Science in Amsterdam

Overview 2015
About

This 2015 overview gives an insight in the intense collaboration between the science faculties of the Vrije Universiteit Amsterdam (VU) and the University of Amsterdam (UvA), in the field of education and in research. In this publication you can read articles that were published in the light of the series 'Science research in Amsterdam'. The articles highlight several research projects in which UvA and VU collaborate and how they, by doing so, strengthen their expertise.
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It is a privilege to be able to work with passionate scientists and lecturers who are all working together to create momentum in teaching and research. The past year, I have felt that privilege first-hand. I am proud to present this selection of research projects in which scientists from the science faculties of the University of Amsterdam and Vrije Universiteit Amsterdam have been pooling their expertise.

Their collaboration did not occur incidentally, as evidenced by the request of three major groups of scientists to formalise their collaboration. The scientific fields of Physics & Astronomy, Informatics, and Earth, Ecology and Environment are exploring the possibility of working as a collaborative UvA-VU institute. This will enable them to make optimal use of the expertise present in Amsterdam.

2015 was also the year in which UvA and VU received accreditation for six joint degree programmes. From next year, UvA and VU will be issuing joint degree certificates for the Bachelor’s degrees in Physics & Astronomy and Chemistry, as well as for the Master’s degrees in Physics & Astronomy, Chemistry, Computational Science and Computer Science. This is an enriching development for students. They will be taught by the best researchers in Amsterdam and their Master’s degree programmes will allow them to choose from the entire range of sciences offered by UvA and VU.

These are great, tangible outcomes, all of them emerging from the most important thing required for high-quality scientific research and teaching: the passion of scientists themselves. Together, they expand the limits of our knowledge. You can read their stories on the following pages. I hope that by reading them you will come to share some of their passion too.

Prof. Karen Maex,

Dean Faculty of Sciences (VU), Faculty of Earth and Life Sciences (VU), Faculty of Science (UvA)
Karen Maex
concrete marriage,’ says Michel Haring. ‘A major step forwards,’ Nico van Straalen agrees. ‘There’s no going back now.’ For both Directors of Education, 2015 was first and foremost the year in which six joint degrees were applied for and accredited, with approval from students and staff alike. Six degree programmes in the fields of chemistry, physics and informatics for which students will no longer receive a UvA or VU diploma but a diploma bearing the names of both universities.

No more makeshift solutions
‘Last year it was immediately clear to us that good cooperation depends on good communication: on discussing everything,’ UvA Faculty of Science Director of Education Haring explains. ‘The education systems, the operating systems: UvA and VU are very differently organised. The differences had been noticeable before,’ he says, ‘but you could arrange things within your own organisation or devise makeshift solutions. That’s not what we want for the future.’

This became evident during talks about the new Teaching and Examination Regulations, for example. Over the past year, the collaborating faculties also reached agreement in this respect, says Van Straalen, Director of Education at the VU science faculties. ‘That may seem a formality, but it demanded discussions between two boards and three faculty student councils. The two universities will jointly award a diploma for the joint degrees, so the requirements of both universities will have to be met.’ The UvA Faculty of Science organisation is more decentralised than the VU faculties, he continues. ‘Thankfully, the VU rector has given me the freedom to tailor our policies for the science collaboration,’ Van Straalen explains.

Wide support
Research-related teaching, high-quality degree programmes and the importance of academic skills and values. According to Haring, these are the crucial elements of the joint Vision for Education, which was also completed in 2015. ‘Students, lecturers and management staff devoted a lot of time to this,’ he explained. ‘It wasn’t something we wanted to do in three months. The vision we now have is a widely supported one that many people contributed
to.’ He calls it highly valuable and enlightening that the cultural differences between the VU and UvA have also been discussed, with their backgrounds and character seeming so very different. ‘Turns out many underlying values are actually very similar,’ Haring concludes.

‘The vision does not describe the future of the degree programmes. That is something the Exploratory Committees too are considering,’ says Van Straalen. With members from both the UvA and VU, the Exploratory Committees develop strategic plans for education. This can lead to joint degrees but also to raising the profile of a programme. ‘Take Biomedical Sciences. Students are very well able to explain the difference between their programme and that of the other university. This is not reflected in the information material, however. We aim to reflect the differences more clearly,’ Haring explains. ‘We will remain two different institutions, but a degree programme may be joint or complementary,’ Van Straalen adds.

International committee
In September an external international committee assessed the progress of the joint education. Van Straalen: ‘This prompted us to continue following this path. The committee even felt we could take it much further, to teacher-training programmes in the natural sciences, for instance. These are so important, we really should present them collectively.’

Van Straalen feels it is thanks to the tremendous efforts of staff and students that so much was achieved over the past year. ‘This must continue. Things sometimes came to a standstill in the past, but now there is a willingness to develop cohesion. Add a little extra energy and you can really achieve something,’ he concludes. Haring agrees: ‘I was moved by how this cooperation has made me notice that we have very good people working with us. People who want to achieve things, and actually manage to do so. The dedication and commitment they demonstrated makes me quite proud.’

The combined educational portfolio is presented at www.science-in-amsterdam.nl.
Researchers at the science faculties of UvA and VU are joining forces to create one of the major science hubs in Europe. Our research areas cover virtually every field of science, with an excellent mix of fundamental, curiosity-driven research and applied research in areas such as climate, sustainability and health. The National Science Agenda recently highlighted the most urgent questions collected from a wide variety of sources in Dutch society. Our main research programs are well-aligned to significantly contribute to solving major societal problems, often in an interdisciplinary context, always based on a strong fundamental foundation.

2015 - Year of new initiatives

A significant part of the research collaboration is funded by grants provided by the Amsterdam Academic Alliance (AAA), the joint effort of UvA and VU to stimulate collaboration between both institutions. AAA fellowships helped to attract six top scientists to Amsterdam. Furthermore, major AAA grants were dedicated to initiate three interdisciplinary research programmes. In the area of Big Data, scientists from the field of informatics started the Amsterdam Data Science initiative, partnering with researchers in the life sciences, economics and humanities. Amsterdam Water Science is a unique interdisciplinary programme focusing on the biological, chemical and physical processes in water systems and an integrated view on water management. Finally, the Solardam initiative enables researchers from the fields of physics, chemistry, life sciences, and engineering to develop novel technologies for renewable energy sources.

Collaborative research and education

A major milestone in the UvA-VU science collaboration is the initiative of departments from three scientific areas to create joint research institutes. Although there are still many administrative hurdles to be taken, our colleagues in these three domains – Physics & Astronomy, Computer Science and Earth, Ecology & Environment - have the intention to fully align their research programmes and to enhance the visibility of their institutes in the highly competitive international research context. Also in 2016, the new building for Human Life Sciences will bring together, for the very first time, researchers from UvA, VU, and the two medical centres to establish a truly multidisciplinary research environment in the area of Human Life Sciences.

All in all, in 2015 enormous momentum has been created to advance Science in Amsterdam.

Prof. Peter van Tienderen, Vice Dean of the Faculty of Science (UvA)
Prof. Hubertus Irth, Vice Dean of the Faculty of Sciences and the Faculty of Earth and Life Sciences (VU)
The time is ripe for data science,’ says Maarten de Rijke, director of Amsterdam Data Science, a network organisation in which 300 Amsterdam-based scientists exchange knowledge and forge partnerships within and outside of the academic community.

Data science, according to De Rijke, is quite simply the science of data: ‘Extracting meaning, reasoning, making files searchable, visualising, acting intelligently and informing.’ You can approach data from two different perspectives, he adds. ‘First, you can look at the type of data: text, numbers, images, sensory data. But you can also look at domains. Data are from different domains, like the medical, financial domains or the creative industry. Data are everywhere.’ He mentions the example of log files from internet search engines. ‘What did a person look for, when, and what did he click on? Data scientists will look for patterns in those data, which also involves behavioural components. That’s why we have many collaborations not just within computing science but with many other academic disciplines, including medicine, economics, humanities and behavioural sciences.’

**Older disciplines**

Although data science is relatively new, says De Rijke, it is rooted in older disciplines such as machine learning and data mining, as well as in more general scientific disciplines such as computing science and statistics. ‘In recent years the amount of data and computing power has increased exponentially to enable all those disciplines to work in a concerted manner.’

This is done at Amsterdam Data Science, a network organisation established in 2013 whose members include UvA, VU, Amsterdam University of Applied Sciences (AUAS) and CWI (the national research institute for mathematics and computer science in the Netherlands). The
organisation was set up to facilitate collaboration in research, enable its members to help each other with fundraising, valorisation and education – the latter being reflected in the involvement of Amsterdam Data Science in 13 Master's programmes.

**Close ties**

There already were close collaborative ties between computer scientists from VU and UvA, De Rijke explains, in which each contributed their own specific specialisation. ‘The scientists at the VU tend to approach reality from a model-based perspective and establish patterns of reasoning accordingly, while people at the UvA take a more data-centred approach of the world around them and try and draw valid conclusions from that perspective. These two approaches are quite complementary.’ He also believes that the collaboration between non-academic partners such as the city of Amsterdam, the Netherlands Institute for Sound and Vision, Elsevier, Yandex and medical centres is a source of inspiration: ‘They often encounter very inspirational data issues that our algorithms can help resolve, while we benefit from the opportunity to test our algorithms in practice.’

**Frequent contacts**

The contacts at Amsterdam Data Science are frequent and can be found at all levels, he continues. For example, he himself carries out research at the VU one day a week on search engine technology and the associated algorithms. Once every three months a broad-based meeting is held, hosted by one of the four partners. ‘This includes presentations, often by external stakeholders, but it’s also, and especially, an excellent occasion for the participants to tell the others what they’re doing and to discuss things. We call that coffee & data science.’

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**HIGHLIGHTS**

Amsterdam Data Science

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In 2007, chemists Evert Jan Baerends of VU Amsterdam and Daan Frenkel of the University of Amsterdam decided it made sense for the two universities to collaborate more closely in the field of molecular modelling. The two professors went on to become the founding fathers of the Amsterdam Center for Multiscale Modeling (ACMM).

‘This was a genuine bottom-up initiative,’ says VU professor of Theoretical Chemistry Lucas Visscher, the current director of the ACMM. ‘The two research groups – Quantum Chemistry at the VU and Molecular Simulation at the UvA – were interested in each other’s work and each had a growing need to make use of the other’s methods, software and expertise.’

Solar cells
About fifty people now work at the ACMM. Visscher explains what they do: ‘The ACMM focuses on the question: how can you improve molecules? We develop new modelling techniques. Modelling can now take place on an increasingly large scale and at a faster pace thanks to the constant advances in the world of computers. This remains an ongoing trend.’

One prime example of an application in which the ACMM is engaged, lies in the world of photochemistry. ‘Along with our experimental colleagues, we are developing solar cells that can convert the sun’s energy into chemical energy,’ says Visscher. ‘It’s similar to the process that occurs naturally in plants and trees.’

Leading the way in Europe
‘Until the mid-1990s, chemists working with models could only analyse the behaviour of existing molecules,’ Visscher recalls, ‘but now we can use computers to design molecules without having to first make them in the lab. Historically there has always been a traditional division between the two branches of theoreti-
cal chemistry, each with its own culture, its own conferences and experts. Now these research areas are gravitating towards one another, as evidenced by the 2013 Nobel Prize for Chemistry, which went to a joint development in Quantum Mechanics and Molecular Mechanics.

In the Netherlands, the ACMM is the focal point where expertise from quantum chemistry and molecular mechanics converges. ‘In Europe, the Netherlands is leading the way in this area,’ says Visscher proudly. ‘There aren’t many countries where all the expertise is concentrated in one city, like it is in Amsterdam.’

**Shared supercomputer**

Twice a year, the ACMM holds a symposium, often focusing on a single theme. Experts from the Netherlands and abroad exchange ideas at these biannual events. ‘In the course of their work, researchers, teaching staff and PhD students see each other regularly on the VU campus or at Amsterdam Science Park,’ Visscher says. ‘As a group we are more and more inclined towards Science Park, for both teaching and research. The universities’ joint Bachelor’s and Master’s programmes are now based at Science Park and it’s also where our shared supercomputer is housed. Developments like these are bringing us ever closer together.’

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<th>HIGHLIGHTS</th>
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The year started auspiciously for Solardam: two years after its founding, the consortium received seed capital for eight postdocs. The initiators are anxious for them to start as soon as they can. ‘We’re all chemists, physicists or biologists; these are going to be real Solardam people.’

Complementing areas of expertise

Solardam is studying the conversion of solar energy into electricity and fuel. The first workshop was held at the end of 2012. Among the 30 participants were Tom Gregorkiewicz, professor of Optoelectronic Materials at the UvA Institute of Physics (IoP), and Joost Reek, professor of Homogeneous Catalysis and director of the UvA Van’t Hoff Institute for Molecular Sciences (HIMS). Gregorkiewicz says that everyone there was already studying solar energy within their own discipline. ‘But the subject matter is complex. So we thought, if you join forces, you get synergy, which increases your overall understanding.’

Reek continues: ‘Individually, the different institutes possess tremendous expertise, but each one has its limitations.’ He cites an example from his own research, in which his team is investigating the possibility of converting water into fuel. According to Reek, ‘Producing molecular components is what we excel at. But we also need devices to convert them. We read about those in the literature and then we experiment. It’s fun, but there are physicists at AMOLF who are real experts at designing devices. And then at VU there are physicists specialised in spectroscopic measurements of light capture and charge separation. Their data is extremely
useful for us. Therefore, our areas of expertise complement each other really well.’
One of Gregorkiewicz’s activities involves modifying the colours of the light spectrum. At the 2012 kick-off meeting, he discovered that biologists are also interested in this topic. ‘In many cases, bacteria only use one or two colours in their conversions, so if you want to use them, you lose a lot of energy.’ As a physicist, he knows how to minimise the loss, for example by only providing them the light that they actually use. By giving the bacteria different light pigments, they can also sometimes use a wider part of the spectrum.

**Working together at Amsterdam Science Park**

According to the two researchers, consortiums are working on new forms of solar energy in various parts of the world, so they are all the more delighted to be expanding the existing Amsterdam partnerships with the postdoc programmes to form a coherent programme. They also want to provide interdisciplinary training to students. If it were up to them, all Solardam members would soon come together in one Science Park office, although a few will probably work from the VU campus. However, the location issue will likely resolve itself in due course: in the near future, both ECN’s photovoltaic research and a large part of VU physics will move to Science Park. But they are already cooperating effectively now. Gregorkiewicz: ‘The energy is fantastic.’

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**HIGHLIGHTS**

Amsterdam Solar Energy Research Initiative: Solardam

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U Amsterdam’s Joen Luirink studies processes in bacterial cell envelopes. One of his projects focuses on a protein complex that plays a crucial role in the division of bacteria. Cell division is also the focus of the Bacterial Cell Biology research programme at the University of Amsterdam. Together, the researchers are working at the Swammerdam Institute of Life Sciences to shed light on this mechanism. And their efforts have not gone unnoticed. ‘There is widespread interest in this research.’

Which factors are involved in the mechanism of cell division? Luirink, who runs the research group at the Department of Molecular Microbiology at VU Amsterdam, is intimately familiar with this very question. ‘It’s all about the proteins,’ he explains. ‘Certain proteins assemble at a specific time in the middle of the bacterium. From there, they draw in the cell wall, which eventually results in the division of the cell. This gives rise to two identical daughter cells. We study the proteins involved in this constriction, since they are essential for the division and survival of the bacterium.’

Complementary knowledge
Since 2007, he has been working closely with Tanneke den Blauwen of the Bacterial Cell Biology research group at the UvA’s Swammerdam Institute for Life Sciences. Luirink is very pleased with their cooperation. ‘Tanneke is a real expert when it comes to cell division and the use of microscopy and other methods to study this process. Our expertise is more in the field of membrane processes, and our approach involves a greater degree of biochemistry and molecular biology. The two research groups really complement each other well.’

The role of proteins in cell division is also interesting from an applied science point of view. ‘They can be used as a target for antibiotics,’ says Luirink. ‘Cell division is a delicate process. If you develop substances that affect cell division proteins, then you can likely also inhibit growth. There is tremendous interest in our research thanks to this potential new application.’

Exchange and hospitality
Luirink feels that the collaboration between the two universities is a very positive development. ‘We get together every two months to exchange experiences and compare notes, and our PhD students join us. And we have regular consultations by telephone or e-mail about project applications or results. We exchange materials, and our PhD students sometimes go to the UvA for a trial and vice versa. It is a true exchange of knowledge and materials, and also of courtesy privileges to conduct trials in each other’s labs.’

The current level of collaboration will get even easier later this year, when both research groups move to the new Building for Human Life Sciences on the VU campus.
HIGHLIGHTS  Bacterial Cell Biology

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Talking about their research is an important activity for mathematicians, but an audience of five colleagues is just too small. And so, every two weeks, UvA researchers and their VU colleagues come together to attend a lecture on dynamic analysis. ‘We often have twenty people in the lecture hall, that’s a nice crowd.’

These are the words of researcher Han Peters of the Korteweg-de Vries Institute for Mathematics (KdVI), organiser of the seminar on behalf of the UvA. The venue alternates between de VU campus and Science Park. ‘It’s like this,’ says Peters, ‘someone stands at the blackboard for 50 minutes describing their work, often writing up formulas, and now and then they answer questions. Afterwards we all go for a drink.’ Naturally, VU and UvA researchers talk about their own work at the seminar, but mathematicians from other institutes in the Netherlands or neighbouring countries are also invited to speak. The choice of an inclusive name was a deliberate one, explains Peters. ‘It covers a broad range: symplectic geometry, real and complex dynamics, applied dynamics.’

**Great wealth of behaviours**

This field of research concerns how things change over time. From the very abstract to the very concrete, says Peters. By way of example, he mentions his own research: polynomial iteration. ‘Let’s say I have a function $x^2+5$. I can input a number in this function, calculate...
the output, then use the output as the input, and so on. That creates an orbit that you could see as, say, a model for the path of a satellite. In his actual research, he works with polynomials that depend on several variables. ‘The paths involved in realistic practical models are usually so complex that they can no longer be described with certainty. We look at systems that are so rigid that they can be precisely understood, yet at the same time produce a great wealth of behaviours. This is exactly the place where interesting mathematics can be found.’

**Unexpected questions**
Peters came to work at the UvA six years ago with a Marie Curie grant, which he used to invite speakers. Something similar existed at the VU, he explains. ‘I gave two lectures there, and then I was asked to combine the events. Right from the outset that seemed like a great idea.’

Whereas many fields of science involve collaboration, as a rule Peters doesn’t work directly with colleagues in Amsterdam. ‘Accordingly, the aim of the seminars is not to publish jointly, although that would be nice,’ he explains. ‘The most important thing is to have a really thorough discussion of your work with other mathematicians.’ And a combined group of VU and UvA researchers includes enough colleagues that you can tackle issues from different perspectives, he continues. ‘Sometimes I am asked questions I’m not expecting; but they can help develop my thinking.’
Chemicals in drugs end up in our waste water and in the environment. Fortunately, some microorganisms may be able to break down these harmful substances. Exactly how these bacteria do this is being investigated jointly by the Earth Surface Science subgroup at the University of Amsterdam and by the Molecular Cell Physiology subgroup at VU Amsterdam.

Just imagine: if you go outside with a spade, each gram of earth you dig up will contain about one billion bacteria, representing at least ten thousand different species. Groundwater, too, contains millions of different species of bacteria. And these microorganisms have an important job to do: clearing up our waste (including chemical waste). This waste includes the drugs we use, which are transported into water (and groundwater) via urine. Wilfred Röling (VU) notes that ‘Substances derived from anti-epileptic drugs are now present in groundwater at measurable levels.’

Breaking down
‘The pharmaceutical industry is involved in the large-scale production of new chemicals for medicines. It is important to know whether the substances they use for this purpose are biodegradable. A given chemical might well be very useful in a drug, but if it enters the environment there is no way of getting rid of it. Röling explains that ‘Before you know it, these substances will have entered the groundwater, and you’ll end up drinking them.’

He is collaborating in this study with John Parsons (UvA-IBED). Together, they want to find...
out how quickly microorganisms can adapt to pollutants of this kind, and how effective they are at breaking them down.

**Joining forces**

To investigate such processes, samples taken at a waste water treatment company are examined in the lab. Wilfred Röling points out that ‘here we are using a new technique, which involves adding water to the bacteria continuously, rather than adding a certain amount just once. That way, you are working with a system that more closely resembles the microorganisms’ natural habitat.’

The University of Amsterdam research team is focusing on changes in the substances contained in the drugs used, while the VU Amsterdam team examines the microbiological aspects involved. They identify the species of microorganisms that are present and the pathways by which pollutants are broken down.

The collaboration between Wilfred Röling and John Parsons is based on a long-standing professional relationship. ‘Our first collaborative research venture dates back to 2002, and we have kept in touch ever since. They have greater expertise in the field of environmental chemistry, while our strengths lie in the area of microbiology. I hope that our recent study will lead to further collaborative projects in the future,’ Röling says.

To our great dismay our friend and colleague, Dr Wilfred Röling passed away on 25 September 2015 at much too young an age, at a time when he was making discovery after discovery in ecosystems biology. The work Wilfred described in the interview is being continued much in his spirit, by his many sad, but enthusiastic colleagues and students.

Hans V. Westerhoff
(Molecular Cell Physiology, VU and Synthetic Systems Biology, UvA)
The University of Amsterdam and VU Amsterdam are home to a high concentration of analytical chemistry professionals. ‘In addition to our individual strengths, we offer a very special, highly unique combination,’ says Peter Schoenmakers, professor of Analytical Chemistry at UvA-HIMS. All the more reason, in other words, to consolidate all our professional knowledge under a single banner: the new Centre for Analytical Sciences Amsterdam, or CASA for short.

Schoenmakers searches through a long list of PowerPoint files on his computer with the word ‘CASA’ in their title. As he explains, the centre was originally conceived of five years ago and comprises five chemical chair groups at VU and UvA. Three of these chairs were occupied by new professors over the past few years. ‘Our old staff were great, and the new team feels right as well. We’re ready to get to work, in other words,’ explains Schoenmakers as he clicks on a recent file.

**Official launch year**

It turns out to be a PowerPoint presentation that will be used to present CASA to colleagues from the UvA and VU on 24 April; 2015 is set to be the centre’s official launch year. CASA’s research revolves around the analytical separation of complex mixtures, the detection and characterisation of the various components they contain and analysis of their interactions. Or, as Schoenmakers sums it up rather more succinctly: ‘We do the measuring.’ Analytical chemistry makes up a major part of the broader field of chemistry, he continues, which could not exist without measurement. Food safety would be a good case in point. ‘People don’t want to eat food produced in a chemical factory.'
We eat a great deal of natural products, such as foodstuffs made from bacteria and yeasts. Every day, tens of thousands of staff in laboratories throughout the Netherlands conduct chemical measurements of food and other substances. Schoenmakers: ‘We’re basically the top of that pyramid.’

They are working to develop, improve and optimise chemical measuring methods. The five chairs – three of which are accommodated at the UvA and two at the VU – overlap significantly in fundamental areas. ‘Apart from me, they’re all experts on mass spectrometry’, Schoenmakers illustrates. ‘We strive to achieve synergy without competition. Our respective specialisms lie in the practical applications.’ For example, Schoenmakers specialises in forensic applications. CASA also covers areas such as food, pharmaceuticals, the environment and polymers.

**Chair groups**

In addition to the five chair groups, CASA also comprises six part-time professors specialising in the five fields, as well as art studies. These professors are funded by and partly employed by businesses. CASA members also frequently conduct projects in collaboration with the business sector. ‘This form of collaboration offers a great deal of support, both in terms of relevance and funding.’ Finally, CASA will also offer joint education, comprised of both the existing Master’s in Analytical Sciences and an Honours programme. In addition to their monthly meetings at the centre itself, the partners meet far more frequently outside of CASA. ‘There were weeks in 2014 where I’d start every day at the VU by preparing joint proposals,’ Schoenmakers explains. CASA will offer chemists the critical mass they need to bring in larger projects, he emphasises. ‘We’re now ready to get to work.’
Academic staff at VU Amsterdam’s Network Institute and the University of Amsterdam’s Master’s programme in Game Studies have created a new platform. A group of researchers working in the field of Applied Gaming. This involves the creation of computer games for uses other than pure entertainment.

Last year, Tibor Bosse (Computer Science, Artificial Intelligence, VU) spent a few months working at Science Park in the context of an exchange project. There, he met Sander Bakkes (Graduate School of Informatics, Game Studies, UvA), a researcher who, like Bosse himself, is very active in the field of Applied Gaming. Both men shared the conviction that there is a need for a cooperative group of researchers, taking different approaches to this topic. Together they founded a new platform: the Amsterdam Applied Gaming Research Community. ‘We wanted to combine expertise from a range of different academic disciplines. Applied Gaming is a ‘hot topic’ and the Netherlands is a major international player in this field.’

**Lifelike**

According to Bosse, the majority of the researchers involved have a background in Computer Science. In addition, a significant number of the platform’s members are affiliated either with the Center for Creation, Content and Technology (CCCT) or with the Network Institute. ‘In developing games, our aim is to make them look as realistic as possible, with lifelike characters and plausible discussions.’

However, the group does not rule out the possibility of extending their work to other domains. ‘Individuals from a range of academic disciplines
have expressed an interest in Applied Gaming. Human movement researchers, for example, are focusing on how games can be used to get people to take more exercise. Humanities researchers are currently exploring games that train the hearing impaired, to stimulate their hearing. And psychologists want to identify the effects of games,’ says Bosse.

Angry doll

He, himself, is currently heading a gaming project for Amsterdam’s public transport operator (GVB), in which public transport staff learn how to deal with aggression. Together with a group of colleagues, he developed a game that creates a virtual world for tram conductors. ‘It looks just like the inside of a tram. Passengers step in and out, talk to one another, or get angry. The tram conductors then have to decide how to deal with this. During the game, they can indicate their actions by answering multiple choice questions. If they select the appropriate option, then the virtual passengers calm down.’ And if they make the wrong choice? ‘Then the virtual doll will get very angry indeed.’

Grant support

Now that the platform is up and running, the focus is on how to proceed. ‘The most important thing is that each member now knows who to call,’ says Bosse. ‘As part of the effort to enhance our public profile, we will soon be launching a website. We plan to attend the Innovation Exchange Amsterdam (IXA) meeting in May, to discuss possible alliances with the company representatives attending that event.’ Another reason for the platform’s existence is to jointly apply for grant support. After all, this will help to further their research into the specific factors needed to make games as effective as possible.
t’s one of the big questions for humanity. Is life on Earth unique? And if there are other forms of life out there, are they simple or complex? It’s long-term research, but I would love to find answers to those questions during my career,’ says Carsten Dominik, professor of Astronomy at the University of Amsterdam.

Dominik is one of the initiators of the Are We Alone? collaboration. ‘The UvA and VU wanted to work together more in the fields of physics and astronomy,’ says Dominik. And in the next few years, the Netherlands Institute for Space Research (SRON) will be moving to Amsterdam. ‘This will create a scientific cluster which gives us a good launch pad for researching this question.’

Exoplanets
Based at the Anton Pannekoek Institute for Astronomy, Dominik and his colleagues work to answer questions about the emergence of exoplanets – planets in solar systems other than our own. This includes making observations of protoplanetary disks which form around young stars and which can go on to develop into planetary systems. He is involved in the new SPHERE telescope in Chile, for example. ‘The telescope dims the light of the star itself so that we can better observe gas giants and disks alongside the star. We’ve already seen a great spiral structure in a disk which indicates the presence of a terrestrial planet.’

He’s also doing scientific modelling research into exoplanet formation, partly in collaboration with Vidi researcher Chris Ormel at the UvA, and a colleague at SRON. And he’s working with a colleague at VU Amsterdam, Wim van Westrenen, who is studying rock formation. ‘He mixes materials and subjects them to high pressure and temperatures to find out what elements were required for the formation of the
Earth and moon. We expect this to deliver exciting results in terms of exoplanets too. Another VU group is doing research into the Earth's atmosphere, which might also be relevant to exoplanets.

**Various points of entry**

All of that expertise offers various points of entry for research into extra-terrestrial life. ‘As astronomers, we try to find places in our galaxy where liquid water exists, because biologists have told us that this is a precondition for life,’ says Dominik. ‘There are moons where ice has been observed, for instance, which may have water underneath. For exoplanets, the distance to a star is important, as that determines whether or not conditions are suitable for sustaining life. Eventually, Dominik also wants to use spectral information to determine the presence of oxygen in the atmosphere of exoplanets, for example. This wouldn’t prove the existence of life, he says, but it’s an indicator.

A year ago, the Netherlands Organisation for Scientific Research (NWO) funded a PhD candidate who divides his time between VU and UvA and tries to ascertain the composition of exoplanets. Dominik is currently still working on bringing in biologists and chemists, before the official launch of Are We Alone? in the autumn.
Two entirely different disciplines brought together: Philosopher Arianna Betti and natural sciences researcher Stefan Schlobach joined forces in research. How does this unique cooperative venture work? Stefan Schlobach explains.

The collaboration between Arianna Betti (UvA-ILLC) and Stefan Schlobach (Artificial Intelligence, VU) goes back eight years. ‘Back then, the Netherlands Organisation for Scientific Research (NWO) called for the submission of research proposals involving a cultural institution,’ recalls Schlobach. ‘The National Library of the Netherlands uses terms with which to describe and identify books, to help people find them. We came up with the idea to study how those book descriptions change over time, and whether the older descriptions are still useable today.’

**Changed concept**

According to Schlobach, the concept of feminism is a good example of a concept that has changed over time and is continuing to change. ‘The meaning of that word a hundred years ago was totally different from its meaning in the 1920s - when women had just gained the right to vote - and in the 1960s, when the contraceptive pill became widely available and campaigning began for the legalization of abortion. In formal terms, the same word is used, but it means something different,’ Schlobach explains.

‘How can you measure ideas that change over time? And how can you study what happens to them? These questions formed the basis for the research proposal that we wrote.’

**Pragmatic**

According to Schlobach, the two disciplines differ in their approaches. ‘In contrast with our methods, the methodology of philosophers is hundreds of years old, and very detailed. They think about and question everything relating to concepts such as time and word meaning, and they are also very critical of assumptions. Our working methods are more pragmatic:'
what is the problem, and how can we resolve it by building a system or developing computer languages?’ The artificial intelligence researcher considers it informative and useful to examine in more detail questions such as: ‘what are words or concepts?’ ‘What is the relationship between concepts and the world?’ He adds: ‘We want to investigate how words can be described, so that ultimately a computer can use logic to reason it out, to bring data together, and to develop tools.’

**Smart database**

The practical impact of the research is great, says Schlobach. ‘Let’s say that historians want to analyse how many civil servants there were between 1790 and 2010. First you have to know what a civil servant is before you can perform a valid analysis. However, the definition of a civil servant in 1880 was probably different from today’s definition. For doctors, the question ‘what is a tumour?’ is important. What has changed with regard to that concept, the meaning, or the name over the years?’ The objective of the researchers is to formulate criteria with which to indicate changing word meanings, so that they can develop a generic theory. ‘And, naturally, we aim to create smart databases that can overcome those kinds of changes over time,’ concludes Schlobach.

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<th>HIGHLIGHTS</th>
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<td>Since</td>
<td>2009</td>
</tr>
<tr>
<td>Subject area</td>
<td>eHumanities</td>
</tr>
<tr>
<td>Staff</td>
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</tr>
<tr>
<td>Participating institutes</td>
<td>ILLC</td>
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<tr>
<td>Funding</td>
<td>Mostly informal collaboration</td>
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Unpredictable, large-scale and complex. Familiar words to members of the NETWORKS consortium; these are the characteristics of the networks that they study and improve.

UvA professor of Applied Probability, Michel Mandjes, is project leader of NETWORKS and describes its objective: ‘We want to use networks with scarce resources as effectively as possible, taking uncertainties into account. The use, for example, of a communications network depends on the unpredictable behaviour of its users and other coincidental elements such as failures. We cope with this uncertainty by incorporating these factors into our models.’

Besides in telecommunications, NETWORKS aims to build self-organising, intelligent networks for transport, energy networks and road traffic. These are all areas chosen for their social importance, says Mandjes. ‘NETWORKS is fundamental in nature but its underlying objective is to actually apply the knowledge acquired.’

Bringing researchers together
NETWORKS will run for ten years, the first of which has already expired. During this year, Mandjes and his colleagues established the structure and defined the themes for PhD research. They also reflected on how they could really bring the participants together. Mandjes: ‘People tend to stick to their own area, but that’s not our intention. That’s why we organised it so that many PhD projects come under two supervisors who have not worked together before.’

He will personally supervise four or five PhD students as part of NETWORKS. Two of these are funded by the VU. UvA is one of the four
core members of NETWORKS; VU is an affiliate member and contributes accordingly. Mandjes is thrilled about this additional collaboration with his VU colleagues. Although researchers at both universities partly study the same themes, there is very little overlap, he explains. ‘This is an opportunity to learn about areas that border on your own expertise.’

One more PhD project
Mandjes and his VU colleagues are recruiting for one more PhD project. ‘It focuses on managing congestion in road traffic networks. This obviously conjures up matters such as optimal positioning and operations for traffic lights but there are also more sophisticated techniques that regulate inflows, as well as matrix signs with speed recommendations.’ Mandjes considers the composition of the supervisory committee to be very interesting. ‘There is a mathematician/physicist on board that approaches the problems with genuine models of statistical mechanics. Then there is someone that addresses uncertainty using operations research and I predominantly take the perspective of applied probability.’

Elegance of mathematics
He believes it is remarkable that they were fortunate enough to obtain funding for a consortium involved in mathematics, which is often viewed as a ‘serving’ science. ‘We all think science is amazing, wonderful and powerful. The fact that we so appreciate the elegance and abstraction of mathematics is what binds us together.’

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**HIGHLIGHTS**

**NETWORKS**

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<tr>
<td><strong>Since</strong></td>
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<td><strong>Subject area</strong></td>
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Stefan Witte (VU department of Physics and Astronomy) is researcher at the Advanced Research Center for Nanolithography (ARCNL), where physicists from the UvA and VU collaborate closely in the field of nanolithography. But what kind of research do they do there exactly?

ARCNL was established in November 2013. Besides VU and UvA, other partners in this initiative are the FOM Institute, the Netherlands Organisation for Scientific Research (NWO) and ASML. The latter is a company that makes machines for the production of computer chips and is a major developer of applications used in physics research.

Nanolithography is a branch of nanotechnology that focuses on creating applications for nanostructures. Or, in the words of Stefan Witte: ‘It is an aspect of physics that involves creating structures on very small surfaces, such as computer chips. The power of this technique lies in the number of structures (each just a few dozen billionths of a centimeter across) that can be fitted onto a single chip. These are becoming astonishingly small. We are talking about structures that are only around a hundred atoms wide.’

Lensless microscope

Such nanostructures are much too small to be visible to the naked eye, so special equipment is needed. One of the devices they are current-
ly using for this purpose is the atomic force microscope. This uses an ultrafine needle to scan the surface in minute detail. ‘However,’ Witte points out, ‘this method is complex and time-consuming.’

As the leader of a research group, Witte has developed a technique for viewing significant areas of a nano-surface all at one go, rather than one bit at a time. He devised a lensless microscope that illuminates an object with extreme ultraviolet light, then detects the scattered light to produce a type of photograph displaying the surface structures. Witte continues: ‘Our initial results confirm that this is a powerful tool for imaging nanostructures. It’s an entirely new approach, offering numerous opportunities both for fundamental research and for applications. This research can be of enormous value.’

**Complete package**

Three new researchers will be joining his team in the summer. Witte is very impressed with the smooth cooperation between the science faculties. ‘The University of Amsterdam and VU Amsterdam naturally differ in terms of their physics research focus, so their areas of expertise are largely complementary and mutually reinforcing. Together, they actually represent a complete package of the various aspects of physics. That combined expertise was also a major factor underpinning the decision to establish the ARCNL here in Amsterdam.’
e’re great and we should take some credit for that,’ says Daniel Bonn, director of the Institute of Physics of the University of Amsterdam and, as professor of Complex Fluids, one of the founders of the Amsterdam Soft-bio Initiative.

The statistics do not lie: physicists from Amsterdam are quoted more often per article than those from Harvard, MIT and Cambridge, even though the latter institutions score higher in scientific rankings. According to Bonn, this has a lot to do with perception. ‘We are authoritative, but simply too small.’ He expects that increasing the collaboration within organisations, such as the Amsterdam Soft-bio Initiative, will increase their visibility.

Different approaches coming together
This collaboration took shape in 2013. Biophysicists at VU and FOM Institute AMOLF conduct theoretical and experimental research on biological systems, whereas Bonn and his colleagues at the UvA study soft condensed materials. ‘The research takes place at this interface,’ says Bonn. ‘They have interesting but complicated systems; we have the necessary technology and baggage to help solve existing questions.’

He gives a joint research project into biopolymer gels as an example. One of these gels is the network formed by fibrin, a blood-clotting protein. ‘Fibrin knits fibres together into a kind of netting, which eventually leads to the formation of scabs on wounds. We call this netting a gel,’ Bonn explains. The VU researchers approach this system from a theoretical angle, whereas AMOLF carries out experimental research and the UvA’s input is a toolbox characterising mechanical properties in a very detailed manner.

‘By doing this, we hope to find out why the characteristics of the fibrin network are so different
to those of other polymers. Eventually, we may even be able to find out more about coagulation in general.’

Hundred researchers
Roughly one hundred researchers are involved with the Amsterdam Soft-bio Initiative, including physicists and biophysicists, but also information scientists, chemists and sometimes biologists. According to Bonn, the collaboration is more of an idea than an entity: ‘We work together if we come across an interesting subject. But researchers often don’t know what their colleagues are currently dealing with,’ says Bonn. ‘So the number of coffee breaks should be increased. My main motto with regard to the collaboration between VU and UvA is: We should all drink our coffees from the same machine.’

And this coffee machine exists, so they are in regular contact. On top of a Master’s degree in Physics and Astronomy, VU and UvA also offer a joint Bachelor’s degree, with all courses taking place at Science Park. The VU physicists therefore have access to their own room at this location. In 2018, their whole department will have transferred, something that Bonn can only encourage. ‘In addition to the UvA, Nikhef, AMOLF and ARCNL, Amsterdam Science Park houses a whole host of physics institutes, which means a gigantic number of top researchers in one place. Hopefully the VU can join us as soon as possible.’

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<th>HIGHLIGHTS</th>
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<td>UvA</td>
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<td>Funding</td>
<td>UvA Research Priority - Soft Matter</td>
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For a good ten years now, systems biologists of the VU department of Molecular Cell Biology have been working together with colleagues of the UvA Swammerdam Institute for Life Sciences (SILS) in one research group. The research group is headed by Hans Westerhoff: professor of Microbial Physiology (VU) and professor of Synthetic Systems Biology (UvA).

Systems biology is concerned with how the functioning of biological systems arises out of interactions between molecules, cells, tissues, microorganisms, et cetera. Westerhoff explains: ‘We do not study the system in and of itself. Rather, we study how systems amass their characteristics. The research group in Amsterdam is endeavouring to discover how systems take on new characteristics. We are searching for ‘laws’: principles that apply consistently. And we are modelling cells in silico to enable us to study these systems precisely.’

Worldwide leader

The added value of this collaboration between the two universities lies in the fact that the whole is greater than the sum of its parts, according to Westerhoff. ‘Amsterdam is one of the world’s leading centres of systems biology. Moreover, we are a pioneer in this field of scientific research.’ As an example: Westerhoff is one of three Fellows of the International Society for Systems Biology (ISSB). The other two Fellows are Lee Hood (Seattle) and Hiroaki Kitano (Tokyo). Other systems biologists from the Amsterdam fold (Barbara Bakker, Frank Bruggeman, Jacky...
Snoep, Bas Teusink and the late Wilfred Röling) obtained their PhD's under his supervision or conducted post-doctoral research with him and later went on to lead their own research groups.

Each of the two Amsterdam universities has its own priorities in the research group. VU focuses on microbial physiology, systems pharmacology, biotechnology, and drug design; UvA specializes in the cell cycle, personalized medicine and epigenetics.

A key early discovery concerned the speed with which the liver produces ATP (adenosine triphosphate): the ATP synthesis flux. ‘Scientists were long convinced that a single gene was responsible, but we discovered that several distributed factors are involved.’

**Metabolic map**

Westerhoff received widespread media attention in 2013, from national papers to television talk shows. His research group had co-authored an article in Nature Biotechnology on the metabolic map: a kind of ‘roadmap’ of human metabolism.

Westerhoff explains: ‘Such a map can be created for any individual, carrying information about the individual’s state of health. This research topic appealed to a wide audience, because it concerned both personalized medicine and nutrition. In theory you could live to be 120 if you are intimately aware of your own metabolic map, in some cases even as a smoker. In practice, however, creating an individual metabolic map is a tall order for many reasons, including privacy concerns.’

**Together in Building for Human Life Sciences**

The systems biologists will be merging their operations in the Building for Human Life Sciences in the spring of 2016. ‘We are really looking forward to the move, because then we will be able to make even better use of each other’s expertise, models, instruments and results in an environment populated by a broad cross-section of medical and pharmaceutical experts. The physical proximity of all this expertise will be a real boon to us researchers. And the seating arrangements will ensure a good mix of VU and UvA scientists, leading to new synergies.’
When doing research, you often use data gathered by your predecessors. But how do you know whether the data you need exist, where you can find them, what their history is? To assist in such matters, the brand new project Re-Search has been set up. It was awarded funding by the NWO programme Creative Industry on 5 October 2015, and will commence in early 2016.

The project is led by Maarten de Rijke, UvA professor of Information Processing and Internet. Re-Search uses Amsterdam’s landscape in an interesting way, he explains, with UvA, VU, and the eHumanities department of the Royal Netherlands Academy of Arts and Sciences (KNAW) joining up with Elsevier (‘one of the big international scientific publishers, just around the corner from here’). The project revolves around research data sets, collected using questionnaires, lab studies, observations and experiments, for example. Researchers share such data sets in scientific publications and digital archives. Re-Search wants to make use of this in three ways, De Rijke explains. ‘We want to make the data findable. We want to find out how we can make it easier to search through data, and how the use of data sets has changed over the years.’

The three participating institutes will each appoint a PhD student to work on this from a particular perspective. VU’s research, for instance, will primarily focus on knowledge representation. ‘How can you semantically enrich research data to make them easier to find?’ UvA researchers have expertise in the field of search engines and self-learning methods to improve them, De Rijke explains. Searching for research data is a greater challenge than simply searching for articles. ‘Research data sets are defined by their mode of usage and the conclusions that follow from that. They build up a sort of curriculum vitae over time, and as with people, that CV defines data sets.’
To illustrate: ‘Research into natural language processing often concerns the recognition of entities in a text: places, buildings, persons. Such a study may begin with a collection of texts, with all entities correctly identified in them, by hand. Other researchers then come up with an automatic method and test it using these manually annotated texts. Hence, I may achieve an accuracy percentage of 80, someone else in a subsequent study 82, etc. The research data set gains more and more value throughout that process.’

‘As a result, users are not just interested in the original data set; what they especially want to know is what has been done with it since its creation, in what order, and with what results,’ De Rijke continues his explanation. ‘All that has to be made findable.’ What is needed is for advanced engines to dig through the data and automatically generate very accurate and detailed descriptions.

Re-Search partner Elsevier owns websites such as ScienceDirect, where researchers search for articles and research results, and where they will increasingly also be able to find research data sets. This is where the project participants will be live-testing their new algorithms, something that De Rijke is looking forward to.

‘For us as an academic party, it is difficult to set up such an experiment. You don’t only need data sets, but also real users, and you need to be able to see how they use the search engine, what they find interesting and what not.’ The results thus obtained will be useful for information retrieval purposes, De Rijke elaborates, allowing the algorithms to continually improve themselves. ‘But it will also allow us, as researchers, to learn about the needs of users, and reveal matters that we had not yet considered. Empirical study always brings surprises. For us, in other words, this is an exciting opportunity for intellectual surprises and enrichment.’
What happened after the Big Bang? Where did all the antimatter go? What is dark matter made of? These are some of the fundamental questions of subatomic physics. Gerhard Raven, professor of Experimental High Energy Physics, is trying to arrive at some answers, along with his colleagues from Nikhef.

Nikhef is the National Institute for Subatomic Physics, a partnership between the FOM Institute, VU Amsterdam, the University of Amsterdam, Utrecht University and Radboud University Nijmegen. The institute carries out research into particle physics and astroparticle physics. Gerhard Raven’s work focuses on the former. He runs the research programme for the LHCb experiment together with Marcel Merk (who holds a special chair at VU Amsterdam) and Antonio Pellegrino (who holds a similar position at Groningen University).

Matter and antimatter
‘At the time of the Big Bang, an enormous amount of energy was released, creating equally enormous amounts of matter and antimatter,’ explains Raven. ‘When these particles came together again, they were annihilated, producing energy and light. But how come our current universe is devoid of antimatter, and filled with matter? Probably only a tiny fraction of the particles of matter created are still there; it is this difference that allowed the universe as we know it to come into existence.’

Raven and his colleagues examine this question making use of the Large Hadron Collider (LHC) at CERN in Geneva. In this particle accelerator particles collide at tremendous speed. By looking at the process of decay and the traces of elementary particles called ‘beauty quarks’ and ‘anti-beauty quarks’, they are able to study the tiny differences between matter and antimatter.

Standard Model
The Standard Model, which was developed in the 1960s and 1970s, is the central pillar of particle physics. The Standard Model was proven to be mathematically consistent and correct with the discovery of the Higgs boson in 2012. But even so, it is not possible that the theory is complete. ‘The difference between matter and antimatter is much larger than the Standard
Model predicts,’ Raven continues. ‘But all the measurements we have done so far have been consistent with the predictions. All the tests add up. So we must be missing something. We just don’t know what yet. The theory is not consistent with the universe.’

Colleagues from the University of Amsterdam, who are working on the ATLAS experiment at Nikhef, are also looking at the Standard Model. ‘Because we are approaching the same problem from different angles, there are many opportunities for collaboration while still retaining our own distinctive profiles. Our research is not the same, but there is a lot we can do together. For example, our colleagues from the University of Amsterdam have expertise that we can use too. If we run into a problem, we can just drop by for a visit.’

Trying to solve the mysteries of the Standard Model is not the only thing that researchers from VU and University of Amsterdam have in common. They are also developing new software together to process the data from the measurements, and they use the same supercomputers at Amsterdam Science Park. They regularly discuss the results of the experiments during the weekly Friday afternoon drinks.

### HIGHLIGHTS

**Nikhef**

- **Since**: June 1975
- **Subject area**: (Astro)particle physics
- **Staff**: 60 FTE WP | 40 FTE postdoc | 100 FTE OIO | 75 FTE technicians, engineers | 25 FTE support staff
- **Participating institutes**: FOM | VU | UvA | UU | RU
- **Funding**: Participating partners | NWO
Jef Huisman describes the inaugural symposium of Amsterdam Water Science held on 25 and 26 November as a great success. ‘Day one saw international guest speakers alternating with Amsterdam-based researchers, which resulted in a lot of variety,’ he says. Water was the topic of the day, and water in and around Amsterdam is what AWS research is all about.

Huisman, professor of Aquatic Microbiology at the University of Amsterdam, and Jeroen Aerts, professor of Risk Assurance and Water Management at VU Amsterdam, jointly founded the consortium. According to Huisman, it unites the existing water research of both universities – research that focuses on a changing Earth due to climate change, microplastics in water, and the effects of fishing. ‘These are all current issues that we are used to approaching from a scientific perspective, but whose social consequences we also wish to address.’

This broad approach is made possible by the wide range of expertise available at both universities. Most researchers at UvA specialise in the ecological and enviro-chemical aspects, Huisman says, whereas the VU researchers concentrate more on hydrology, earth sciences and governance. These differences in focus are exactly what gives collaboration at AWS its strength, he says, given that the areas are so complementary to one another.

In May, three postdocs commenced studies on topics that lie in the field of collaboration of the two universities. One study, for example, is looking into adverse algal bloom – a speciality of Huisman’s group – in relation to CO2. Huisman: ‘Blue algae is a huge problem, not just in the Netherlands, but internationally. In the past, people in the United States and China have gone without drinking water for days due to blue algae.

What we want to know is how this problem will continue to develop now that temperatures are...
rising and more carbon is becoming available, both of which produce favourable conditions for algal growth.'

To find out, calculation models have been created that factor in how carbon is absorbed into the water. Huisman: ‘What we do not yet know much about is the exchange of CO2 between water and the atmosphere in unbalanced conditions. To learn about it we are going to take measurements, both in a lab and in a lake in Amsterdam. At the UvA, we don’t know exactly how to measure this, but it is run-of-the-mill for a group at VU, they’ve just never done it in an aquatic environment before.’ If the model can be validated by the measurements, Huisman hopes that scientists will be able to apply it worldwide.

One final branch of AWS concerns education. The two Master’s programmes in water science at the UvA and VU are currently separate worlds, says Huisman. ‘And we do not want to merge them either, because they specialise in very different areas. But we would like to give biologists from the UvA the opportunity to acquire knowledge on hydrology from VU and vice versa. To do so, we will be offering specific courses to bridge the gap.’

The Amsterdam researchers do not wish to tackle the water problems alone, however, and so day two of the symposium was dedicated to collaborative partners such as district water boards. Huisman: ‘Some of the funding has been earmarked for research projects with other parties, who have already held eight workshops with people from AWS. In January, six of the projects will be selected for implementation.’

HIGHLIGHTS Amsterdam Water Science

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<tr>
<td>Funding</td>
<td>€ 1 million from the Amsterdam Academic Alliance (AAA)</td>
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Pim de Voogt
How can computer scientists work with academics from the humanities? That is a topic the future Center for Humanities and Technology (CHAT) will be focusing on. One of its founders is Lora Aroyo, a researcher from the Web & Media Group at VU Amsterdam’s Computer Science department. Data in the humanities is hugely diverse, says Aroyo, ranging from ancient texts to all sorts of very different objects. Organisations such as the Netherlands Institute for Sound and Vision and the Rijksmuseum have started to digitise those various items, she adds, and have made significant progress in doing so.

New era
Because of this huge quantity of digital data and the associated technological developments, the humanities are on the verge of a new era, or have entered it already, according to Aroyo. ‘It’s no longer about choosing a topic and studying it in exhaustive detail. Now you can take a birds-eye view of data on a large scale, bring it together, and gain insights into it. And all from the comfort of your own desk.’ This brings with it changes in the questions that academics in the humanities will ask. Take the question of ‘What were the most popular expressions in the 16th century?’ says Aroyo by way of example. ‘It’s still reflective scholarship, but might have statistics and data science added to it.’

This is because the tools for that kind of new research are largely provided by computer scientists. They, in turn, have to work with data they have never used before. And that data is welcome, says Aroyo. ‘Applications were once taboo in computer sciences. Ten years ago you
Lora Aroyo could still publish only on algorithms and statistics. Now it’s impossible to get funding or to publish a paper without an application showing the scientific and social value. Collaboration is essential.’

**Ambitious project**

Aroyo says CHAT is a highly ambitious project which will bring together computer scientists from the UvA, VU, the Netherlands eScience Center and IBM, with academics in the humanities from both universities and the Royal Netherlands Academy of Arts and Sciences. They will work together to both develop and use new tools. The founders of CHAT have been discussing the initiative since 2011, and in 2014 they published details of their plans in a white paper.

The thinking that has gone into it over the past few years has already helped spark a series of new initiatives. These include the digital humanities project CLARIAH; DIVE+, for the creation of online heritage collections; and the UvA-VU research project QuPID2. Aroyo herself is involved with the latter, researching the modelling of data quality and how it can be improved.

She is enthusiastic about working with computer scientists from the UvA. They complement each other well, she says, both in general and specifically in this project. ‘The UvA is a global leader in multimedia analysis and computer visualisation. At VU, we’re good at the semantic aspects of the web and in the modelling and textual processing of data. If we bring all that together, we’ll have all the expertise we need.’

**HIGHLIGHTS**

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| Since | First plans were made in 2011, establishment will follow soon  
| Subject area | Digital humanities: Computer sciences & Humanities  
| Participating institutes | IBM | KNAW | Netherlands eScience Center | UvA | VU  
| Funding | Goal: € 65 million (CHAT partners & others)  

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*SCIENCE IN AMSTERDAM 2015*

University of Amsterdam | Vrije Universiteit Amsterdam
We work together because we want to; together, we produce good science. This is not an institutionalised collaboration that was forced upon is, this really is bottom-up,’ says Filipe Branco dos Santos. Between 2008 and 2013, he was part of Bas Teusink’s Systems Bioinformatics group at the VU institute IBI (or Centre for Integrative Bioinformatics). In 2013, he launched his own group at UvA’s Swammerdam Institute for Life Sciences.

Strong relationship
Branco dos Santos explains that he maintained a strong relationship with Teusink and other colleagues and he still visits the VU every Friday. He is currently involved in several collaborations there with a few UvA colleagues. ‘We share a lot of research questions with each other, although the organisms subjected to this research are largely different. I study cyanobacteria and lactic acid bacteria. The latter slightly overlaps with Bas’ research, but other than that he studies very different microorganisms.’

Teusink and Branco dos Santos have a few outstanding research requests for new PhD projects. Their first joint PhD student has been studying regulatory networks and lactic acid bacteria since last year. ‘These bacteria either express proteins or don’t, depending on their immediate environment. We want to know how exactly this is regulated: which genes are expressed and when?’ Branco dos Santos explains that in order to study this, genes are characterised and, for instance, slightly modi-
fied, which in turn provides information on what these genes actually do. The researchers also compare strains with slightly different regulatory networks, under different circumstances. ‘The underlying theme is: how is life shaped by its environment?’ he summarises.

**Common denominator**

This is also the biggest common denominator of all joint research carried out by both groups, Branco dos Santos continues. ‘In evolution, life is shaped by natural selection. A process exists, for instance, called optimisation, which allows only the best-adapted species to survive. If you were to carry this notion to the extreme, very little diversity would exist. But in actual fact nature is very diverse! And this is not only due to the fact that there are many different environments and different species are better adapted to each of these environments. That’s what we’re trying to find out.’

The expertise or techniques used are not strictly divided between both groups, according to Branco dos Santos. ‘Bas, for instance, has quite a lot of genome scale models, but I was partially responsible for creating those when I was still working there.’ The most important thing for him about this and other research projects is that he can collaborate with people who are good at what they do. ‘This sometimes leads you outside of your comfort zone, but it can also create a synergy that still works really well in our case.’
One of the longest-running Amsterdam research collaborations, the Holland Research School of Molecular Chemistry (HRSMC), was formally launched in 1994 when the Dutch Ministry of Education, Culture and Science sought to merge research in the Netherlands into research schools.

‘There was a kind of natural conglomeration around research with the molecule as its basis,’ relates professor of Molecular Spectroscopy Wybren Jan Buma. ‘It consisted of researchers from Amsterdam’s two universities and the then state university of Leiden. That collaboration became the HRSMC, which still exists today.’ The research school was founded and accredited by the Royal Netherlands Academy of Arts and Sciences (KNAW) and is currently in its fourth accreditation period.

Education and symposia
Buma says that a key aim of the HRSMC is to provide education for doctoral candidates and advanced Master’s students in the form of local courses, summer schools and career-focused activities.

‘In that respect, our schools have acquired an outstanding reputation. We attract renowned foreign speakers and a considerable part of our participants come from other Dutch and, especially, foreign universities. For our doctorate candidates, this is also a good opportunity to develop their networks.’

Buma goes on to say that the school also runs a graduate programme, which he describes as interuniversity and multidisciplinary. After a thorough introduction to the affiliated groups, talented Master’s students are given an opportunity to write their own research proposal, which they can then go on to conduct under the guidance of supervisors of their own choice. However, after two cohorts the funding for the programme has ended, Buma says. ‘Nevertheless, the programme is still proving attractive: this year another four talented students have been selected.’

Buma says that the participating doctoral candidates are able to network effectively during the
annual symposium which features a number of poster sessions, PhD and staff lectures. For the staff members, too, the annual symposium is the perfect opportunity to meet up. Buma reports that three Nobel laureates spoke at the school's 20th anniversary in 2014. ‘That shows just how much of an international reputation we enjoy.’ The HRSMC also runs a fellowship programme that attracts international researchers to the Netherlands for a period up to six months.

Diversity in research
The research carried out at the HRMSC is unquestionably the most diverse conducted at any Dutch research school. ‘It’s all about the properties and applications of molecules. Applications may be in areas of importance to society, like health, energy and sustainability. But it’s important that they are underpinned by fundamental research. The HRSMC’s research themes of synthesis, spectroscopy and theory are components of the research programmes at all three universities, he says. ‘In the case of theoretical chemistry, for example, at VU they work mostly ab initio, or at the atomic level. Here at the UvA, we focus more on larger distances and time scales; while Leiden’s research is mainly geared towards processes on surfaces.’ There is no competition between groups. In fact, the opposite is true: ‘People are aware of their colleagues’ areas of expertise and know where to find one another. Together, we are a powerhouse of knowledge at the molecular level.’

Added value
Many of the other research schools established in the 1990s have since closed. The HRSMC is very much alive and recently decided to add Radboud University Nijmegen on the basis of an associated membership following a request from Nijmegen groups. According to Buma, the HRSMC has shown that it provides considerable added value to science and education. ‘Despite having to operate on a limited budget for a long period in the past, we have developed into a highly successful research school. With its broad educational activities and graduate and fellowship programmes, the HRSMC offers an excellent platform for interuniversity and multidisciplinary cooperation, as well as an incentive for world-class education and research in molecular chemistry and physics.’

| HIGH-   | **Holland Research School of Molecular Chemistry** |
| LIGHTS | Since 1994 |
| **Since** | 1994 |
| **Subject area** | Molecular chemistry | Physics |
| **Staff** | ±60 professors, associate and assistant professors | ±190 Postdocs & PhD candidates |
| **Participating institutes** | € 300,000 annually | NWO funding for 4 PhD's |
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