KAVLI NEWSLETTER
Kavli Institute of Nanoscience Delft

No.06
March 2013

IN THIS ISSUE:

From the director

GREAT NEW FUNDING, THE UPCOMING KAVLI COLLOQUIUM WITH WOLFGANG KETTERLE, AND MORE

Great news: Our institute recently received some major funding for our scientific research. In a consortium where our Kavli Institute teamed up with our nanoscience colleagues at Leiden, we proposed to explore and exploit the frontiers of nanoscience in a program called NanoFront. This proposal was successful in a very competitive national program, yielding an impulse of 35.9 M€ from OCW/NWO, which will be matched by an additional 15 M€ from the executive boards of Delft and Leiden University. Next to that, Leo Kouwenhoven and Lieven Vandersypen from our Institute together with Carlo Beenakker (Leiden), won a prestigious ERC Synergy grant (15 M€) for their proposal to build a quantum computer in a very competitive European funding round (11 proposals awarded out of 700+). These large grants will certainly help to sustain and further build our nanoscience research – read about it on page 6-7 and 9.

On March 7, we will host Nobel laureate Wolfgang Ketterle from MIT as our Kavli Colloquium speaker. Wolfgang leads a research group in the field of atomic physics and laser spectroscopy. A major focus of his group is the exploration of new forms of matter in ultracold gases, in particular novel aspects of superfluidity, coherence, and correlations in many-body systems. His observation of Bose-Einstein condensation in a gas in 1995 and the first realization of an atom laser in 1997 were recognized with the Nobel Prize in Physics in 2001.
We very much look forward to his Kavli Colloquium on March 7. This colloquium – see page 2 and 3 of this newsletter – is going to be a special event, so don't miss it.

In this newsletter you can furthermore read a first column by new columnist Miriam Blaauboer, who digs into some interesting history, as well as enjoy the second column by Bojk Berghuis who promotes his idea of the future of publishing. And there is yet more in this newsletter: self-introductions by faculty members Marie-Eve Aubin-Tam and Peter Steeneken, and a variety of other new items. Enjoy!
• Cees Dekker

Miriam Blaauboer

Column

LANGEVIN

I happen to own an original copy of Paul Langevin's PhD thesis. It came into my hands around fifteen years ago, when my great-aunt and I were sorting out books in her basement. Her husband, my great-uncle, who was a professor of geophysics in Munich, had died a few months earlier and she had no wish to keep the fairly large library he had built in the basement intact. So we devised three broad categories — to be kept by family and friends, to be offered to the geophysics department at LMU Munich, and to be trashed — and set out to look through all the books he had accumulated throughout his entirely pre-internet career. There were basic physics textbooks, geophysics journals, German-Indonesian dictionaries (used during his many field trips to Indonesia), stacks of notebooks and also quite a few PhD theses in various languages. And among these there it was: "Recherches sur les gaz ionisés" by M.P. Langevin, dated 1902. Looking at the handwritten "Au docteur Wiechert" on the first page, Langevin probably once gave this copy to Emil Wiechert, seismologist at the university of Göttingen and best known for the Liénard-Wiechert potential describing a moving point charge in an electromagnetic field. I presume that my great-uncle, working in the same field as Wiechert, must have inherited the thesis from him.

Langevin's PhD work actually does not contain the equation that has been named after him. That equation was published a few years later, in 1908. In its original version, the Langevin equation describes Brownian motion – the seemingly random motion of a particle in a fluid due to collisions with molecules. Later it has been used to study a great variety of physical problems, such as Johnson noise in electrical circuits and dynamics of stochastic oscillators.

While leafing through the thesis it occurred to me that Langevin's equation forms a bridge between the theorists in the two departments at our Kavli Institute. In the theory section at QN, my colleagues Yuli Nazarov and Yaroslav Blanter regularly use Langevin equations, for example to study feedback and noise in nano-electromechanical systems or fluctuations in Josephson lasers. At BN, Timon Idema and Martin Depken develop models based on Langevin dynamics to investigate phenomena such as collective motion of self-propagating particles and the motion of the molecular machines that process the genetic information stored in our genomes.

As it stands now, the theorists in our two departments lead separate scientific lives. There is nothing wrong with that — both have their own fascinating challenges within their own fields. But if we are ever in need of investigating types of problems that may be of common interest, Langevin's work offers one direction worthwhile to take a look at.

• **Miriam Blaauboer**

Interview

INTERVIEW WOLFGANG KETTERLE

Wolfgang Ketterle is Professor of Physics at MIT. In 2001 he was awarded the Nobel prize for "the achievement of Bose-Einstein condensation in dilute gases of alkali atoms, and for early fundamental studies of the properties of the condensates". I had the honor to interview the upcoming Kavli Colloquium speaker

What where you fascinated by as a child?

Mathematics and playing with gadgets such as Lego, electronics and chemistry kits. We did not have any special Lego parts at that time so you had to be creative. One of my creations was a car with flapping wings. When I was 12 years old I started taking things apart to see what was inside. I am the first scientist in the family so I did not have anyone to ask for help, and the booklets supplied with the kits were not of much use to really understand what was going on. If I managed to fix something it went just like it goes in the lab: you take something apart and see for example a leaking capacitor or a disconnected resistor. It wasn't because I fully understood the electronics.

How would you describe your PhD?

After doing theoretical work I wanted to get closer to the real world and perform experiments. It turned out that the topic I was working on during my first year would not succeed because of lack of the right equipment. This was extremely frustrating. I was the only person working on the project and had no one to ask for help. I experienced this as an inefficient and frustrating year and learned the hard way. Then I switched to molecular spectroscopy (I wanted to stay in the same group). This was not my first interest but it soon became interesting after I went deeper and deeper into the topic. It was a successful PhD.

Sometimes my friends tell me that scientists work an insane number of hours in the lab without seeing any daylight. Does this comment sound familiar to you?

Your PhD should be the most important thing in your life, but not the only thing. It's ok to spend six days a week on it. Your PhD is the only chance you get in your life to fully focus. You can make things work that were thought to be impossible. It will change your life. After your PhD you are no longer afraid of approaching any problem.

You returned for a short time to the University of Heidelberg to work on applied physics (laser diagnostics of combustion in diesel engines). Why did you spend a short time there?

During my studies I had the feeling that I wanted to do something for society. After my postdoc I had almost accepted a position in industry but I liked the academic atmosphere more so I went for this position at Heidelberg. I quickly adjusted to the new challenges there and soon become a group leader. I missed the extra challenge though, I wanted to work on things I didn't even know there would be an answer to. I realized that not everyone should do the same thing in society, but people should do what they're best at. What I learned from this experience was that you shouldn't be afraid of changing field. It's really the skills that matter.

Do you foresee any big changes in the way scientists will be working in the near future?

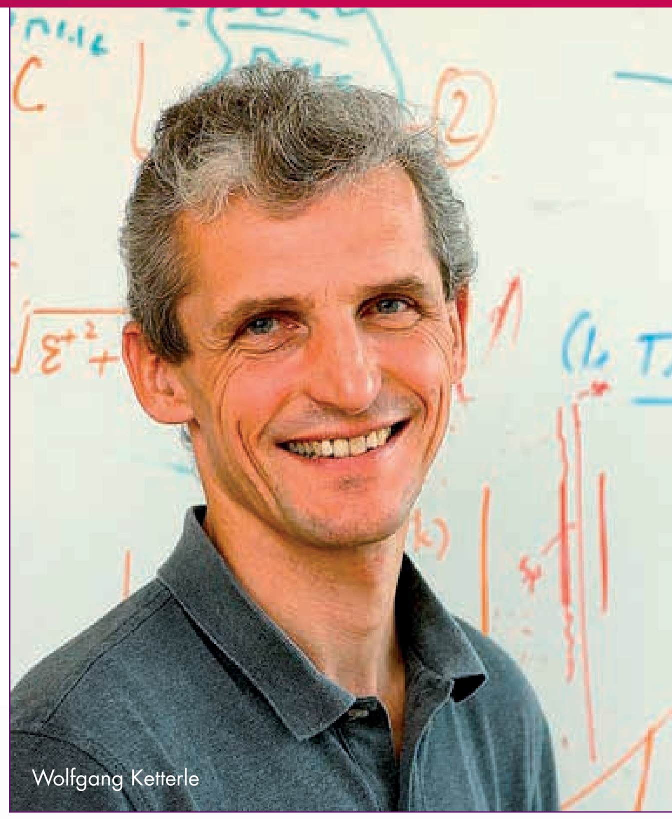
The scientific method for sure will not change. I do see a strong acceleration of progress because of technology and the availability of many more commercial components. Experiments can be put together much faster. But in the end this still won't be a major change; the limitation in science is how fast young scientists can learn. A second design run is always ten times faster than the first one. We are limited by human creativity. I can buy ten more lasers but it won't speed up the research.

• **Tim Baart**

Tim Baart

Kavli Colloquium

ULTRACOLD ATOMIC GASES WITH STRONG INTERACTIONS



Wolfgang Ketterle

WOLFGANG KETTERLE, MASSACHUSETTS

March 7, 2013 will feature a Kavli colloquium by Wolfgang Ketterle. The abstract of this colloquium reads as follows:

What form of matter can be simpler than a dilute gas of particles? The cases of non-interacting and weakly interacting particles are well understood. So what happens if the interactions get stronger? Depending on the interactions this will lead to a vast variety of materials with strong correlations. Simple models assume short range (delta function like) attractive or repulsive interactions.

Such systems can be realized with ultracold atoms, using the tools of atomic physics. We have studied a gas of ultracold fermions with both attractive and repulsive interactions. Fermions with attractive interactions undergo a phase transition to superfluidity. This is the simplest system which captures the essence of existing superconductors, but also extends to regimes where the transition temperature is very high. For repulsive interactions, a transition to a ferromagnetic phase has been predicted, but our experiments have shown that such a transition does not take place.

This illustrates the role of ultracold atoms as quantum simulators of seemingly simple Hamiltonians, for which no reliable solutions have been found computationally. •

15.00 h	Pre-programme : Nanoscopy with electron microscopes
	Henny Zandbergen : In-situ TEM, gateway to a better understanding of properties of materials and devices Rafal Dunin-Borkowski : Electron holography in the TEM: a unique view of magnetic fields and electrostatic potentials at the nanoscale Andreas Engel : TEM as a unique tool for nanoscale imaging of biomolecular structures
15.45 h	Break
16.00 h	Kavli colloquium by Wolfgang Ketterle: Ultracold atomic gases with strong interactions
17.15 h	Drinks & time to meet

Extra seminar

TOWARDS QUANTUM MAGNETISM WITH ULTRACOLD ATOMS

On March 8 Wolfgang Ketterle will additionally present a lecture: "Towards quantum magnetism with ultracold atoms". The abstract for this lecture reads as follows:

Over the last 20 years, science with ultracold atoms has focused on motion: slowing down motion, population of a single motional state (Bose-Einstein condensation, atom lasers), superfluid motion of bosons and fermion pairs. In my talk, I will address the next challenge when motion is frozen out: Spin ordering. A two-component boson or fermion mixture can form magnetic phases such as ferromagnetic, antiferromagnetic ordering and a spin liquid. The challenge is to reach the low temperature and entropy required to observe these phenomena. I will describe our current efforts and progress towards this goal. This includes Bragg scattering of atoms in a crystal of light (optical lattice), and a new adiabatic gradient demagnetization cooling scheme which has enabled us to realize spin temperatures of less than 50 picokelvin in optical lattices. These are the lowest temperatures ever measured in any physical system. We have also reached negative temperatures (which are, however, hotter than positive temperatures) •

Kavli Colloquium

'ULTRACOLD FERMIONS WITH STRONG INTERACTIONS '

Date : March 7, 2013 at 15.00 hours
Location : Aula Congress Centre, Mekelweg 5
Lecture room A

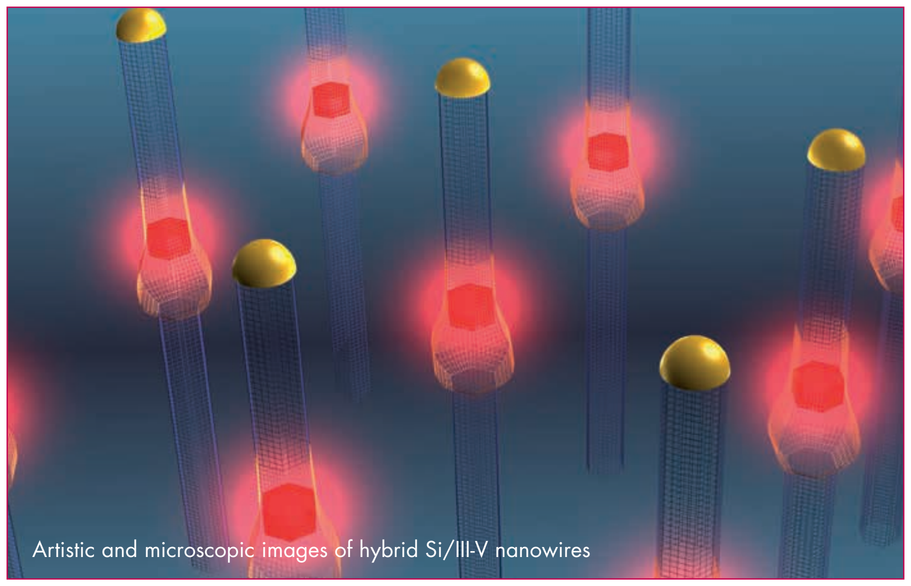
Extra seminar

'TOWARDS QUANTUM MAGNETISM WITH ULTRACOLD ATOMS'

Date : March 8, 2013 at 11.00 hours
Location : TN Building, Lorentzweg 1
Lecture room F

News

IMPOSSIBLE MATERIAL COMBINATIONS NOW REALIZED IN NANOWIRES



Artistic and microscopic images of hybrid Si/III-V nanowires

The electronics industry has experienced a dramatic evolution over the last decades thanks to remarkable developments in material science. To keep up with the roadmaps the next big step would be, according to industry experts, to integrate light-emitting compound semiconductors within silicon technology. Also in the different field of quantum information processing, the integration of III-V semiconductors with Si has great promise. It would facilitate the manipulation and storage of quantum information. So far, this III-V/Si integration has been hampered by differences in crystal parameters between these materials.

The promise of nanotechnology is that "impossible" material combinations can be realized in, for instance, nanowires. Several combinations have already been shown in nanowires, but are limited to within a specific semiconductor family. A team from the Universities of Delft and Eindhoven together with Philips Research Laboratories in the Netherlands used such nanowires to bridge the gap between the different semiconductor families (silicon and III-V compound semiconductors such as gallium arsenide), fusing the best properties of both worlds–those of optics and electronics–in one device. This work is an important step in the field of semiconductors and will trigger many groups from microelectronic industry and academics. The one-dimensional nature of a nanowire permits the epitaxial integration of strongly lattice-mismatched materials. They created atomically abrupt III-V/Si (and reversed) interfaces in nanowires grown by a gold catalyst via the vapor-liquid-solid growth mechanism. Despite the lattice mismatch between Si and III-V, the interfaces are sharp and without dislocations. The ability to controllably switch between these materials allow to make a new type of superlattice, a periodic stack of III-V's and Si. Most importantly, they integrated a GaAs segment with a high optical quality in a Si wire, a graal for light integration in microelectronic. More details about the experiments can be found online in Nature Communications. •

KAVLI DELFT THESIS PRIZE - NOMINATIONS WELCOME!

A prize will be awarded for the best PhD thesis written by a graduate student at our Kavli Institute of Nanoscience at Delft in the past two years. This prize, which consists of an award and an amount of € 3000 which can be freely spent by the laureate, is given out every two years and is awarded at the annual Kavli day in September. A PhD thesis is eligible for the 2013 prize when the research was done at the Kavli Institute and when the defense ceremony was held between between 1-4-2011 and 1-4-2013.

Nominations are now welcome for the 2013 Kavli Delft Thesis Prize. Deadline for submission is May 1. Everyone is welcome to nominate – please send suggestions to Cees Dekker, c.dekker@tudelft.nl. Concretely, please send a motivation letter why you consider this to be the most outstanding PhD thesis from our institute in the past 2 years that is worthy of this prize, and provide access to print 5 copies of the thesis. •

YAROSLAV BLANTER APPOINTED ANTONI VAN LEEUWENHOEK PROFESSOR

The Executive Board has appointed physicist Dr Yaroslav Blanter (1967) as Antoni van Leeuwenhoek professor. Blanter works at the Kavli Institute of Nanoscience Delft (QN/TN). The Antoni van Leeuwenhoek chairs at TU Delft are intended for the early promotion of outstanding scientists to professorships in order for them to optimally pursue the ongoing development of their academic careers. •

RONALD HANSON APPOINTED ANTONI VAN LEEUWENHOEK PROFESSOR

The Executive Board has appointed Ronald Hanson (1976) as Antoni van Leeuwenhoek professor. Hanson works at the Kavli Institute of Nanoscience Delft (QN/QT) and specialises in the study of quantum effects in nanotechnology. •

Introduction new faculty

Peter Steeneken

A SELF-INTERVIEW BY PETER STEENEKEN

Have you ever wondered how your mobile phone will look in 2025? Thinking back to when I got my first mobile handset in 2000, I didn't imagine that by 2013 smartphones would have become technology-crammed devices with broadband internet connections, GPS, high-res color touch-screens, accelerometers, gyros, compasses, acoustic wave filters, silicon microphones and processors strong enough to beat grandmasters at chess. Smartphones are just one example of how science has made a big impact on the way we live and it is up to the discoveries, inventions and vision of the scientists, engineers and entrepreneurs of today to enable similar steps in the future.

In order to have a more short-term impact on this future, I decided in 2002 to decline a postdoc position at Stanford University and to continue my career as an industrial scientist at Philips Research. At that time I had just finished my Ph.D. research on electron spectroscopy of strongly correlated oxide materials in Groningen. At Philips, I developed electromechanical micro-switches and micro-resonators (MEMS) for mobile phones and we transferred several of these technologies to our production divisions. When Philips sold its semiconductor division in 2006, I continued my work in Eindhoven at the research department of NXP Semiconductors, a new company with more than 20,000 employees. At NXP Research, we have a large freedom to explore new and innovative topics, as long as we have a good plan on how these investigations will contribute to business in the long term. Industrial research is very dynamic due to economic and strategic changes that ask a flexible attitude to continually expand one's expertise to new areas.

Even though I really like industrial research, there are aspects of academic research which I miss. Therefore I am very glad to have the opportunity to come back to university and to join the Kavli Institute as a part-time professor in the QN department for one day per week. In Delft I will investigate nanodevices based on new materials and fabrication technologies. These devices can serve as physical and chemical sensors, or as next-generation transistors, either to postpone the end of Moore's Law or to increase the energy efficiency of electronics. Besides my research activities, I will contribute to education and facilitate the collaboration between academic and industrial scientists by identifying mutual challenges.

In my spare time I enjoy playing tennis, the piano and chess. During my holidays I love to go mountain hiking. But most of my spare time I spend with my wife and 7-year old twin sons, for example on the soccer field or playing board games at home.

The Kavli Institute is clearly a place that houses and attracts the best scientists in the world working on key challenges in science. Besides the high scientific level, I have thoroughly enjoyed the enthusiastic, friendly and open atmosphere during my first days at the institute, and I look forward to seeing more of the institute and its people.

• Peter Steenken

THE NEW GENERATION IN OUR KAVLI INSTITUTE

Primary school children visited Bionanoscience department

Major new funding

Henny Zandbergen, Joost Frenken, Cees Dekker, Leo Kouwenhoven, Carlo Beenakker, Jet Bussemaker (Dutch Minister of Education, Culture and Science)

TEN-YEAR INVESTMENT IN BASIC NANOSCIENCE IN DELFT AND LEIDEN

NANOFRONT: EXPANDING THE FRONTIERS OF NANOSCIENCE

Research into the outer frontiers of the nanoscience field: the nano-researchers of Delft and Leiden were recently awarded a prestigious 10-year 'gravitation program' by the Netherlands Organisation for Scientific Research (NWO). After a fierce competition with a wide variety of basic research programs ranging from cancer genomics to language development, the Delft-Leiden nanoteam won the largest grant. Cees Dekker, who is leading the consortium, shares his views and excitement on this starting point for new research.

Why has this grant created so much buzz?

We have really waited over 10 years for an opportunity to start an integrated program of this magnitude. The researchers within the Kavli institute obtain many substantial research grants in Europe and the Netherlands on a regular basis, but to get a program of this size and scope will really give our international competitiveness an additional boost. The Nanofront program offers the opportunity to freely perform basic research at the forefront of science and engineering. We are extremely pleased that both universities, Delft and Leiden, have jointly decided to co-invest an additional 15 million on top of the 36 million that NWO has awarded us.

This will enable us to maintain state-of-the-art facilities for the best of the best scientists and to maximize chances of true breakthroughs in this highly competitive field. An investment like this will keep the Netherlands on the map for the next decade.

Why have you chosen these three themes (see box) and how will you maintain the integrative aspect in the program?

We did choose not to address the entire field of nanoscience, which is very broad. Instead we got together very early on with the key PI's and chose to focus on those areas within nanoscience where the most exciting developments are looming. In these three areas of quantum nano, bionano, and new nanotechnology, often based on TEM or scanning probe microscopy, we can also build on current strengths. The existing collaborations between PIs and other involved scientists were great stepping stones to shape the integrated NanoFront program. Examples are the quantum computing cooperation between Carlo Beenakker and Leo Kouwenhoven, the joint work of Henny Zandbergen and Joost Frenken on in-situ imaging techniques, and the joint interest of Herre van der Zant and Jan van Ruitenbeek in single molecule electronics.

Although constructing the 60-page proposal was a tedious job, we had great fun devising the scope and topics within the program. The NanoFront researchers already form a close-knit consortium through our joint Casimir Research School. We had lengthy discussions pinpointing the topics with the highest potential for scientific progress. This process itself already built a sense of 'community' amongst the participating research groups. I want to stress that many people besides the six main PI's contributed their ideas towards the NanoFront research agenda. The creative power of this research community is exactly what we will be leveraging throughout the upcoming 10 years of the program.

The NanoFront programme

The NanoFront program was selected for funding by the Dutch Ministry of Education, Culture and Sciences, based on its academic excellence and expected progress in science. It was one of six 10-year programs for basic research that were chosen from all fields of science. Main PIs are: Cees Dekker[1] (Coordinator), Carlo Beenakker[2], Leo Kouwenhoven[1], Joost Frenken[2], Michel Orrit[2] and Henny Zandbergen[1], (1 Delft, 2 Leiden). The program consists of the following three themes that are interlinked at all levels.

Theme 1. Frontiers of quantum nanoscience - from quantum surprises to quantum devices: Nanostructures open up new possibilities for exploring the nature, limits, and use of quantum mechanics. Quantum objects such as qubits or nanowires are now so well controlled that they can be increased in complexity for both the purpose of exploring and exploiting. In this theme, we aim to take important steps towards the quantum computer that has been dreamt of for so long.

Theme 2. Frontiers of bionanoscience - exploring and building life from the nanoscale up: This theme will explore the intriguing boundaries between the living and non-living world: the nanoscale components of the biological cell. Building with biological material at the nanoscale by developing new biomolecules, sensors, networks, and functional cellular structures will move towards the ultimate challenge, the creation of a minimal cell.

Theme 3. Frontiers of nanotechnology - get real, go live: Nanoscience has always been driven by the development of novel tools to image and control materials at the nanoscale. The aim is to develop new 'nano-vision' tools focused on imaging under live conditions, from live imaging in biological cells to catalytic reactions under realistic conditions. Tools will also be used to develop and exploit new nanodevices, from nanomechanical systems to atom-by-atom construction. •

Celebrating the first news of the award of the grant

What do you expect to gain in your own research in bionanoscience from the integration with these other two fields?

The most obvious example is in improved nanotechniques to study biological processes, in live cells in real time. I am fascinated by what goes on inside a cell, and I try to mimic the cell's sub-functions with artificial nanostructures. My group has for example worked on mimicking the holes in the membrane of the cell nucleus, where we can study how gatekeeper proteins affect transportation of molecules, such as proteins or RNA through these holes. And there are many other examples, ranging from bacterial cell division to DNA repair mechanisms.The novel nanotechnology theme in NanoFront offers great promises of bringing in new techniques to look inside the cell to, say, study DNA repair. The direct benefit from the interaction with the quantum nanoscience theme is more subtle. While the physics of quantum phenomena is fascinating and intellectually stimulating, I expect the practical knowledge exchange to result from the overlap in the nanotechniques that we both use. We already have a joint interest in labs and research infrastructure.

Will this program generate opportunities for the younger scientists?

Yes, I am convinced that this will help to offer the younger scientist a stimulating and challenging work environment. We plan to be at the forefront of the field. It is a great opportunity for young people to start their career in a intellectually stimulating place where state-of-the-art methods and equipment are available. Over the course of the decade, NanoFront will most likely fund almost 100 PhD students. We plan to conduct basic research, but with an outlook on novel future applications. We will, among many other things, start offering courses on how to start your own company. The interest clearly is there – I already have PhD students who are starting a company. NanoFront will yield many 'start-up-worthy' outcomes.

If we could fastforward to the future and I would speak to you again in 10 years' time, what would be the real achievements of this program? Can I tempt you to make a prediction?

I am really convinced that my colleagues here at Delft will be able to build a quantum computer that can perform calculations. In the technology theme, we will by then have achieved realtime dynamic imaging on the atomic level. And in my own field at the interface of nano and bio, we will have succeeded in uncovering the molecular fundamentals of some major diseases, leading to novel types of nanomedicine. And in all these examples, the cooperation between the Kavli bio- and quantum-nanogroups in Delft and our nanoscience colleagues from the Leiden Institute of Physics will have shown itself to be a solid base for a truly excellent centre of gravity in nanoscience.

Anouschka Versleijen

• Anouschka Versleijen

The announcement

News

TED YOUNG NEW INTERIM CHAIRMAN BN

As from January 1st 2013, prof. Ted Young has been appointed as interim chairman of the Department of Bionanoscience. Ted Young is emeritus professor of Applied Physics, former chairman of the Medical Delta and former department chair of Imaging Science & Technology department at the Faculty of Applied Sciences at the TU Delft.

The departing chair and founding father of Bionanoscience, Cees Dekker, will be turning his full attention to his research again. Besides the research activities he will remain fully active as director of the Kavli Nanoscience Institute of Delft, chairman of the recently granted NanoFront program, and scientific director of the 3TU Center of Excellence 'Bionanoapplications'.

We like to thank Cees for all his hard work, drive and vision over the last few years and wish his successor Ted every success with his new task. •


Ted Young

New employees

NEW EMPLOYEES DEPARTMENT BIONANOSCIENCE

Name	Date of employment	Title	Lab
Roland Kieffer	11/01/12	Technician	Marie-Eve Aubin lab
Simon Lindhoud	11/15/12	Postdoc	Marie-Eve Aubin lab
Luuk Loef	11/15/12	PhD	Chirlmin Joo lab
Marc Emanuel	12/01/12	Postdoc	Martin Depken lab
Ted Young	01/01/13	Interim Chairman	Department
Andreas Engel	01/01/13	Faculty	Andreas Engel lab
Ruben van Drongelen	01/01/13	PhD	Timon Idema lab
Eshter Reinders	02/01/13	Department manager	Department
Henneke Filiz-Piekhaar	02/01/13	Secretary	Department
Alireza Mashaghi	02/01/13	PhD	Cees Dekker lab
Malwina Szczepaniak	02/01/13	Postdoc	Chirlmin Joo lab
Mariana Köber	02/01/13	Postdoc	Nynke Dekker lab
Jaco van der Torre	02/01/13	Technician	Department
Jolijn Leeuwenburgh	02/01/13	Secretary	Department
Solia Arriani	02/01/13	Secretary	Department
Stephanie Heerema	03/01/13	PhD	Cees Dekker lab
Zhongbo Yu	03/01/13	Postdoc	Nynke Dekker lab
Richard Janissen	03/01/13	Postdoc	Nynke Dekker lab
Jacqueline Enzlin	03/01/13	Technician	Department

NEW EMPLOYEES DEPARTMENT QUANTUM NANOSCIENCE

Name	Date of employment	Title	Section
Fanming Qu	08/01/12	PhD	QT
Gijs de Lange	09/17/12	PhD	QT
Gaurav Nanda	10/01/12	PhD	KN
Christian Bonato	01/10/12	PhD	QT
Maja Cassidy	10/05/12	PhD	QT
Max Koole	11/01/12	PhD	MED
Stefan Bogdanovic	11/01/12	PhD	QT
Julia Cramer	12/01/12	PhD	QT
David van Woerkom	12/01/12	PhD	QT
Wiel Evers	01/01/13	PhD	MED
Peter Steeneken	01/01/13	Faculty	MED
Andrea Caviglia	01/01/13	Faculty	MED
Julien Dugay	01/01/13	PhD	MED
David Herranz	01/01/13	PhD	CN
Srijit Goswami	02/15/13	PhD	QT
Önder Gül	01/01/13	PhD	QT
Srijit Goswami	15/01/13	PhD	QT

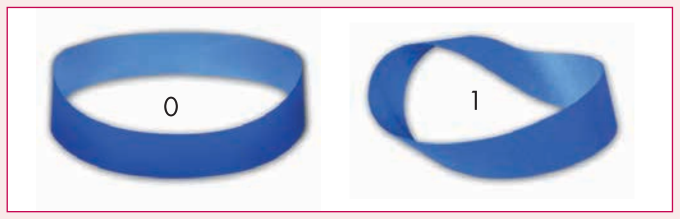
ERC SYNERGY

Scientists of the Delft Kavli Institute of Nanoscience were awarded a 15 million Euro Synergy grant of the European Research Council, for research on quantum computation. The applicants, Leo Kouwenhoven, Lieven Vandersypen and Carlo Beenakker (Leiden), together with their colleagues Ronald Hanson, Leo DiCarlo, Yuli Nazarov and Erik Bakkers, proposed to join forces in order to push quantum computation beyond the tipping point where it becomes a viable technology

Quantum mechanics represents our deepest understanding of nature, describing the behavior of microscopic particles such as atoms and electrons. Quantum behavior can be highly non-intuitive and fascinating, for instance the absurd-sounding possibility that an object is simultaneously at two well-separated locations, in a state called a superposition. Entanglement between particles is possibly even more absurd, since it implies that measurement of one particle influences the other particle even if it is far away.
These two quantum possibilities can be very powerful. It is our goal to investigate how superposition and entanglement can be used as a new resource in technology. Ideas about quantum mechanics as a resource have developed particularly in the context of information processing. Currently, information is encoded as strings of bits. This is a classical way of encoding; bits are either zero or one. The quantum way allows for superpositions where bits can be simultaneously zero and one. Such superposition bits are called quantum bits, or qubits. It turns out that a computer based on qubits instead of bits is much more powerful than any classical computer will ever be.

Grand scientific challenge

Why do we not yet have quantum computers today? Quantum states degrade over time, a process known as decoherence. Larger objects usually decohere faster, which is why we never encounter big objects in a superposition. This fragility is also the reason that superposition is not used in current technology. The realization of a quantum computer is primarily a fight against such errors coming from decoherence. The scientific challenge is to understand, control and extend coherence so that quantum mechanics can be used as a resource. The concrete objective of the ERC Synergy Grant is to demonstrate methods to prolong the lifetime of quantum states as long as necessary for computation. Such a fundamental level of quantum control has never been realized in nature or technology and can rightly be classified as a Grand Challenge.
A scientific breakthrough of the last few years gives us a promising direction for overcoming this challenge. The key idea is to use elements of topology for preventing decoherence. To illustrate how this works, think of a ribbon with a twist, as shown in the figure (such a ring is known as a Mobius ring). We can perturb the ribbon in many ways, stretch it, fold it, etcetera, but the twist will remain. So if a twist would represent 0 and no twist represents 1, this bit will not easily be perturbed.



In the Synergy proposal, the aim is to fight decoherence using elements from topology at all levels, from qubits to circuits. At the qubit level, the Majoranas discovered last year in Delft are predicted to be intrinsically protected against decoherence by their topological properties. At the circuit level, a large two-dimensional lattice of many qubits can organized in a so-called surface code, so that the topological properties of the lattice protect superpositions. Both Majoranas and surface codes are extremely interesting scientifically, extremely powerful for protecting quantum states, and completely unexplored experimentally today.

Quantum computer hardware

Quantum behavior has been beautifully studied in microscopic particles such as atoms or ions, as well as in packets of light (photons). For their groundbreaking work in this area, David Wineland (NIST, Boulder, CO) and Serge Haroche (ENS Paris) received the 2012 Nobel Prize in Physics. Still, a large-scale quantum computer will likely be based on solid-state devices that leverage readily available fabrication and integration techniques developed by the electronics industry. The Synergy team will pursue a platform in which memory qubits and processor qubits are all interconnected using a superconducting coplanar waveguide as a shared databus (see figure). As processor qubits, which are optimized to compute, both a superconducting device and a semiconducting device built from silicon will be pursued. As memory qubits, which are optimized for storing information, Majoranas and donor atoms will be used.

The ERC Synergy grants were awarded for the first time this year. Competition was very strong: only 11 out of 700 proposals were funded. The grant will be used to fund PhD and postdoc positions, build new measurement set-ups, and to expand technical know-how in new directions. A new lab space will be created to host the new set-ups, optimized to facilitate exchange of ideas. The years ahead should be very exciting! The grant will be used to fund PhD and postdoc positions, build new measurement set-ups, to create a new tenure-track position, and expand technical know-how in new directions.
• Lieven vandersypen

Introduction new faculty

Marie-Eve Aubin-Tam

A SELF-INTERVIEW BY MARIE-EVE AUBIN-TAM

What is your background?
I have always been an experimentalist. I love to touch, smell, see, taste, and explore new things. As a toddler, I would scrutinize plants seeds and pollen grains for hours. (Still today I think they are intriguing!) I grew up in Québec, the French-speaking province of Canada. After studies in Engineering Physics, I went on to the Ecole Polytechnique in Paris to continue with more engineering studies. It was during this time in France that I had a first encounter with biology. It prompted me to pursue a Ph.D. in the department of Biological Engineering at MIT. During my doctoral work, I developed strategies for efficient bioconjugation of proteins to metallic nanoparticles. I liked MIT so much that I decided to stay for a postdoc to study motor proteins and protein unfolding with optical tweezers.

What is your research plan?
In the past ten years, I have developed a real fascination for proteins, their conformation, their mode of action, and how they interact with one another. I found particularly attractive the idea that I could directly interact with them and then observe their reaction, almost as if I could touch them and see them myself. With today's biophysical tools, we can get a more intimate view on the inner workings of proteins, and even control in real time some conditions that may affect their function. More recently, I have become especially interested in membrane proteins. Together with my group, I am planning to develop single-molecule tools to investigate membrane-associated motor proteins. The cell membrane used to be viewed as an inert barrier, but we now know that it is the host of numerous dynamic biological processes. The transport of proteins across membranes in particular is a key biological process, which is essential for intercellular communication and protein trafficking across cell compartments. Single-molecule tools have a lot to contribute to shed light on these important processes.

What are your hobbies?
I enjoy discovering nature's beauty. Everywhere I go, I try to find the best spot to go hiking. (I'm still open to recommendation in the Netherlands…). Some of the most memorable images in my mind come from hikes up the Julian Alps or down the Grand Canyon. Two little troopers (2 and 5 years old) have now joined my husband and me in this wonderful activity.
Maybe my inspiration for doing research is the same as for climbing mountains. You persevere and work hard to reach a target, and at the same time, you cannot fully predict how it will look when you finally get there. How exciting!

What is your first impression of the Kavli Institute of Nanoscience?
My first impression of the Kavli Institute of Nanoscience is of a dynamic and collaborative group of scientists at the interface between physics, biology and material science. Interesting phenomena usually arise at interfaces: the interface between biomolecules, the interface between disciplines, etc. The Kavli Institute is therefore an ideal place because it is filled with people embracing all kinds of interfaces. I am looking forward to interacting more with this vibrant community, which I expect to be a very fruitful experience.

• **Marie-Eve Aubin-Tam**

News items

SAVE THE DATE

FRIDAY 5 APRIL 2013

KICK-OFF EVENT NANOFRONT

The NanoFront kick-off event will be held on Friday 5 April 2013. This kick-off event is going to be a spectacular happening that you will not like to miss, so please note it down! The event will take place in the afternoon and evening, further details will be announced later. •

GENOOTSCHAPSMEDAILLE

On Friday, November 30th, Leo Kouwenhoven has received the 'Genootschapsmedaille'. This medal has been awarded by the Society for the promotion of Physics, Medicine and Surgery. The Genootschapsmedaille was established in 1790 and is awarded to a researcher whom original research contributed to the scientific areas covered by the Society.

Leo Kouwenhoven is the 21st scientist who is honored with the medal. The list of laureates includes names like Nobel Laureates, Van der Waals, Kamerlingh Onnes, Lorentz and Einstein. •

STOKVISPENNING

On Saturday, October 27th, Leo Kouwenhoven has received the 'Stokvispenning'. This medal has been handed out by De Verening 'Het Nederlandsch Natuur- en Geneeskundig Congres' and is awarded for Kouwenhovens lecture 'Majorana fermion and Quantum Computers'. The aim of the Stokvis lectures is to involve a wide public with broad interest. •

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. •

Bojk Berghuis

Column

PEER PRESSURE

As an editor of The Lancet once stated: "We portray peer review to the public as a quasi-sacred process that helps to make science our most objective truth teller. But we know that the system of peer review is biased, unjust, unaccountable, incomplete, easily fixed, often insulting, usually ignorant, occasionally foolish, and frequently wrong." Though stated quite bluntly, those familiar with the process would quite likely tend to agree to some extent – or admit that though useful, peer review (PR) is a time-consuming and inefficient process, to say the least.

In November 2011 a group of Finnish ecologists set out to 'fix the woes of peer review without breaking what works'. They founded a commercial service and named it Peerage of Science (PoS). With over 1100 scientists and 20 journals currently participating, PoS has been attracting quite some attention in the media lately.

In short, this is how it works: a scientist uploads a manuscript anonymously and free of charge to the online PoS community, which becomes available for member-peers to review. Upon review, reviewers write a peerage essay (PE), which the authors receive along with comments and a categorical recommendation, ranging from 'publishable' to 'withdraw'. Instead of entering another round of review, reviewers evaluate and grade each other. Reviewers could also choose to publish their PEs. Authors re-edit the manuscript, reviewers evaluate the final version using a 1-5 scoring of seven aspects (breadth, impact, originality, data, methods, inference and literature coverage). Finally, a quality index is calculated for the manuscript, the authors and the reviewers. Journals in turn pay to gain insight and can send publishing offers to authors.

I like this approach as it takes care of a couple of existing PR problems. First of all, reviews aren't lost following rejection – like in a traditional down-the-ladder publication trajectory for instance. Reviewers evaluating and grading each other might also contribute to the making of a more objective system. Authors in turn need not worry about the lottery a new set of reviewers might raise when submitting to a new journal. Second, bravo to quid pro quo; directly linking effort of review to the benefit of having your own work reviewed quite likely acts motivating. Offering the opportunity for reviewers to build up a track record and to publish their reports also makes reviewing less of an one-sided effort. For this PoS can be applauded.

However, the chance of reviewers being biased or selective is still present and could be hard to distinguish from an honest review. The value of anonymous submission is also questionable since in many cases author identity can be easily guessed by peers. As each journal also has its own format requirements, it is not clear to me how PoS deals with this one-size-fits-all approach. Editors, usually charged with the task of managing reviewers for authors, benefit from a reduced workload. But with no-one actively policing and seeking reviewers, there is a chance that some manuscripts might just sink without a trace. Just to name a couple of many concerns that could – and should – be raised.

All in all, I think PoS takes a refreshing approach. Though not the first attempt to improve the efficiency and objectivity of the PR process, this open source and collective initiative seems to be catching on. I cordially invite the early adopters amongst you to participate; others can read the 'peerage essay' of Hettyey et al., which will appear in Cell this month.

•Bojk Berghuis

Science art

Artist impression of stamping a carbon nanotube. The researchers 'stamped' one individual carbon nanotube from the (transparent) growth chip onto the bottom chip (with golden electrodes). The resulting bend in the ultra-clean nanotube allowed the researchers to manipulate single electron spins.

Credit: Fei Pei, Edward Laird, Gary Steele, Leo Kouwenhoven Nature Nanotechnology 7, 630-634 (2012).

Artist impression made by Fei Pei and Avalon designs.

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

Upcoming Kavli Colloquia

CHARLES MARCUS

June 13, 2013

University of Copenhagen

Kavli Day

SEPTEMBER 12, 2013

September 12, 2013

Delft University of Technology

Upcoming Kavli Colloquia

PAUL ALIVISATOS

October 31, 2013

UC Berkeley

Colofon

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