KAVLI NEWSLETTER
Kavli Institute of Nanoscience Delft
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IN THIS ISSUE:

EDUCATION AT OUR INSTITUTE, OUR UPCOMING KAVLI COLLOQUIA WITH BEN FERINGA AND NOBEL LAUREATE NOVOSELOV, AND MORE

Our newsletters are an important forum to announce news and upcoming events at our Institute. The next event is the Kavli Colloquium on April 12 that will highlight the work of Ben Feringa from the University of Groningen. Feringa is a chemist who develops very appealing linear and rotary molecular motors and molecular switches that are chemically powered. These are inspired on the protein machines in biology but Feringa builds these bottom up using synthetic chemistry. Another major upcoming event is the Kavli Colloquium on June 28 that will feature a seminar by Kostya Novoselov who shared the 2010 Nobel Prize in Physics with Andre Geim for their wonderful work on graphene. Novoselov, a professor at the University of Manchester, will tell us about graphene, the ultimate material in flatland. He will discuss both its basic properties as well as the most recent developments to extend its capabilities to form novel materials in multilayers with other type of layers. It is going to be a special event so don't miss it. As a teaser, PhD student Stijn Goossens interviewed him. Read all about it on page 2 and 3.

Cutting-edge research is the focus at our Kavli Institute. Importantly, we combine this with education of students. We decided to highlight the latter in this issue of our newsletter. So you'll find an interesting opinion piece by Jos Thijssen about the privilege of teaching, an interview by Miriam Blaauboer with graduate students that came from all over the world to get a PhD at our Institute at Delft, exciting news on an entirely new BSc studies in Nanobiology that David Grünwald and Claire Wyman set up, and more. I hope these articles will convey the enthusiasm for both research and education that I probe within the Institute.

It was interesting that the Kavli Foundation contacted me to compliment us on our newsletter ('really wonderful, beautifully designed, excellent pieces, informative…'). They feel that our newsletter format is exemplary and perhaps a nice idea for other Kavli Institutes to follow up, something that we are of course happy to hear. All further feedback, positive and critical, on our newsletter is welcome!

In this newsletter, you can furthermore enjoy self-introductions by new faculty members Elio Abbondanzieri and Liberato Manna, read columns by Jan Lipfert and Yuli Nazarov and learn about a variety of other news.

Last newsflash – actually a note added just before this newsletter went off to the printer: Leo Kouwenhoven and his group have achieved a breakthrough in their search for Majorana's! Leo's presentation at the American Physical Society's March meeting made him the talk of the town in physics labs worldwide. We added a quick and undoubtedly incomplete note on this in the newsletter. We look forward to the follow up and the paper on this exciting discovery.

• Cees Dekker

Column

ON COMPLEXITIES OF SCIENCE

My beloved PhD supervisor recently celebrated his 80th birthday. He is still active helping his institution in complex affairs where experience and political influence is required. I run into him at conferences from time to time. He still attends most scientific talks despite having an apparent concentration challenge. In the breaks, he'll light a cigarette and say: "How complex science is nowadays!"

I always nod politely. Yet I disagree in a way. Science was complex back when my supervisor was my present age and I attended my first scientific talks without understanding the slightest bit of them. Since that time, tremendous efforts have been undertaken by our community to make science as simple as possible. These efforts totally changed everything we know, or, to put it better, knew. When I learned from Cees Dekker about his first *Nature* submission 15 years ago, I wondered why he did not choose the British Sunday tabloid *News of the world*: in my mind, the audience and style of both editions had a strong overlap, while the latter journal had bigger circulation thus providing potential for significantly bigger impact. Gosh, how wrong I was for so many reasons! Today, *News of the World* is dead, while Nature is prospering and expanding as fast as an *E. coli* colony. Quantum sciences once focused on infinitely many degrees of freedom: now we often focus on systems with 2 (or in a stretch 2x2x2) degrees of freedom. *Nanobiologists* once pushed to see life emerging from macromolecules: while now it is often more fun to use life to build *nano-yoyos* and other fantastical devices. Why, I had attended the same talks my supervisor did: all correct ones were simple, and good ones were trivial, and even the least comprehensive speaker did try to be comprehensive, aiming to rank-and-file the granny audience, something he understood as a matter of survival. Now, our boldface texts even break hearts of the modern journal editors who could not enjoy education as classical as the grannies could.

One needs to go to a wider context to appreciate the wisdom of my supervisor's remark. Since action always equals counter-action, our efforts to simplify science only make it more complex. Or more specifically, they make science more complex to make. If a bachelor student understands their first scientific talk, they would probably not attend the second or the third, and finally opt for a much more mysterious and entertaining career as a manager. If a manager grasps the essence of your "for-grannies" talk, he/she will be able to project it to the system of needs, norms and values of the modern society, stamp you with a relevance mark, and give money to those who "deserve" it. If a person who judges your intellectual potential from the boldface text, he/she would hardly have any further questions to you.

So I foresee that sooner or later complicating science will become a matter of survival. And I hope we will be able to accomplish the task. And then when I'll climb above 80 and light a (fake by the time) cigarette, I will say "How wonderfully complex is science nowadays!"

• **Yuli Nazarov**

Interview

INTERVIEW WITH KOSTYA NOVOSELOV

Kostya Novoselov is Professor of Physics at the University of Manchester. In 2010 he was awarded the Nobel prize for 'Groundbreaking experiments regarding the two-dimensional material graphene'. I had the honor to interview the upcoming Kavli Colloquium speaker about several subjects, reaching much further than graphene.

On the intranet drive of our Quantum Transport group one can find a movie of you carrying around a traffic sign in the middle of the night. Do you still recall that conference?
Oh yes, I do. It was good fun during the conference in Genoa. I remember we were with some guys from the Quantum Transport group. Generally I enjoy interacting with people at conferences, but I cancelled all my invited talks for the coming year. For the graphene week and the Kavli Colloquium in Delft I made an exception.

Did you cancel all your invited talks because you are starting something new and big in your lab?
The complexity of graphene research is exploding. This complexity takes time. Presently, we are combining graphene with other layered materials. Hexagonal boron nitride and Molybdenum disulfide are examples. The current record is a stack of 14 layers. The same way as hetero-structures changed physics, now stacks of layered materials will.

André Geim does not like to be asked about applications for his research. Do you share his opinion?
I do things because they are fun. I am constantly looking for fields where I can apply our simple laws of physics. If there is some fun in creating a coating from graphene for a beer bottle, I do so. I would also spend an hour giving advice to people wanting to make a business out of my ideas. But I would not do applied research just for money.

How has the daily work of a researcher changed in the last 20 years?
Twenty years ago, students published one paper during their PhD. Setting up an experiment was very involved at that time. In our days you can order that set-up and as a result PhD-students publish 15 papers. In principle, I don't mind that students are not building their setups themselves anymore, but unfortunately they lose some critical, basic experimental skills. As a result, if there is critical soldering work, I'd rather do it myself.

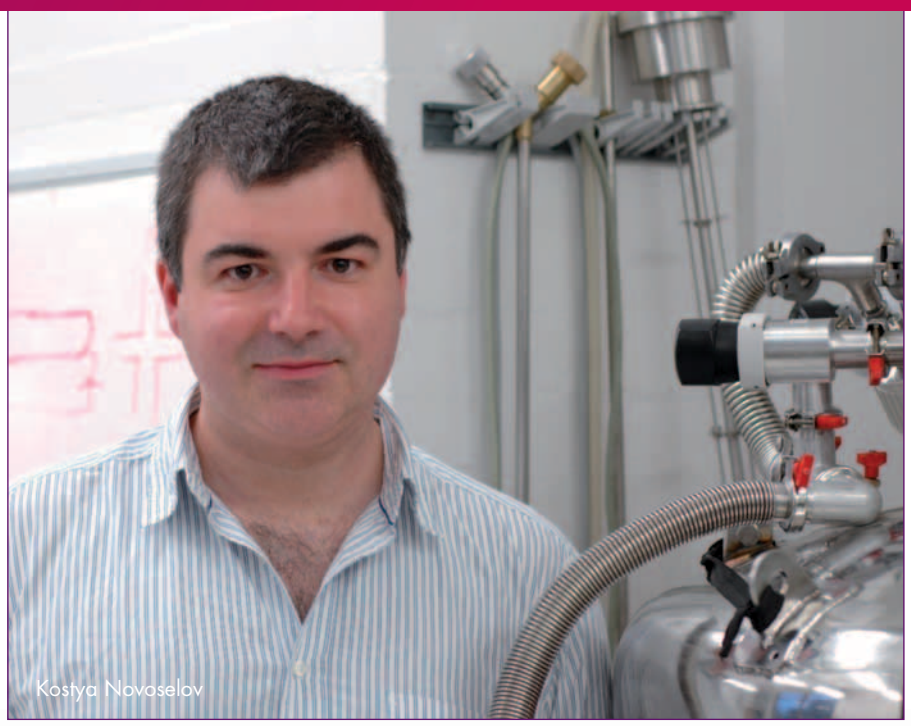
Talking about publishing, do you think that peer review will still be in place in 20 years?
I would advocate for peer review to stay. Arxiv will not be a replacement. I see Arxiv more as the Facebook for scientists. We still need people to filter the overwhelming amount of publications, and peer review is doing this. Moreover I would like to see double blind peer reviewing being installed. It would be even better to reduce the number of professors and papers and increase the quality of the publications.

As a final question, do you have an advice to the professors of the Kavli Institute of Nanoscience Delft?
First, I am not in the position to give advice. I am deeply impressed by research done in your institute. I learned many things from Delft. I think the best advice is that one should not listen to advisors and be creative.

Kavli Colloquium

GRAPHENE: MATERIALS IN FLATLAND

KOSTYA NOVOSELOV, MANCHESTER


Kostya Novoselov

June 28, 2012 will feature a Kavli colloquium by Kostya Novoselov. The abstract of this colloquium reads as follows:

When one writes with pencil, thin flakes of graphite are left on a surface. Some of them are only one angstrom thick and can be viewed as individual atomic planes cleaved away from the bulk. This strictly two dimensional material called graphene was presumed not to exist in the free state and remained undiscovered until a few years ago. In fact, there exists a whole class of such two-dimensional crystals. The most amazing things about graphene probably is that its electrons move with little scattering over huge (submicron) distances as if they were completely insensitive to the environment only a couple of angstroms away. Moreover, whereas electronic properties of other materials are commonly described by quasiparticles that obey the Schrödinger equation, electron transport in graphene is different: It is governed by the Dirac equation so that charge carriers in graphene mimic relativistic particles with zero rest mass. The very unusual electronic properties of this material as well as the possibility for it's chemical modification make graphene a promising candidate for future electronic applications.

Recent progress in graphene samples production allowed for a dramatic improvement in quality. Thus, mobilities of the order of 106 cm2/Vs can be routinely achieved in mono- and bi-layer graphene samples. This brought an influx of novel phenomena, previously non-observable in this material. The influence of electron-electron interaction become dominant and exhibit itself in spectrum modification, fractional quantum Hall effect, etc.

Micromechanical or chemical exfoliation can also be successfully applied to other layered materials such as Bi2Sr2CaCu2Ox, NbSe2, BN, MoS2, Bi2Te3 and other dichalcogenides, and epitaxial growth has been applied to grow monolayers of boron-nitride. As with graphene, the crystal quality of the obtained monolayer samples is very high. Many of the 2D materials conduct and even demonstrate field effects (changes of the resistance with gating). The properties of the obtained 2D materials might be very different from those of their 3D precursors.

Furthermore, as we have full control over the 2D crystals, we can also create stacks of these crystals according to our requirements. Here, we are not merely talking about stacks of the same material: we can combine several different 2D crystals in one stack. Insulating, conducting, probably superconducting and magnetic layers can all be combined in one layered material as we wish, the properties of such heterostructures depending on the stacking order and easily tuneable, introducing a new concept in material engineering – Materials on Demand. •

15.00 hr	Pre-programme: 'The versatility of carbon'
	Herre van der Zant : 1D fullerene nanotubes Lieven Vandersypen : 2D graphene Ronald Hanson : 3D diamond
15.45 hr	Break
16.00 hr	Kavli colloquium by Kostya Novoselov: 'Graphene: Materials in Flatland'
17.15 hr	Drinks & time to meet

Extra seminar

HETEROSTRUCTURES BASED ON 2D CRYSTALS

On June 29, Kostya Novoselov will additionally present a lecture: 'Heterostructures based on 2D crystals'. The abstract for this lecture reads as follows:

I will consider a new paradigm in materials science: heterostructures based on two-dimensional atomic crystals and the development of several devices based on such a concept. Two-dimensional (2D) atomic crystals (such as graphene, monolayers of boron nitride, molybdenum disulphide, etc) have a number of exciting properties, often unique and very different from those of their three-dimensional (3D) counterparts. However, it is the combinations of such 2D crystals in 3D stacks that offer truly unlimited opportunities in designing the functionalities of such heterostructures.
One can combine conductive, insulating, probably superconducting and magnetic 2D materials in one stack with atomic precision, fine-tuning the performance of the resulting material. Furthermore, the functionality of such stacks is "embedded" in the design of such heterostructures. I will discuss several types of devices based on such heterostructures, including tunnelling transistors, tunnelling diodes, charge drag, photodetectors, etc. •

Kavli Colloquium

'GRAPHENE: MATERIALS IN FLATLAND'

Date : June 28, 2012 at 15.00 hours
Location : Aula Congress center, Mekelweg 5, Lecture room D

Extra seminar

'HETEROSTRUCTURES BASED ON 2D CRYSTALS'

Date : June 29, 2012 at 11.00 hours
Location : TN building, Lorentzweg 1, Lecture room E

News

EVIDENCE FOR MAJORANA FERMIONS AT DELFT

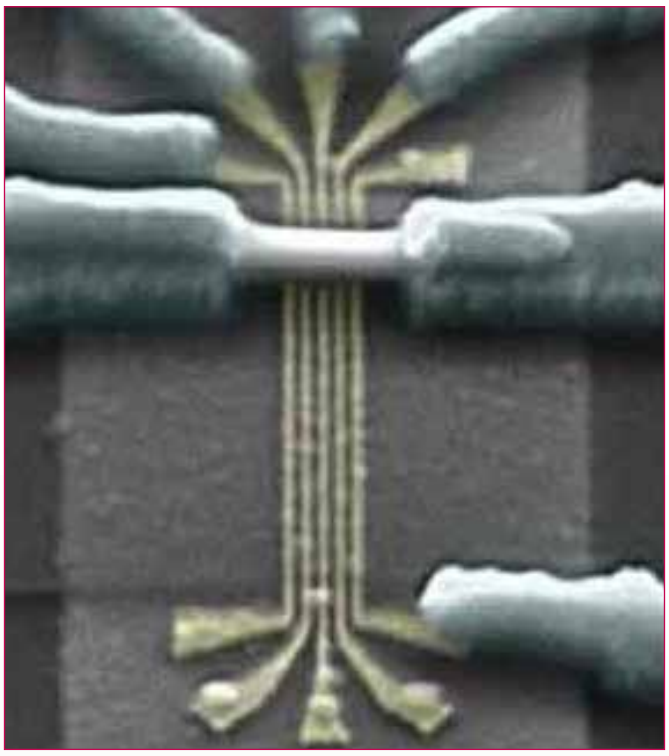
Leo Kouwenhoven and his group made an exciting discovery. As Nature News reported:

Getting into nanoscience pioneer Leo Kouwenhoven's talk at the American Physical Society's March meeting in Boston, Massachusetts, was like trying to board a subway train at rush hour. The buzz in the corridor was that Kouwenhoven's group, based at the Delft University of Technology in the Netherlands, might have beaten several competing teams in solid-state physics — and the community of high-energy physicists — to a long-sought goal, the detection of Majorana fermions, mysterious quantum-mechanical particles that may have applications in quantum computing.

Kouwenhoven didn't disappoint. "Have we seen Majorana fermions? I'd say it's a cautious yes," he concluded at the end of a data-heavy presentation.

Quantum particles come in two types, fermions and bosons. Whereas bosons can be their own antiparticles, which means that they can annihilate each other in a flash of energy, fermions generally have distinct antiparticles; for example, an electron's antiparticle is the positively charged positron. But in 1937, Italian physicist Ettore Majorana adapted equations that Englishman Paul Dirac had used to describe the behaviour of fermions and bosons to predict the existence of a type of fermion that was its own antiparticle. Over decades, particle physicists have looked for Majorana fermions in nature, and after 2008, condensed-matter physicists began to think of ways in which they could be formed from the collective behaviour of electrons in solid-state materials, specifically, on surfaces placed in contact with superconductors or in one-dimensional wires.

Kouwenhoven's apparatus is along the latter lines. In his group's set-up, indium antimonide nanowires are connected to a circuit with a gold contact at one end and a slice of superconductor at the other, and then exposed to a moderately strong magnetic field. Measurements of the electrical conductance of the nanowires showed a peak at zero voltage that is consistent with the formation of a pair of Majorana



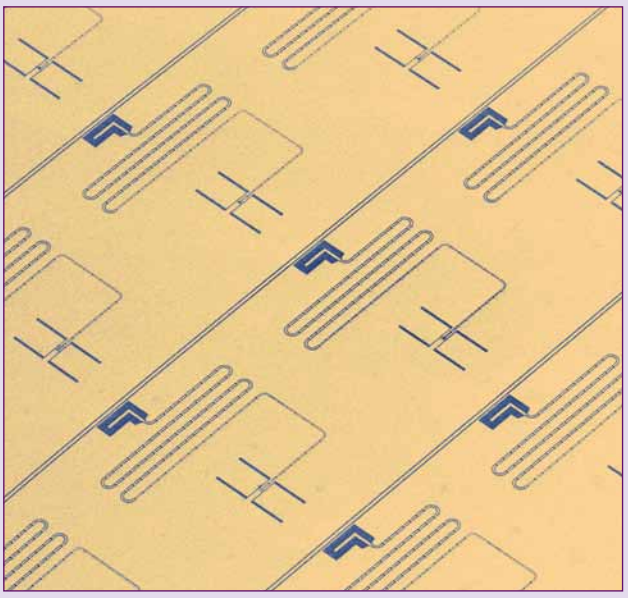
particles, one at either end of the region of the nanowire in contact with the superconductor. As a sanity check, the group varied the orientation of the magnetic field and checked that the peak came and went as would be expected for Majorana fermions.

Although other groups have previously reported circumstantial evidence for the appearance of Majorana fermions in solid materials, Jay Sau, a physicist at Harvard University in Cambridge, Massachusetts, who attended Kouwenhoven's talk, says that this is a direct measurement. "I think this is the most promising-looking experiment yet," he says. "It would be hard to argue that it's not Majorana fermions."
More on this exciting breakthrough in the next newsletter. •

Credit: Nature International weekly journal of science (doi:10.1038/nature.2012.10124)

COSMIC NANOSCIENCE

Akira Endo received an NWO grant of 755 thousand euros to develop a spectrometer DESHIMA to study submillimetre waves emitted by distant, dust-obscured galaxies. Instead of using external mirrors and gratings to separate the wavelengths, the new detector he is developing carries everything onboard one superconducting chip. This allows for a multi-pixel chip that produces a 3D image of the galaxies, since the wavelength or 'colour' is a measure for its distance (because of the red-shift). Endo works together with Dr. Paul van der Werf of the Leiden Observatory, and researchers from SRON and Groningen University. •



THE SOUND OF ONE ELECTRON: LEO KOUWENHOWEN @ TEDXDELFT

Leo Kouwenhoven from our institute gave an inspiring talk titled *'That's a one-centimeter step for man, one giant leap for mankind'*. In it he featured his multi-qubit circuit work and aired the sound of one electron. •
www.tedxdelft.nl

DUTCH PHYSICA PRIZE 2012 AWARDED TO CEES DEKKER

Cees Dekker was awarded the Physica Prize 2012 of the Dutch Physical Society (NNV). He will present the annual Physica lecture at the FYSICA-CHEMIE 2012 conference on May 30th at the University of Twente (for more information and registration, see www.fysica.nl •

FROM PIZZAS TO NANOCRYSTALS

Introduction new faculty

A SELF-INTERVIEW BY LIBERATO MANNA


Liberato Manna

My background is in Physical Chemistry and my initial interests in science were more focused on crystallography. However, during my PhD I approached colloidal science with great enthusiasm, fascinated by the fast advances of the scientific community in the fabrication of nanostructures by chemical approaches. At that time I decided to join the group of Prof. Paul Alivisatos at UC Berkeley, a great environment where I learned so much – not only on synthesis of nanostructures but also on the physics of confined systems and, above all, on the influence of crystal structure on physical properties and shape evolution of nanomaterials.

Since I returned from the US, my research has gone through many developments, branching from synthesis to assembly to applications of nanoparticles in energy related fields and in biology. If I could give a broad definition of my research plans at the Kavli Institute of Nanoscience, I would say that I am mainly interested in finding new, unconventional approaches to assemble nanoparticles into superstructures and in studying the properties stemming from such assemblies. For example, binary superlattices of nanoparticles having elaborate shapes could work very efficiently in collecting light, in generating and separating charge carriers and in driving them to opposite electrodes. This work might have a strong impact in photovoltaics, for example.

My first impression of Delft and of the Kavli Institute of Nanoscience, apart from the rain, was that of a fantastic place, with so many groups doing cool fundamental research in many areas in physics and biophysics. Being a chemist who often used to regret of not having majored in physics, I am extremely fascinated by the unique environment in Delft. On the other hand, after having worked my way through nanochemistry for quite a while and having experienced a few times the joy of creating brand new nano-objects from scratch, I would like to see more chemistry research done at the Institute.

With a wife, 4-year-old daughter (both with strong characters), another daughter due in late spring, and plenty of work-related travel, time for sports and hobbies is getting thinner and thinner. But, I do really enjoy photography and soccer (playing with my PhD students and postdocs, who are still keen to keep me in their team, although my skills are honestly far from those of an Italian soccer star).

Sometimes I think that I really took inspiration in science from making pizzas in pizzerias, which is something that I have been doing since I was a student (and even in later times). Like pizzas and quarks, nanocrystals come in many flavors, and it is surprising how tiny ingredients, or small variations in the cooking conditions, can have a profound effect on the final outcome, and how much science is involved in all this!

• **Liberato Manna**

Kavli Delft Publication Prize

THE KAVLI DELFT PUBLICATION PRIZE 2012

As was announced earlier, this year we will start awarding a bi-annual prize for the best publication resulting from our Kavli Institute of Nanoscience at Delft that appeared in print in the previous two years. This prize, which consists of an award and an amount of € 3000, will be given out every two years and is awarded at the annual Kavli day in September. Half of the prize money will be awarded to the first author* of the winning paper; the other half will be distributed among the other co-authors. The prize money can be freely spent by the laureates.

Nominations are now welcome. Deadline for submission is May 1, 2012. A publication is eligible for the 2012 prize when it is published from our Kavli Institute (as must be clear from the address) and when the publication date was between 1-1-2010 and 1-4-2012.

Please send your nomination(s) by email to c.dekker@tudelft.nl. Concretely, please send a pdf of the publication and a motivation letter why you consider this the most outstanding paper from our institute in the past 2 years that is worthy of this prize.•

For details see: Kavli.tudelft.nl

Announcement

CASIMIR SPRING SCHOOL

From 12 to 14 June 2012 the fourth edition of the famous biannual Casimir Spring School will be held in Arnemuiden. Subtitled 'Sun, Sailing and Science' the location for this event is chosen near a lake, allowing for sailing activities in between lectures and discussions. It is entirely organized by PhD students, and aimed exclusively at Casimir PhD students and postdocs. The fact that senior research staff is excluded from participation helps creating a special atmosphere, with more room for open exchange of ideas between the young researchers.

The program comprises invited talks by leading international external experts (confirmed speakers: Jean Noël Fuchs (Univ. Paris-Sud); Karl Berggren (MIT); Dieter Braun (LMU Munich); Niek Lopez Cardozo (Eindhoven)) and contributed talks by Casimir participants, and a poster session. Details of the program can be found on the casimire website. The program committee is formed by Jetty van Ginkel (BN, Delft), Hedde van Hoorn (BM, Leiden), Vincent Maurik (QN, Delft), Jelmer Renema (QO, Leiden), Jan van Ostaay (TP, Leiden), en Mickael Perrin (QN, Delft).

PhD students and postdocs: mark your calendars. All other researchers: sorry, junior researchers only!

• **Jan van Ruitenbeek**
Scientific director Casimir

TEACHING AS A PRIVILEGE

Quite frequently, I participate in a `benoeming-advies commissie' (BAC): a selection committee for recruiting new staff, most often for the Kavli institute of Nanoscience. The candidates being interviewed naturally choose this institute because it matches their research interest and high ambitions. However, in addition to research, teaching is always an important aspect (and the reason why I am on these committees). Of course, the teaching skills and attitudes towards teaching of the candidates vary quite strongly. The candidates must present a 10-minute lecture from which I sometimes learn a lot (especially when it is taught by a biologist) and where at other times it is a relief when the lecture is over. It is always interesting to see where the candidates stand on the scale between regarding teaching as a duty or a privilege. Those who are at the bad end of that scale will make us, themselves and, most importantly, the students unhappy. But even those who really like to teach never fail to emphasize in the interview that time spent teaching is time not spent on research. Yes, we all know that teaching has the effect of slowing down your research, but it also stimulates new research ideas. One of my colleagues recently said: `I like to teach. It is so easy to believe that you understand things when talking to experts in the field. But when you explain it to a student you experience this merciless unveiling of those details you did not quite understand.' As for myself, teaching has helped me a lot in finally understanding what I learned in my own degree course. Last semester, I taught advanced quantum mechanics together with Leo di Carlo. Often, we were e-mailing late at night about the problems or the lecture notes, desperately trying to have something presentable for the next day. In the end, we learned a lot of new things from each other.

Kavli is primarily known as a place where wonderful research is taking place. However, as researchers, we know that we would be nowhere without excellent PhD students participating in our research projects. These students are recruited worldwide, but a significant fraction of them come from our own undergraduate programs: the Bachelor and Master of Applied Physics and the soon to be opened program in Nanobiology. Within our faculty each staff member is involved in both teaching and research, so we often view the careers of our students along similar lines – lecturers encourage the top students to complete projects in their research groups so that the best ones might remain for their PhD. However, a large fraction of students leave the university to enter a job in society, for example as a consultant or to set up their own company. So, although researchers tend to train students for a research career, we should also clearly be aware of the usefulness of what we teach for those students who end up taking a different path. From this perspective, I find it worthwhile to distinguish between general and specific knowledge. Examples of general knowledge are analytical skills, the skill to raise systems and problems to an abstract level, and transferring methods used for one problem to another. Finally, of course, it is important that our students should be able to communicate effectively and to look beyond the boundaries of their own discipline. With these general skills, we train not only the next generation of top researchers. We train the next generation of top thinkers.

As lecturers of the Kavli institute we can be proud of our teaching: generally the student evaluations are very positive and we are strongly overrepresented in the annual elections for `teacher of the year' within the faculty. And, viewing the staff being hired, I think we can maintain and even increase this high standard, developing new teaching, both in content and in teaching methods.

Jos Thijssen

• **Jos Thijssen**

THE LEIDEN-DELFT CASIMIR RESEARCH SCHOOL

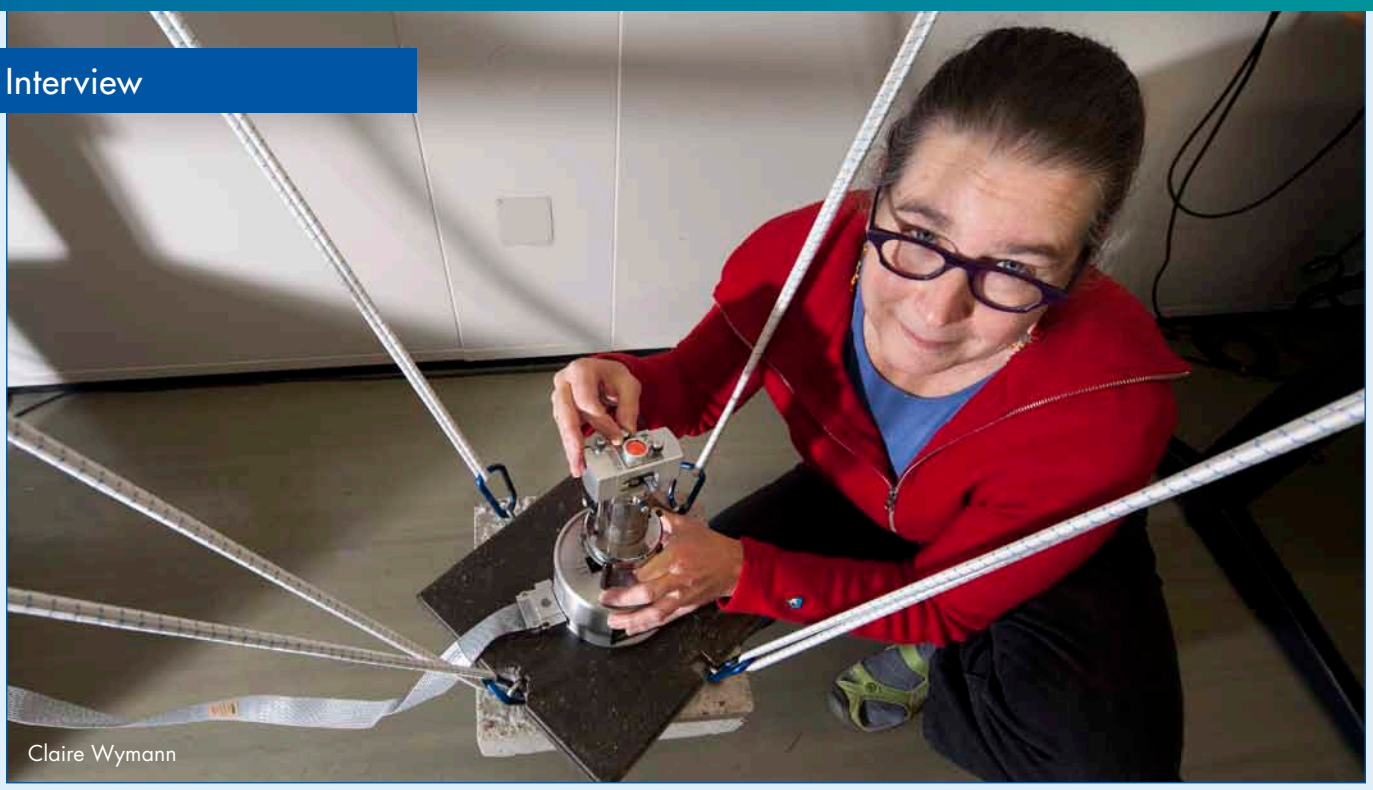
The Casimir Research School, Casimir for short, unites the Leiden Institute of Physics at Leiden University with the Kavli Institute of Nanoscience at Delft University of Technology. Casimir aims at providing a stimulating research environment for the joint Delft and Leiden community of PhD students and postdocs. The School has developed a program of courses that is aimed at maintaining the science teaching in the School at the frontiers of knowledge, repairing deficits in undergraduate education, and bridging the communication gap between disciplines. For details of the program please visit the website, www.casimir.researchschool.nl.

Casimir was founded in 2004, when we became aware that the research at the two Institutes is very complementary. Casimir embraces research in fundamental physics, applied research and industrial collaborations. It has been our ambition from the start to eliminate the barriers between these sectors and to set the stage for mutual inspiration between all branches of research. Examples of successful joint Leiden-Delft research projects include the work on quantum computation and Majorana fermions between the groups of Leo Kouwenhoven, Lieven Vandersypen and Carlo Beenakker and the large program on 'Nano-Imaging under Industrial Conditions' running between the groups of Joost Frenken, Tjerk Oosterkamp and Henny Zandbergen.

• **Jan van Ruitenbeek**
Scientific director Casimir

A BRAND NEW BACHELOR PROGRAM

Interview


Claire Wymann

NANOBIOLOGY BRIDGES

Erasmus University Rotterdam and TU Delft will start a brand-new Bachelor program Nanobiology per September 2012. Nanobiology is a new research field at the interface of physics and biology, which great importance for advancements in medicine. This new Bachelor's program focuses on interactions between molecules, cells and organisms, based on fundamental physical principles. Interestingly, it bridges disciplines but also two universities.

Below is a short transcript of a discussion on the new Nanobiology BSc between David Grünwald (assistant professor at the Department of Bionanoscience at Delft) and Claire Wyman (Professor of Molecular Radiation Biology at the Erasmus University Medical Center) who have been working hard on the set-up of this new program over the past two years.

(David Grünwald) Hi Claire, I have been thinking how great it has been to work with you was and that sometimes I am still puzzled what made us do what we did.

(Claire Wyman) Well, I've seen my own research into molecular mechanisms of genome stability move to the nanoscale. That biology is at one level a collection of interacting molecules, nanoscale objects, is not a new idea. But the technology that allows us to poke, pull, watch, feel, steer and otherwise manipulate and observe single molecules in action is. We have only begun to explore living things at this level. However most of us were educated in one discipline or another. I call myself a molecular biologist and I collaborate with people who identify themselves as physicists or theorists. It can take a lot of effort to simply learn each other's language. Translating between disciplines is not easy.

(David) I feel similar. Having a degree in Biophysics I quite frequently find myself translating between disciplines, not so much content, but amazingly frequently translating the concepts and culture.

(Claire) I see that point too! So this was the intrinsic motivation for a combined Bachelor program. But to develop a whole new educational program and make it a reality we needed an opportunity…

(David) Like the Kavli Institute of Nanoscience and its new department of Bionanoscience in Delft to synergize with the desire for a fundamental science education program in Rotterdam.

(Claire) Yes, that was part of it, but most of all we assembled a small team of committed people with a common vision, in content and style. Because after taking the risk to start, it was a matter of hard choices and hard work. We had to generate enthusiasm to teach, infect administrators with this enthusiasm and get through a lot of rather bureaucratic report writing. Within about a year our plan was good enough for an official go ahead from boards and deans at both Universities, a truly joint effort.

(David) Yes, we reached an amazing consensus! The result is unique and even the government sees this as a highly innovative program that is extremely focused, something rarely seen these days. So we are on schedule to start this year?

(Claire) Certainly! In October we received government approval as a new program, a process that only 1 in 10 proposals pass. Now we're busy with formal accreditation. Once that is done, hopefully before May 2012, we can start signing up students. Open days at Delft and Rotterdam have already generated interest from hundreds of high school students.

(David) This is indeed remarkable. In surveys to see which name matched student expectations of our curriculum best, Nanobiology won. This also sparked interest among the pool of potential students. At the open days of the TU Delft last fall, this new program attracted more people than the Applied Physics program. Also, more female students are interested in Nanobiology than in Physics, a hidden goal of this program. But what is the core of the program content?

(Claire) Since we aim to integrate Biology, Physics and Math, the 3-year BSc cannot cover all aspects of each. We asked ourselves what do students NEED to know; to solve problems, to understand living things and keep learning to eventually create new knowledge? The Nanobiology curriculum is not just a bunch of different courses listed together. Most of the curriculum, all of the biology courses at Erasmus for example, is being developed specifically for this program.

(David) On the Math and Physics side this meant considering what topics can be learned later, if needed. In my experience this battlefield often kills new programs pre-maturely. We settled for full Physics and Math education, ignoring quantum mechanics and nuclear physics, both topics anchored in classic physics education but not essential for Nanobiology.

(Claire) I can only guess what this means for a physicist, but the freedom gained was used to great advantage in creating the new program! And just for the record, for molecular biology we also sacrificed content normally not up for discussion.

(David) Well I think it really comes down to this: the curriculum that you and I worked out made everybody drop their weapons and sit down to understand the benefit we created. But: Nanobiology innovation goes beyond the curriculum content.

David Grünwald

(Claire) Yes, the new program is also an opportunity to teach in new ways. We're working hard to inspire our teachers with methods in scientific teaching. The Nanobiology curriculum is demanding, both for the faculty developing it and for the eventual students. We make no apologies for this. Most things worth doing are not easy. Inspiring students to succeed at new ways of doing biology will be the best part.

(David) The one thing that really makes Nanobiology so special is the interest and commitment of the scientists to create this new program. I think that our aim of introducing start-up days, of creating self-awareness of students for their learning styles, combined with extensive use of teamwork is why even the government evaluation was so positive. For me, this is a dream come true.

• Claire Wymann

KAVLI GRADUATE STUDENTS

Interview

From left to right: Tatiana Kozlova (originally from Russia), Michela de Martino (Italy), Vishal Ranjan (India), Andrés Castellanos-Gomez (Spain), Zohreh Nourian (Iran), and Fabai Wu (China).

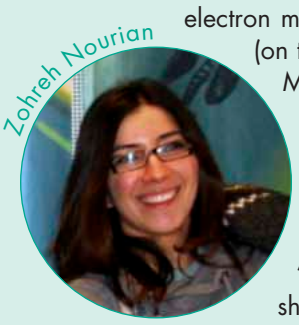
GETTING A PHD AT THE KAVLI INSTITUTE IN DELFT

AN INTERVIEW WITH KAVLI GRADUATE STUDENTS

They came to Delft from all over the world, attracted by a particular topic or research group. Find out what PhD students think about their research and education at the Kavli Institute of Nanoscience in Delft.

When Fabai Wu began looking for a PhD position, either the UK or the Netherlands seemed the best option for continuing his research. Having earned both an MSc in Molecular Bioengineering (from Dresden) and an MSc in Nanoscience (from Delft), Wu's ambition was to do PhD research in the Juan Keymer and Cees Dekker Labs in the Department of Bionanoscience (BN). Wu: "I was looking forward to further study the biophysics and evolution of cell shape using the techniques I had developed during my MSc research in these groups."

For Tatiana Kozlova and Vishal Ranjan (both in QN) and for Michela de Martino and Zohreh Nourian (both in BN) the research topics were the primary reason for coming to Delft. After working on graphene during his MSc research at the University of Groningen, Ranjan wanted to make a switch to quantum information processing with, as he puts it, "as much quantum content as possible". Kozlova, who holds an MSc from Novosibirsk State University in Russia, was determined to specialize in semiconductor physics and electron microscopy. Kozlova: "Wherever I looked (on the internet), the High Resolution Electron Microscopy group appeared as one of the strongest European groups in this field". The articles of Prof. Henny Zandbergen, the leader of the group, impressed her and her decision was easy and fast: she applied for a PhD position in the group. "I had no idea about Kavli at the time" she comments on the Institute.



The same was true for De Martino. With an MSc in Agri-Food Biotechnology from the University of Naples, she is now working on the stress response of bacteria in the Meyer Lab in Delft. In addition to being attracted by the topic, a decisive factor for her to come to the department of Bionanoscience was "the dynamic atmosphere of a department in its pioneering years, which I really liked, and also the large amount of young people, including young faculty". Also Nourian praises the atmosphere at BN - during her MSc research in Chemical Engineering in Delft she discovered her interest in Bionanotechnology and started looking for a PhD research topic in that field that "would keep her interested for at least four years". Nourian found it at the Danelon Lab, where she started her research on the reconstitution of genetic networks inside liposomes around 1.5 years ago.

When asked about their opinion on PhD education at the Kavli Institute and the range of courses offered, the wish to specialize immediately comes up. Ranjan: "The more specific a course is aimed at my research, the better. MSc education is for taking general courses - during the PhD I want to specialize".

He is currently taking the course on quantum information processing offered by the Casimir research school (the joint graduate school between Leiden University and Delft University of Technology) that is "directly relevant for my research on developing hybrid quantum systems for quantum information processing purposes". Wu agrees on the importance of relevance of PhD courses: "The best course I have taken so far was the Casimir biophysics course, because it was interesting, inspiring and directly relevant for my research".

Also the "Electronics for Physicists" graduate course is popular, as confirmed by Kavli postdoc Castellanos-Gomez: "It is based on lab sessions that are directly related to daily-life measurements. And the theory part of the course taught us the foundations for understanding the limitations of many measurement schemes".

Kozlova, who arrived in Delft at the time when this course had already started, is looking forward to joining next year "because the topic is relevant for my PhD and I like to perform experiments". Both Nourian's and de Martino's favourite PhD courses taken so far - "Cellular Dynamics" and "Origins of Life" respectively - are taught by faculty members from the department of Bionanoscience. Nourian: "Cellular Dynamics is a good introduction to different research projects running in the department and at the same time quite specialized".

Given their clear preference for PhD courses that are related as closely as possible to research, it is perhaps not surprising that the students are not in favour of having to attend too many general courses or events. All of them agree, however, that the Kavli colloquia (held three times a year and "really great, especially when held on the beach") and the biannual Casimir Spring school - a three-day school organized and attended by PhD students and postdocs from Delft and Leiden- offer ample opportunity to mix with students from different sections and departments within the Institute and learn about each other's work.

On the practical side, the students are in favour of organising PhD courses in concentrated time blocks (similar to dedicated 1-2 week PhD schools) rather than having them running during an entire semester. Ranjan: "It is much easier to plan time off from research for courses this way". Kozlova emphasizes the need for PhD students to balance research with courses, which can be somewhat of a struggle for experimentalists. Especially if a course is not (fully) taught in Delft. Ranjan and Wu: "Having to travel to Leiden to attend a course is an obstacle for enrolling in the course" –a statement to which the others nod their agreement.

We end the interview on a positive note: Kavli PhD students are content with their research and education in Delft, and appreciate the wide variety of graduate courses offered. Before heading back to their labs, Kozlova has the final say: "Part of doing a PhD is about self-education - but the input from in-house famous people is really great".

• **Miriam Blaauboer**

SATISFIED WITH OUR FAMILY CAR

Introduction new faculty


Elio Abbondanzieri

A SELF-INTERVIEW BY ELIO ABBONDANZIERI

I am generally pretty satisfied with our family car. It gets good gas mileage, can store plenty of cargo, and has never given us many mechanical problems. Even so, sometimes I wish it worked better. For instance, we recently had to install new windshield wipers, but wouldn't it be an improvement if our old windshield wipers just spontaneously popped off and new windshield wipers floated down in their place? And come to think of it, sometimes we want to use the car but we have left it at home. When we need to drive somewhere, I would prefer to just activate some sort of signal and watch the wheels, engine, and other parts of a car drift out of the sky and form a new vehicle just for us. It probably seems strange to imagine a car that works this way, but there is a reason I imagine these far-fetched scenarios: inside our cells are hundreds of intricate nano-machines that work just like this.

The process I am describing has a name: molecular self-assembly. It refers to the ability of biological molecules to adopt an ordered structure without any guidance or management from an outside agent, and this process is an essential feature of all living systems. For instance, if a bacterium senses it is time to divide into two cells, it sets about duplicating its DNA first. The machine that accomplishes this task, the replisome, is a juggernaut comprised of as many as 69 unique proteins and is freshly constructed for the job from spare parts floating about the cell. The replisome is more impressive than my car in a number of other ways. After all, this machine doesn't just drive through the cell - it also unpacks and copies a few megabytes of data. And don't forget that the replisome drives itself! Although there has been limited success at human design of self-assembled nano-structures inspired by nature, we have a long ways to go. Researchers have learned to program DNA to fold into, say, a paper airplane, but our cells are building the equivalent of functioning fighter jets.

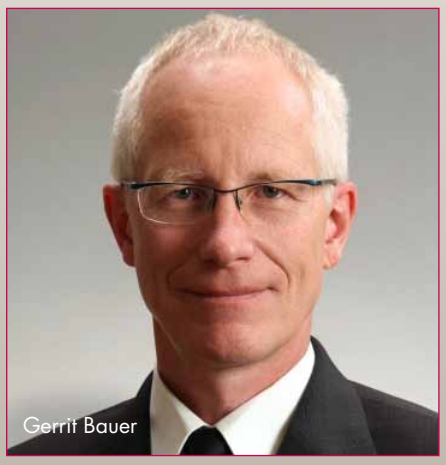
In my own research, I hope to uncover a few of the design principles that make these "fighter jets" possible. One system that has captured my attention recently comes from one of the most deadly modern viruses: the HIV intasome. HIV proteins have interested me since beginning my work on reverse transcriptase in Xiaowei Zhuang's laboratory at Harvard University. In the case of the intasome, there is a long-standing mystery about why this complex behaves very differently in a test tube than in a cell. My lab is preparing to tackle this problem by developing new techniques that will allow us to follow intasome assembly at a new level of detail in conditions that can closely mimic those found in the cell. These experiments are technically complex, which is one reason why I was drawn to the state-of-the-art facilities available in the Department of Bionanoscience. I believe studying the intasome will provide valuable insights into how molecular self-assembly works more generally. Alas, these insights probably won't help us to design self-assembling cars (some things just don't scale up well). But they will bring us closer to engineering novel self-assembling nano-machines. And we may discover new ways to fight deadly diseases along the way. I think that is a pretty decent trade-off.

• **Elio Abbondanzieri**

News

GERRIT BAUER 2012 IEEE MAGNETICS SOCIETY DISTINGUISHED LECTURER

Gerrit Bauer was recently selected as a 2012 IEEE Magnetics Society Distinguished Lecturer. Speakers were chosen on the basis of international reputation for excellence in their respective fields, speaking acumen, and the wide spread interest within the greater magnetics community of their proposed lecture topics. Gerrit will lecture in more than fifty places all over the world on the basic physics of spin caloritronics. •


Gerrit Bauer

Kavli Colloquium

MOLECULAR SWITCHES AND MOTORS, DESIGNING DYNAMIC SYSTEMS

BEN FERINGA, THE UNIVERSITY OF GRONINGEN

Ben Feringa

April 12, 2012 will feature a Kavli colloquium by Ben L. Feringa. The abstract of this colloquium reads as follows:

In our body a fascinating collection of ingenious molecular motors and machines make it possible that our cells divide, that we can use our muscles and that the consumption of ATP can be used to generate force and mobility. A billion times larger than these nanoscale protein motors in Nature are the plethora of macroscopic motors that power the cars and machinery in daily life. The ingenious structures and complex functions present in biological systems offer a great challenge to develop synthetic nanostructured materials with functions controllable at the molecular level.

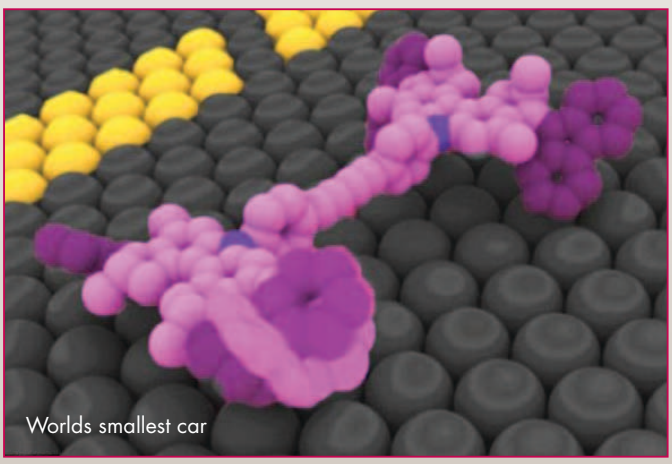
Molecular switches allow dynamic control of structure and function by an external input. Applications of molecular switches include optical data storage, fluorescence, transport, conductance and control of assembly and organization. Molecular motors stand out among the most challenging goals in nanoscience and will provide the heart of future molecular level machinery. Both linear and rotary motors are shown as well as the principle of a chemical powered molecular motor. Progress in the construction of molecular motors anchored to surfaces, the realization of autonomous movement and the application of molecular motors to perform useful functions is discussed. •

	Programme: 'Molecular switches and motors, designing dynamic systems'
15.30 hr	Tea and cakes
16.00 hr	Kavli Colloquium by Ben Feringa on Molecular switches and motors, designing dynamic systems
17.15 hr	Drinks & time to meet

Curriculum Vitae

BACKGROUND OF BEN FERINGA

Ben L. Feringa obtained his PhD degree at the University of Groningen in the Netherlands under the guidance of Professor Hans Wynberg. After working as a research scientist at Shell in the Netherlands and the UK, he was appointed lecturer and in 1988 full professor at the University of Groningen and named the Jacobus H. van't Hoff Distinguished Professor of Molecular Sciences in 2004. He was elected Foreign Honory member of the American Academy of Arts and Sciences and member and vice-president of the Royal Netherlands Academy of Sciences. In 2008 he was appointed Academy Professor and was knighted by Her Majesty the Queen of the Netherlands. Feringa's research has been recognized with a number of awards including the Koerber European Science Award (2003), the Spinoza Award (2004), the Prelog gold medal (2005), the Norrish Award of the ACS (2007), the Paracelsus medal (2008), the Chirality medal (2009), the RSC Organic Stereochemistry Award (2011), Humboldt award (2012) and the Nagoya gold medal (2013). Feringa is currently director of the Center for Systems Chemistry at the University of Groningen. The research interest includes stereochemistry, organic synthesis, asymmetric catalysis, molecular switches and motors, self-assembly and molecular nanosystems. •



Worlds smallest car

Kavli Colloquium

'MOLECULAR SWITCHES AND MOTORS, DESIGNING DYNAMICS SYSTEMS'

Date : April 12, 2012 at 15:30 hours Tea and Cakes, Colloquium starts at 16.00 hours
Location : Aula Congress center, Mekelweg 5, Lecture room C

RUBICON GRANT FOR FERRY PRINS

Ferry Prins has received a Rubicon grant from the Netherlands Organisation for Scientific Research. The Kavli scientist will head to MIT in the United States. The major challenge in linking optical and electronic components on a chip is the difference in scale. To breach this gap, the researcher will develop an opto-electronic component the size of a single nano particle. •

VICI FOR SANDER TANS FOR RESEARCH ON MOLECULAR ORIGAMI

NWO has awarded a VICI grant of 1.5 M€ to Sander Tans, professor at the BN department of our Institute, for his research on protein folding. In our cells certain proteins help to fold new chains of amino acids into a 3D functional protein. Folding mistakes of these so-called chaperones can lead to conditions such as Alzheimer. Tans will study the secrets of this complex form of 'origam'i by looking at the folding of single proteins, using optical tweezers. This will enable to directy observe the the pushing and pulling forces that are part of the folding process. •

NEW EMPLOYEES DEPARTMENT OF BIONANOSCIENCE

Name	Date of employment	Title	Lab
Margreet Doctor	01/01/2012	Technician	Department
Alexei Aksimentiev	01/01/2012	Guest Professor	Department
Mahipal Ganji	15/01/2012	PhD	Elio Abbondanzieri lab
Lilian Jimenez	15/01/2012	PhD	Nynke Dekker lab
Natalia Vtuyivina	01/02/2012	PhD	Elio Abbondanzieri lab
Fareh Mohamed	01/03/2012	Postdoc	Chirlmin Joo lab
Angela de Ceuninck van Capelle	01/03/2012	Project administration	Department
Corine Meuleman	01/03/2012	Department manager	Department
Jennifer Kockx	01/03/2012	Program director Kavli institute of Nanoscience Delft	Kavli institute
Rutger Hermsen	15/03/2012	Postdoc	Cees Dekker lab
Daniel Lam	01/04/2012	Coordinator microscope facility	Department

NEW EMPLOYEES DEPARTMENT OF QUANTUM NANOSCIENCE

Name	Date of employment	Title	Section
Vishal Ranjan	01/09/2011	PhD	QT
Shibabrata Basak	01/09/2011	PhD	HREM
Tatiana Kozlova	01/09/2011	PhD	HREM
Chenggang Shen	15/09/2011	Postdoc	HREM
Tim Baart	01/01/2012	PhD	QT
Masha Neklyudova	01/01/2012	PhD	HREM
Francois Nguyen	15/01/2012	Postdoc	QT
Eva Zakka Bajjani	15/01/2012	Postdoc	QT
Attila Geresdi	01/02/2012	Postdoc	QT
Berlinson Napitu	01/02/2012	Postdoc	MED
Lizzy Wellink	01/02/2012	Project administration	QN
Alessandro Bruno	15/02/2012	Postdoc	MED
Sal Bosman	01/03/2012	PhD	NF
Bas Lisseveld	01/03/2012	PhD	QT
Jennifer Kockx	01/03/2012	Program director Kavli institute of Nanoscience Delft	Kavli institute
Bas Hensen	05/03/2012	PhD	QT
Vibhor Singh	01/04/2012	Postdoc	MED

MARIE CURIE FELLOWSHIP FOR ANDRES CASTELLANOS-GOMEZ

Andrés Castellanos-Gomez received a Marie Curie Intra-European Fellowship. In his project he will engineer the electronic and mechanical properties of freely suspended 2D crystals, such graphene, by strain engineering. He will start at the beginning of 2013. •

MARIE CURIE CAREER INTEGRATION GRANTS FOR DICARLO AND ABBONDANZIERI

Leo DiCarlo and Elio Abbondanzieri both received a Marie Curie Career Integration Grant. Elio will use this grant to work on the mechanics of HIV Reverse Transcriptase and Leo will work on circuits quantum electrodynamics in 3D.•

RUBICON GRANT FOR AARTJAN TE VELTHUIS

Aartjan te Velthuis, a PhD student working at the Nynke Dekker Lab and in the molecular virology department at the LUMC, received a Rubicon grant from the Netherlands Organisation for Scientific Research (NWO), which he will be using to work for two years at the University of Oxford in England on his research project entitled 'Influenza virus replication per second'. •

CONTRIBUTE TO THIS NEWSLETTER

Input to forthcoming newsletters is very welcome.
Please send any relevant material to
Amanda van de Vlist (A.vanderVlist@tudelft.nl).
If you like to contribute to this newsletter as an editor, please contact Cees Dekker. •

Jan Lipfert

Column

FRAUD!

Looking back on 2011, scientific fraud seems to be on the rise. In Germany, a much publicized case came to light last March, when Karl-Theodor zu Guttenberg, at the time German minister of defense and widely considered a likely heir to Merkel's chancellorship, resigned when instances of plagiarism were found on over 90% of pages in his PhD thesis. The scandal has even given the German language a new verb: "guttenbergen", "to shamelessly copy".

The Netherlands had their own set of scientific scandals in 2011. Perhaps most notable was the case of Diederik Stapel, who lost his job as professor and dean of social psychology at the University of Tilburg when it came out that he had made up data on a large scale. In another prominent fraud case, the cardiologist Don Polderman was fired from his job as professor at the Erasmus Medical Center in Rotterdam for falsifying data and for failing to obtain patient consent for medical procedures.

While these cases are interesting and lamentable, they only present anecdotal evidence. Is scientific fraud generally on the rise? Analyzing the PubMed database, I found that while the number of indexed articles per year has increased roughly 3-fold between 1980 and 2011, the number of retractions has increased about 100-fold (Fig. 1a)! So it does appear that dishonesty is expanding. Admittedly, not all retractions are due to fraud. Honest mistakes happen. Nevertheless, it seems to me that in order for a paper to be retracted (and not just corrected), some serious lapses must occur, to the point of (gross) negligence, even if fraud was not the intent. The roughly 30-fold increase in the fraction of retracted articles does suggest, in my opinion, that fraudulent (or borderline fraudulent) behavior in science has become more common in recent years.

Further analyzing the retractions by journal (Fig. 1b), it appears that some of the journals that we seem to value highest have the highest retraction rates. A priori, it is not obvious whether higher profile journals publish more articles that are wrong (possibly due to the pressure to publish unsuspected and "sexy" findings), or whether the higher profile leads to an increased scrutiny and a higher detection rate of mistakes. I am not aware of any data that directly speak to this, but it seems to me that both mechanisms are at play.

What can be done about it? Firstly, on an individual level, as researchers we must keep scientific integrity in highest regard; the search for truth is at the heart of the scientific enterprise. However, this is not enough. Secondly, at the level of research groups and departments, we must strive to create an environment of open discussion, free exchange, and good scientific practice. I believe that such an environment is the best safeguard against scientific fraud. Thirdly, at the department and university level, we need clear rules and competent structures to appropriately address (possible) cases of scientific misconduct. While reporting on high profile fraud cases tends to emphasize the "moral" failure of the individual researcher, I feel that it is as important to draw lessons about the desirable research environment and the organizational framework to handle allegations of fraud. One concrete suggestion would be to have an ombudsperson or confidential counselor who is i) impartial, ii) confidential, iii) easy to find, and iv) approachable. As a thought experiment, you might ask yourself what you would do if you suspect one of your colleagues (your advisor?) of manipulating or plagiarizing data.

• Jan Lipfert

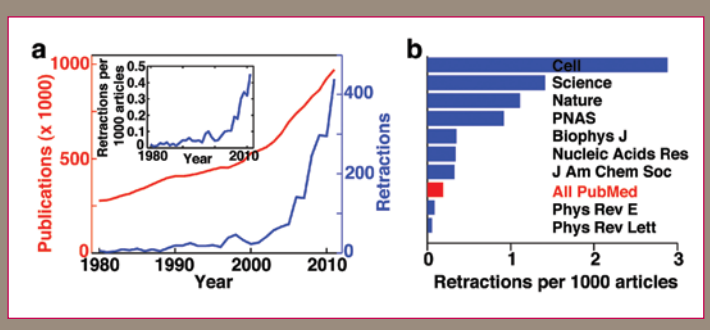
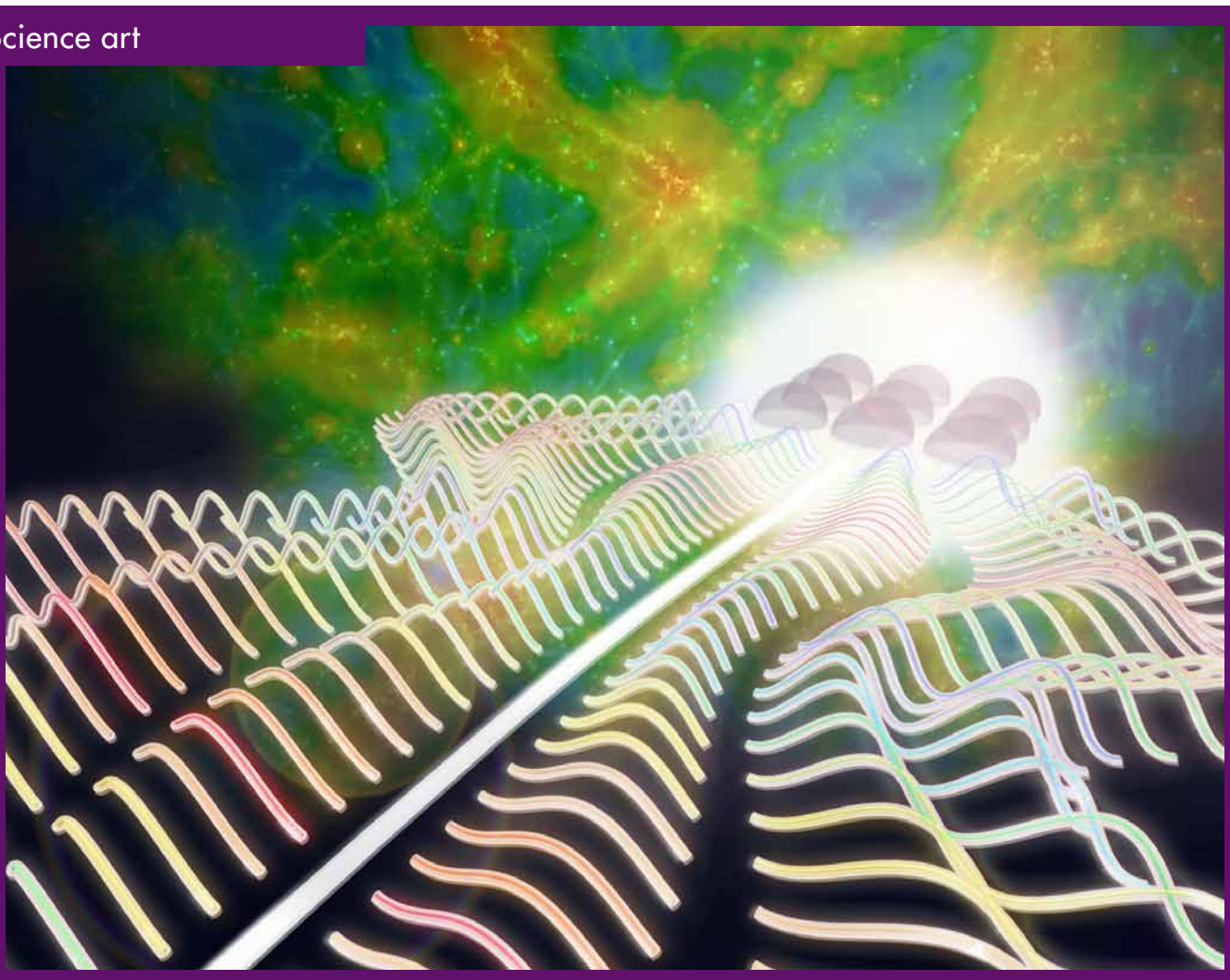


Figure 1. Analysis of retractions indexed in the PubMed database.

a) Total number of publications (left axis) and retractions (right axis) between 1980 and 2011. The inset shows the number of retractions per 1000 articles in the same time period.

b) Number of retractions per 1000 articles published in selected journals during 2000-2010. The red bar shows the same number for the entire PubMed database.

Science art



Artist's impression of a superconducting circuit on a chip (foreground) measuring the 3D distribution of galaxies, which are aggressively growing in the early Universe (background). An array of superconducting resonant filters separates the light traveling from the lens-antenna by color. The amount of cosmological 'redshift' is a direct measure of the distance to the galaxy. Based on this concept, Akira Endo (Physics of Nanoelectronics group) and his collaborators are developing an instrument that can be installed on the APEX telescope, located at 5100 m altitude in the Chilean desert. (See also the News article on page 4.)

Credit: Akira Endo, and the DESHIMA-team consisting of members from the Kavli Institute of Nanoscience Delft, Leiden Observatory, and SRON. (Graphics rendered by ND, Cosmological hydrodynamic simulation provided by B.D. Oppenheimer, University of Leiden.)

Please send suggestions for 'Science Art' to Amanda van der Vlist, A.vanderVlist@tudelft.nl

Upcoming Kavli Colloquia

BEN FERINGA

April 12, 2012

University of Groningen

KOSTYA NOVOSELOV

June 28, 2012

University of Manchester

BONNIE BASSLER

November 22, 2012

Princeton University

Kavli Day

ANGELA BELCHER

September 13, 2012

MIT

Colofon

The Kavli Newsletter is published three times a year and is intended for members of the Kavli Institute of Nanoscience Delft and those interested. PDF versions of all Kavli Newsletters can be found at www.kavli.tudelft.nl

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