty's policy to facilitate sustainable mobility and promote more of it, such as through accommodating pedestrians, cyclists and those who take public transportation.

GREATER AND GREENER SPACES FOR FACULTY ACTIVITIES

LAB42's construction and the subsequent bicycle parking relocation led to some de-greening of the area. But the Faculty of Science, together with the UvA, took action. With student input, a design was drawn up to add or enhance green areas outside the new bicycle parking. The design incorporates biodiversity by including a mix of flowers and plants as well as a pond. To accommodate the Faculty's various activities, open space is also built into the layout. Greenery fills the gravel pit at the main entrance to Science Park 904, and because all life needs it, water is made more readily available via an additional tap. This design came to life, when outdoor renovations began in early 2021 and are due to conclude before autumn.

Interior images: Studio Groen + Schild. Exterior images: Bentherm Crouwel Architects

LAB42 Under construction

In October, robot Pepper gave the official go-ahead for the construction of LAB42 to begin. The new building is scheduled to become operational by August 2022, serving as a hub for innovative research and teaching in the information sciences, as well as co-creation with partners in industry and society.

LAB42 is a collaboration between the UvA, the City of Amsterdam and the business community. The 42 in its name is a reference to the answer to life calculated by a supercomputer in science fiction series *The Hitchhiker's Guide to the Galaxy*.

LAB42's design incorporates principles of sustainability, circularity and energy neutrality. For example, rainwater will be collected and used for flushing toilets; solar panels will be installed on the roof and façade; server rooms will use smart cooling. The building will feature teaching and lecture halls, meeting rooms, offices for small businesses, catering facilities, research facilities, workstations and spaces conductive to AI collaboration with other UvA disciplines and external parties.

Commencement of construction was celebrated entirely in the spirit of LAB42. In a livestream, there were talks by representatives from the City of Amsterdam and the architecture team. Viewers could take a VR tour of the premises. Speaking via homemade deepfake videos, famous scientists from history gave their blessing. And then, robot Pepper, a future resident of LAB42's RoboLab, symbolically put the pile driver into operation.

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Interviews by Joost van Tilburg (p.10-13, 36-39, 50-53, 58-61) and Edda Heinsman (p.18-21).

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