KAVLI NEWSLETTER
Kavli Institute of Nanoscience Delft

No. 14
October 2015

IN THIS ISSUE:

Intel invests heavily into QuTech technology

An interview with Lieven Vandersypen and Leo DiCarlo

American semiconductor chip manufacturer Intel and QuTech, the quantum technology institute of TU Delft and TNO, have announced a ten-year intensive collaboration. In addition to financial support for QuTech totaling approximately $50 million, Intel will also contribute expertise, manpower and facilities. Lieven Vandersypen and Leo DiCarlo are two of the lead scientists of QuTech and members of our Kavli Institute of Nanoscience. Here, they answer some important questions regarding this new endeavor.

How did this collaboration come about?

We have been looking to join forces with a leading semiconductor company for more than two years since we believe that their input will be essential to make the next big steps forward in our field in the coming 5-10 years. Around the same time, Intel decided to start an activity in quantum computing and started looking for a university partner. One year ago now, we had contact with people from Intel for the first time, and after several visits back and forth and many productive discussions, we are very happy to finally start working together!

What contribution can Intel make to quantum computing?

Apart from the many open scientific questions, there are a number of important technological challenges that need to be overcome in order to scale up from a handful of quantum bits today to thousands or millions of quantum bits in the future. This includes achieving sufficient qubit uniformity and quality, developing classical hardware to control large number of qubits, connecting the qubits to these electronics, and designing an overall architecture for the future quantum computer. Intel is the leading semiconductor company in the world and has unique expertise in these areas.

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IN THIS NEWSLETTER

Lots of interesting items in this newsletter. We start with our opening item on the great new M$ 50 deal between Intel and our QuTech consortium – read all about it in the interview with Lieven Vandersypen and Leo DiCarlo. Furthermore we have an extensive interview with four of our support staff members who are absolutely critical for maintaining the quality of the science in our Institute. Read their stories on page 4.

A highlight looking ahead will be on Thursday November 5, when we will host Hendrik Dietz from TU Munich for a Kavli Colloquium on 'Molecular systems engineering with DNA'. Hendrik is one of the leading scientists in the field of DNA origami, a new technique to construct basically any structure at will from simple DNA molecules. Hendrik also is a master in presenting the material, so I look forward to a very exciting Kavli Colloquium. Note also that there will be an interesting preprogram with short presentations on the content of the Nobel Prizes 2015 that were awarded this month.

Furthermore, we have a new columnist! After a number of years where we enjoyed great columns by Bojk Berghuis and Miriam Blaauboer, we set out to seek new columnists. Martin Depken picked up on the challenge, while we hope to allocate an interested columnist from QN. Read Martins column on page 2. And there's much more to this newsletter. Enjoy!

• Cees Dekker

COLUMN

Should I stay or should I go?

Doing science is the job we do, and what an awesome job at that! But, it is just one job in a world full of jobs—some of them great, some of them not. For most of my career I bought into the myth that doing science is better than anything else one could possibly do. I was desperate to stay, and going was synonymous to personal failure. I only regained some sense of perspective once I stopped my nomadic postdoc life and got friends outside academia. Though I now find my old views absurd, I suspect that a good fraction of scientists still believe the myth. I am also convinced that the myth hurts science itself. Worst of all, the myth is self-perpetuating.

The myth is damaging since it paints too stark a contrast between science and other human endeavors. As the best science is born out of bold and risky projects, science will suffer when scientists fear personal failure. For who can be visionary when clinging to the overcrowded train that speeds to paradise, and who dares the road less travelled when the cost of failure seems too high to contemplate? For the ones still onboard when arriving at Tenure Station, the myth suddenly becomes justified, and perhaps believable. Indeed, success retroactively justifies the tough choices made along the way, and so the myth gets fed to the next generation of scientists. When talking to postdocs, I often hear worries about "not knowing what else to do". Talking to senior professors, I often hear doubt that there is a problem at all. After all, they tell their students and postdocs that "it's OK" to leave academia. Talk is cheap though, and unless you know what exciting things you would be doing if leaving science tomorrow, chances are that the myth is alive and well in you too. Chances are also that your students and postdocs sense it, and that this affects the science they do.

To solve a self-sustaining problem, one has to break the chain of reinforcement. It is hardly surprising if scientists put science on a pedestal, if all they see is a narrow definition of scientific success. Most our teachers and mentors are scientists, and our textbooks and seminars are full of them. Though this is natural, the hiring pyramid is obtuse, and most PhDs will not play out their full career in academia. With this in mind, we could do a much better job balancing the images of success that we foster. A good start would be to hold regular high-profile seminars with people that achieved great and inspiring things outside academia. It is also important to know the true nature of the options within science. By allocating most postdoc funds in the form of personal grants, we could give young scientists an early and deserved independence, along with an invaluable taste of what it takes to become a successful PI.

Together we should find many more positive ways to help scientists build successful careers starting in academia, but not necessarily ending there. To do this, we first need to reexamine our notion of success—for the sake of science, and for the sake of the people who do the science.

• **Martin Depken**

INTERVIEW

An interview with Hendrik Dietz

Hendrik Dietz is a Professor of Biophysics at the Physics Department in Technische Universität München and also a Principal Investigator of the Laboratory for Biomolecular Nanotechnology there. He is one of the leading scientists in DNA-based nanotechnology where he has pioneered three-dimensional DNA origami. He was awarded several prizes for his scientific contributions, most recently the prestigious Gottfried Wilhelm Leibniz-Preis (2015) by Deutsche Forschungsgemeinschaft.

You were trained as a physicist and you moved towards biology. Could you maybe tell us briefly about your fascination for biology?
It started when I first learned about the existence of all those fascinating molecular machines. In high school I had opted out of biology, thus I really had no clue. I think somewhere around 1998 as a physics undergrad, I saw a talk about ATP synthase and its rotary motion, as seen in single-molecule experiments. At that moment, I decided to learn more and moved to Munich to study biophysics.

From single-molecule biophysics to designing nano-sized DNA objects, what was your journey like? Do you remember the moment when you were fascinated by DNA and DNA-based structures?
The seed was planted by Ned Seeman - the pioneer of DNA nanotech - in 2003 or so, when I first saw a talk by him in Austria. I had just started my master's thesis project. I heard him talk at a conference in Austria. (Cees Dekker was also there, btw.) I loved Ned's slides with skulls and bones, and the connections to DNA objects that he made. But it triggered also some thoughts on whether one might build tools for biophysics, based on DNA. In 2005, I gave a long talk in one of our PhD seminars purely about speculative DNA "tweezer" like objects for influencing protein conformations. Then Paul Rothemund published his wonderful DNA origami work in 2006, having made a huge step forward in the complexity of those objects. At the time I was about to finish my PhD and I had considered going into de novo protein design for a postdoc. But Paul's work tipped the balance again toward DNA nanotech. Finally, I met William Shih at a conference in Venice shortly after Paul's paper came out. He said he wanted to extend Paul's design approach to building 3D DNA objects. We had a long, productive chat on the beach to flesh out a project. And so I joined his lab at Harvard.

Since the first DNA Origami report in 2006, the technology has moved from simple geometric structures to mimicking biological systems. What is, according to you, the key moment that has changed the way that we look at DNA origami?
I am not sure whether there was "the" key moment. There were certainly a number of milestones. However, what is important is the continuous progress that the field shows towards building objects with greater complexity, greater precision, and also greater utility.

You moved from 2D DNA structures to 3D structures. Is there a huge difference in the way these are made?
The design of 3D is slightly more tedious. There are also significant differences in the topology of the chain connectivity. As a result, multi-layer DNA origami requires somewhat more attention during practical assembly in order to obtain good yields.

This field featured gadgets from DNA smileys to DNA dancing men to DNA bunnies. Do you think there will be the real world applications of DNA origami and structures in medicine, nanorobotics and technology?
Yes. There are also already a number of applications that show its utility. Smileys and bunnies are not just fun, but good communicators of a technological advance. If you can make a Nanobunny, surely there must be a way to build something useful.

DNA has been the most interesting biological molecule discovered in the previous century. Could you walk us through the emergence of DNA Nanotechnology?
This cannot be done in three sentences. I suggest coming to my talk or reading a recent review by Matthew-Jones, Seeman, and Mirkin in Science this year.

Do you think there will be a protein origami in the future?
Probably. There might also be hybrid approaches: designed proteins on DNA scaffolds, with the proteins there for fitness and function, and the DNA for overall shape and mechanisms.

Do you still go into the lab? And if not, do you miss going to lab?
Unfortunately, I have rarely been in the lab lately. We even bought new

KAVLI COLLOQUIUM

Date: November 5, 2015 at 15.00 hours Location: Lecture room D, Aula

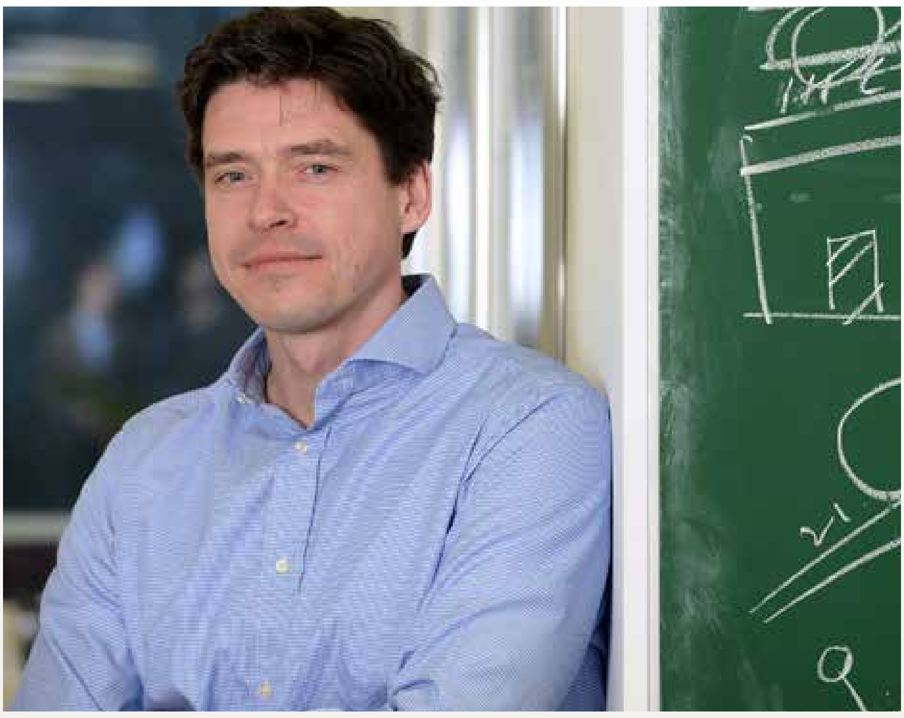
"Molecular systems engineering with DNA"

Hendrik Dietz

TU Munich

November 5, 2015 will feature a Kavli colloquium by Hendrik Dietz.

It is notoriously difficult to observe, let alone control, the position and orientation of molecules because of their small size and the constant thermal fluctuations that they experience in solution. Molecular self-assembly with DNA provides a route for placing molecules and constraining their fluctuations in user-defined ways and with up to Angstroem-scale precision. These positioning options open attractive and unprecedented avenues for scientific and technological exploration. In my talk I will introduce some of the key concepts and methods, and highlight a number of recent developments.



15.00 h	Pre-programme:
	The Nobel 2015 prize in medicine presented by Henk Schallig (KIT) **The Nobel 2015 prize in physics presented by Stan Bentvelsen (NIKHEF)** **The Nobel 2015 prize in chemistry presented by Claire Wyman (Erasmus)**
15.45 h	Break
16.00 h	**Kavli colloquium by Hendrik Dietz: "Molecular systems engineering with DNA"**
17.15 h	Drinks & time to meet

EXTRA SEMINAR

Date: November 6, 2015 at 10.00 A.M. Location: Lecture room E, TN

"Getting more from single molecules "

We have studied the interactions between nucleosome core particles (NCP) and between the blunt ends of DNA. In the former project, we have quantified the distance-dependent energy profile between NCPs which makes interesting predictions for the dynamical structure of chromatin fibers. In the latter project, we have measured the forces and the timescales needed to break a single DNA basepair stack. In both projects we benefited strongly from DNA based scaffolds to accurately position the molecules under study.

equipment and I did not get a chance to play with it. Sometimes I miss going to the lab. On the other hand, what I like most is pondering about data and coming up with ideas for new experiments, and this is what I currently spend most of my time with.

Maybe a rhetorical question: what do you think you would have been if you had not become a scientist?
Jet fighter pilot, physician, lawyer, and economist, in this order. This is the trajectory of things that I started or briefly considered before I actually decided to study physics.

According to you, what are the most important aspects of being a scientist?
Curiosity, optimism, creativity, being open to being wrong. And some tolerance to frustration.

- **Adithya Ananth**

Intel invest heavily in QuTech (continued from page 1) >>

Why does Intel invest in quantum computing?
This is really a question for Intel to answer, but our understanding is that they see an opportunity to advance the field by working alongside quantum nanoscientists. Eventually, they hope to make products based on this technology. What is important to us is that they understand that developing a quantum computer is a long-term effort.

What type of quantum bits will Intel work on?
The focus of the program is on superconducting circuits (transmon qubits) and on electron spin qubits in semiconductor quantum dots, along with the control electronics, interfacing and architecture.

Why did Intel choose to come to Delft?
First of all, we are very honored that they chose to come to Delft. We believe that the main reasons are that we have strong expertise in the two types of qubits that interest them most; that we understand the enormous engineering challenges ahead and that we already work on them together with engineering colleagues of TU Delft and TNO; and, finally, that we expressed a strong interest in an active collaboration with Intel.

How does this connect with QuTech research done with Microsoft?
The work with Microsoft is on topological quantum computing, a different approach to realizing quantum computers that is easily distinguished from the Intel approach that uses transmons and spin qubits. Even though they are separate activities, we certainly hope that having these two strong efforts side by side within QuTech will benefit both.

Will this collaboration restrict your ability to publish?
We will be able to publish all of our work that comes out of this collaboration. In some cases, we may first file a patent, but then we will still publish. We are also free to discuss our work with other scientists in the field, at conferences, etc. Both QuTech and Intel believe that the best progress will be made if we continue to be fully integrated in the scientific community.

What will you spend the $50 million on?
This will fund PhD students, postdocs and other staff, as well as equipment across all the activities within the scope of the project.

What are you most excited about?
We are most excited about the unique opportunity to advance the field beyond what is possible otherwise, by combining the best chip fabrication and design technology in the world with our physics expertise. We started just a month ago but already received our first 300mm substrate containing a Si/SiGe quantum well, and the first superconducting resonators made at Intel. Two Intel engineers are visiting us this week, and in November we will have a three-day workshop with everyone involved in the project. There is a lot of enthusiasm on both sides, which makes it a lot of fun to work together!

For more information, please visit http://qutech.nl/project/qutech-quantum-institute-enters-into-collaboration-with-intel/

Lieven Vandersypen, Jim Clarke, Mike Mayberry, Leo Di Carlo

NEW EMPLOYEES

Name	Date of employment	Title	Lab
Christopher Bruot	01/07/15	PD	QN/MED
Sanchar Sharma	15/08/15	PhD	QN/TN
Eveline Diepenveen	15/08/15	PhD	Liedewij Laan lab
Belen Solano	15/08/15	Lab Manager	Nynke Dekker lab
Da Wei	17/08/15	PhD	Marie Eve Aubin lab
Jeremie Capoulade	01/09/15	Technician	Department BN
Marco Saltini	01/09/15	PhD	Marileen Dogterom lab
Nicole Imholz	01/09/15	PhD	Greg Bokinsky lab
Ferhat Buke	01/09/15	PhD	Greg Bokinsky lab/Sander Tans
Greg Pawlik	01/09/15	Postdoc	Cees Dekker lab
Jouri Bommer	01/09/15	PhD	Qutech, group Leo Kouwenhoven
Celine Alkemade	01/10/15	PhD	Marileen Dogterom lab
Sam Leachman	15/10/15	Postdoc	Nynke Dekker lab
Mehran Mohrebbi	01/11/15	PhD	Hyun Youk Lab
Qi Yan Kai	01/11/15	PhD	Hyun Youk Lab
Ramiro Sagastizabal	01/11/15	PhD	Qutech, group Leo DiCarlo
Jie Sjen	01/11/15	PD	Qutech, group Leo Kouwenhoven

iGEM team awarded the Grand Champion Prize!

We are proud to inform you that the TU Delft iGEM team won the award for Grand Champion, making them the best team in the world! Anne Meyer won the Judges' Prize.
This year's team worked to design a 3-D printer capable of printing controlled biofilms, thin layers of bacteria, using the children's toy K'NEX. The engineered biofilms we created could be applied as a test platform for research in both industrial and medical applications. Congratulations to the iGEM team and to all that were involved in making this such a great success!!

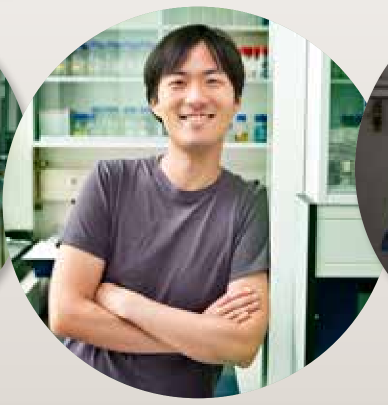
Three ERC Starting Grants awarded to our institute

Congratulations the three members of our Kavli Institute of Nanoscience Delft

Andrea Caviglia
Designer Quantum Materials Out of Equilibrium. In this project we will use short bursts of light to manipulate the electronic properties of materials on very fast time scales. Using innovative techniques to generate intense light pulses, we will investigate metal-insulator and magnetic transitions in artificial materials as they unfold in time.

Hyun Youk
MultiCellSysBio; Deconstructing complexity to reveal quantitative systems-level principles that enable multicellular systems to coordinately regulate genes over space and time.
This ERC starting grant allows Hyun Youk's group to build information-processing multicellular living structures from bottom up by using baker's yeasts as building blocks.

Simon Groeblacher
Strong single-photon radiation-pressure coupling for Quantum Optomechanics. Reaching the so-called single-photon strong coupling regime in optomechanics has been a long outstanding goal. In this project we will use a novel approach based on multi-element optomechanics to reach this regime, which will finally allow for full quantum control of a massive mechanical object.



Rubicon fellowships Rifka Vlijm and Felix Hol

Two Postdocs, Rifka Vlijm and Felix Hol, both from Cees Dekker's lab, received the Rubicon fellowship. With this fellowship, NWO provides young scientists the possibility to get experience in international research as a stepping stone to a scientific career. Rifka will conduct her research in the Lab of Prof. Dr. Hell in Heidelberg on the exact location of proteins in the kinetochore structure at each point in time, by using STED super-resolution microscopy in life cells.
Felix's research will focus on the development of innovative tools to investigate mosquitoes and the pathogens they carry in field settings. He will do this in the Lab of Manu Prakash, Department of Bioengineering, Stanford University.

Mostly, we read in the Kavli newsletter about great science and scientists. There is often news about prizes, awards, grants etc. Rarely, however, we read about the excellent technical support these scientists get. Who are these colleagues, these support staff members, who are standing next to the scientists? We talked to a few research technicians and asked them what their work is about and

Jacob Kerssenmakers (46) has worked at the BN department as a research technician for the Cees Dekker and Nynke Dekker labs since 2007. He graduated in 1993 (Physics), got his PhD in 1997, has done 3 postdoctoral fellowships and briefly worked for a commercial company in Berlin. This company experience made him longing to come back to academia. He found his place at BN, as a part-timer who combines his work as a research technician with his art work (as he also graduated as a painter from the Art Academy in 2012).

Jacob describes his job in terms of helping scientific staff at academic and practical levels in the physics labs. Among them, he assists in building microscope and laser set-ups, works with the PhDs, postdocs and students to determine how to analyze data, helps in interpreting the measurements, and (co)develops the required software. You could call all of this a 'hardware' support. He also provides some 'software' support. Such as finding out what kinds of support for instance a PhD or postdoc needs, and in what ways this support can be best provided by taking into account the level of knowledge, personality etc of the person he is helping. His main goal is to come to a fruitful collaboration. That is what makes Jacob the most proud; constructive and pleasant collaborations and seeing the results of this collaborations reflected in the outcome of measurements and, finally, in a paper. With the years passing, he admits that he has become a bit more sentimental when attending a promotion of a PhD student. ' It's quite something, this burden of proving yourself to others in science', he says. Jacob feels very valued by his co-workers as well as by his supervisors.

His main goal is to come to a fruitful collaboration.

He sees himself (and is also seen) as a scientific peer, and as someone who stands outside the hierarchical line. This enables him to act as a moderator, helping and guiding his scientist colleagues, always with integrity, respect and with an interest in the well-being for the person. These are the things that he values the most.

He is very proud of TU Delft and is sometimes concerned about the level of centralisation here. In his opinion it is important to have the support, whether it is finance, ICT, FMVG, or research support, close to where the action is. And he really enjoys the lab and department outings. These don't need to be fancy or expensive; a spontaneous get together and listening to someone making music is just as nice.

Things that he is not very fond of are those typical chores, those tasks that are very repetitive. And he doesn't understand why these new coffee machines throughout the building are so overly complicated, slow and really bad tasting.

The best advice that Jacob would give to his new research technician colleagues is to be empathic and to try putting yourself in the shoes of someone you support as well as avoiding in becoming cynical. Academia is a cyclical world, where every (young) scientist should find out his or her story. It could be that you heard the same story before. 'A bit of amnesia can sometimes be helpful, after let's say 10 years' service as a research technician…'

Marco van der Krogt (41) started studying physics at Leiden University, but switched to Applied Physics at TH Rijswijk where he graduated in 2002. Since 2002, he works for the TU Delft. During the first period he was combining his work in the Nanofacility cleanroom with his work as a research technician in the Flux Qubit group of Hans Mooij. Next he did a similar combined job with the Photonic Devices group of Huub Salemink. Nowadays he is a fulltime member of the technical support staff of the Kavli Nanolab cleanroom, which is managed by Frank Dirne.

His task is to make sure that the equipment in the cleanroom keeps running well, in particular the evaporators, sputter tools, PECVD and STS-ICP. He also takes care of the maintenance and helps users with questions regarding the use of the machines. With his built-up experience and knowledge of the equipment and the processes, he can routinely deal with many problems and questions that arise. A simple solution for a technician can be an enormous help for a student who just started working in the cleanroom. This appreciation makes it all worthwhile.

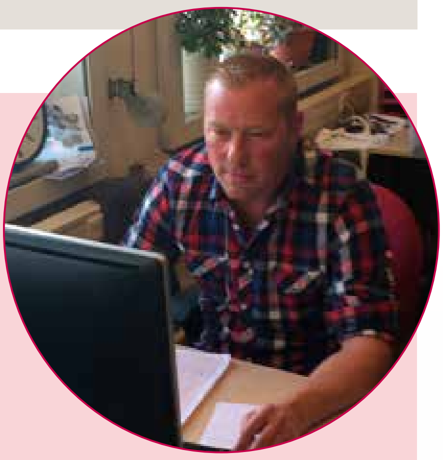
A simple solution for a technician can be an enormous help for a student

The Kavli Nanolab is a cleanroom facility for users from the Kavli Institute of Nanoscience (QN and BN), but is also freely accessible to other TU Delft departments and users outside of TU Delft. The number of users of the cleanroom has grown exponentially in the past years and Marco has little time left to substantially participate in any one project of a specific research group. Sometimes that is what he is missing: joining the group meetings and presentations and the pursuit of a specific goal. As for projects, he has actually more involvement with users outside QN and BN because the large user groups from within the Kavli Institute have a balanced system of training and sharing knowledge with their new members whereas other users usually depend more on the cleanroom staff.

His advice to the Kavli users is to well document process data and to make sure that data remains accessible. Otherwise you will see that processes have to be reinvented after some time. A clear example of an evolving recipe is the following: At first people were accustomed to bake PMMA 950k e-beam resist for a full hour, which became 'at least half an hour' and just a few years later people baked the resist for just a minute (and got in trouble). A request to all is to not only to report problems, but to also share the good results.

In the early years of the work in the cleanroom the usage of gold in the e-beam evaporators was not even 100 grams per year. But it has now steadily grown to as much as one kilogram per year. Apart from the number of users, this is another fact that illustrates how much the usage of the cleanroom has expanded over the years.

what drives them. We don't exaggerate when we call research technicians the backbones of our labs. To whom do you turn to when you are new, when your measurements fail, when your equipment breaks, when you get stuck with data, when you don't know enough about the techniques and the set-up, and so on? Read for yourself about some of these fantastic colleagues!



Tino Kool (37) has been working at the QN department for more than a year now. Before, he was a Project Manager for international pipeline inspection projects. His job as a research technician is mainly about solving problems with measurement equipment, designing and making new equipment for the PI's, PhD's and Postdocs. He does this for the labs in the MED section and partly works in the workshop, from where he also provides support to other QN scientists.

He especially likes the part where he can work together with one of the scientists on designing and fabricating new (measurement) equipment. The process from first sketches and ideas through the ups and downs of fabricating and finally seeing it working is very rewarding. It feels like a contribution to the success of the scientist or the project and he feels that the scientists often perceive it that way as well. For instance, you can hear this in the work meetings where progress and results are discussed.

Of course there are also other aspects to the job, like maintenance of the technical infrastructure, keeping supplies on stock, lab safety and so on. Every new member of the department has to enrol in a short safety instruction course before working in a lab. This instruction for students is also given by the technician. Nevertheless safety in the labs is always an issue. Scientists, in general, are more into running their experiment than in doing their utmost to keep things safe. He sees it also his task to point out the hazards, but he is trying not to become a busybody. One of the things that he has learned is that the best way to get things done is by learning the jargon that scientists are familiar with and being part of the solution. So tidying up a lab, together with the users, is better than just telling them to do so without participating.

The process from first sketches and ideas through the ups and downs of fabricating and finally seeing it working is very rewarding.

In general he likes to be part of the group, but also being the person to go to for advice or questions about technical issues. Within the department, not only are the specifics of each equipment important but so are the conditions of the labs. Overseeing this part of the job is more frustrating. Sometimes there are too many building-related variables to come up with quick solutions for when problems arise. With only a year of experience at TU-Delft and the department QN, he is not getting bored at all. He feels like he is now more able to give sound advice on designing equipment and on possibilities of making or buying an equipment.

The only thing that is now lacking is more coherence among the technicians in the faculty of Applied Sciences. There is not enough coordination among the different departments, sometimes because everyone works on totally different things such as the cleanroom and the workshop. But he still would like to look for more common ground and agreements about use of equipment and such. Informal communication is good, and the technicians help each other out.

Esengül Yildirim (40) has started working for the TU Delft about 17 years ago. The first 16 years she was employed at Kluyver laboratory for Biotechnology as a supporting staff member on education and research. In February of this year, she switched to the BN department where she now works as a research technician in the wet-labs of Marileen Dogterom and Christophe Danelon. Here she supports the PhD students and the MSc/BSc students with their molecular biology, synthetic biology and biochemistry questions. Since 2008, Esengül is also involved as a co-supervisor in the TU Delft iGEM team. iGEM is an annual international competition in the field of synthetic biology in which a team of inter-department and interdisciplinary motivated BSc and MSc students are challenged to design and build their own genetically engineered machines with standardized biological parts. In recent years, this has resulted in successful iGEM projects and they have even won prestigious prizes. This year's iGEM team even became the Overgraduate Grand Prize winner. This means the World's best out of 286 participating teams!

Esengül Especially enjoys the collaborations with young scientists and students

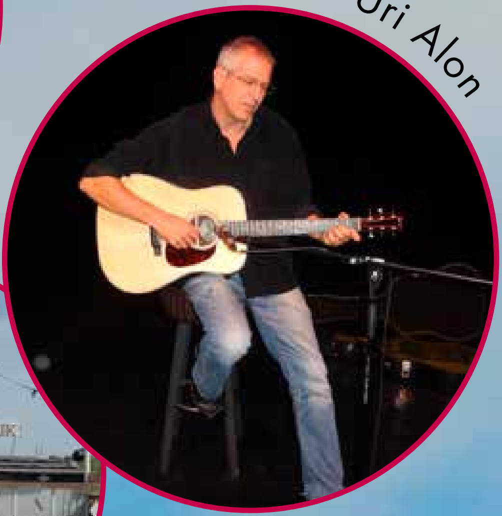
Esengül especially enjoys the collaborations with young scientists and students with different backgrounds because different facets merge together for the same research question. "Honestly these students need way more training and require more patience; nevertheless it makes me proud to be an integral part of this interdisciplinary research".

It is difficult for her to indicate what she likes less in her job except for now and then having her patience being put to the test.

At Biotechnology, a while ago, she was seen as the 'queen of protocols' and she took all her responsibilities concerning (bio)-safety sometimes too seriously. In that same year, a few student colleagues made her believe (by mailing her from a fake email address that pretended to be a real communications department) that a national television crew with undercover journalist Alberto Stegeman was spotted on the campus. Stegeman was known for his extreme undercover programs where he was testing accessibilities of certain bio-laboratories and even investigating the state of labs' hygiene. After receiving this message, Esengül immediately informed everyone, including the management team, the biosafety officer, the Dean, the Communications department etc. Within several minutes the alarm bells of the whole university went off. This "joke" was about as sensible as shouting "fire!" in a crowded theatre'. The students were punished for sending this fake message by receiving a collective yellow card and she was gratefully thanked for her adequate response. I can laugh at this joke anytime, it's funny and stupid at the same time.' If it were up to Esengül, she would like to advise any upcoming new research technician to work with passion and to embrace their work. As an advice to the University and the department she recommends to take the needs of the students seriously. Since they are our university's future, we should take into account their wishes and advice.

Estec

Prof. Uri Alon



Fencing clinic

Sandsculpting

Powerkiting

Water rafting

Kavli Delft thesis prize 2015

Awarded to Hannes Bernien

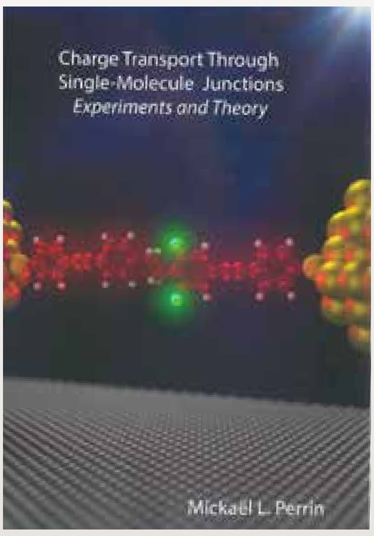
On the Kavli Day, the 2015 Kavli Delft thesis prize was awarded to Hannes Bernien for his thesis "Control, Measurement and Entanglement of Remote Quantum Spin Registers in Diamond". Hannes Bernien's thesis, which he defended cum laude in February 2014, was of exceptional quality, both in terms of productivity and quality. His thesis describes this as well as a number of other groundbreaking experiments that use quantum optical control of single NV centres in diamond to generate entanglement and implement quantum teleportation. The thesis work was published in excellent journals: 2 Nature papers, 1 in Science, and a number of PRLs.

The Kavli Delft thesis prize is a prize for the best PhD thesis written by a graduate student at our Kavli Institute of Nanoscience at Delft in the previous three years. It consists of an award and an amount of € 3000 that can be freely spent by the laureate.

ALW Grant to Greg Bokinsky

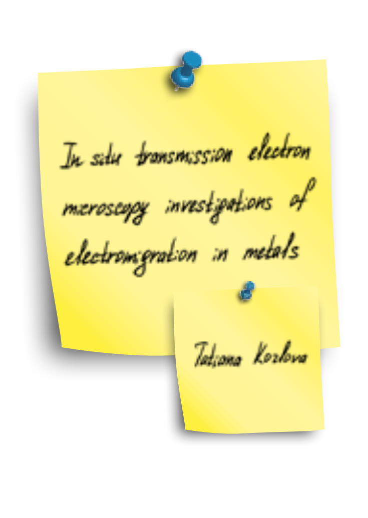
Congratulations to Greg Bokinsky, who has received the (NWO) ALW Open grant. This grant will enable Greg Bokinsky's lab to investigate how bacteria cells synchronize growth with metabolic activity. Discovering this synchronization mechanism may eventually guide the design of new antibiotics against drug-resistant bacterial infections.

RECENT PHD THESIS

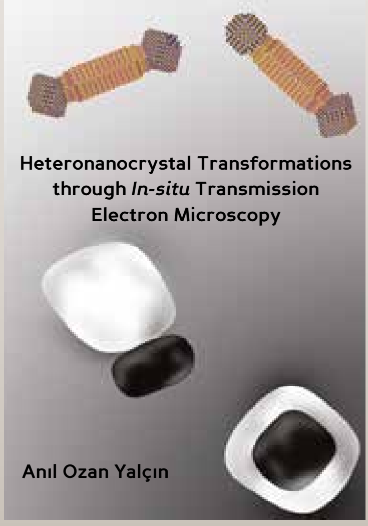


Mickael Perrin
19-6-2015

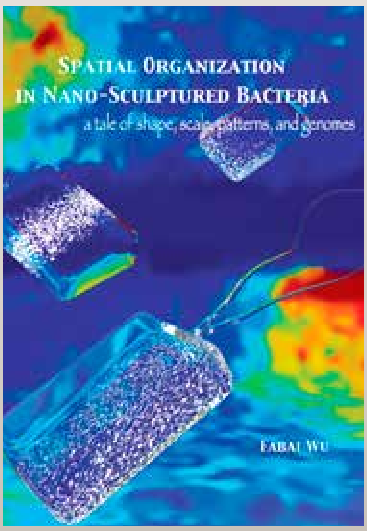
Anna Spinelli
2-7-2015



Tatiana Kozlova
25-9-2015



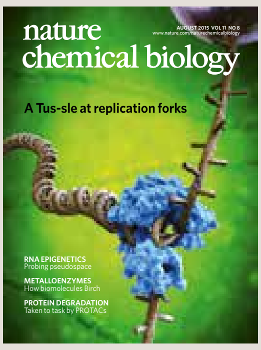
Anil Ozan Yalcin
28-9-2015



Fabai Wu
27-10-2015

Strand separation establishes a sustained lock at the Tus–Ter replication fork barrier

In E. coli, the DNA replication termination site is flanked by Tus proteins bound to Ter-DNA sites, allowing passage of replication machinery moving towards, but not away from the termination site. We performed DNA unzipping experiments and demonstrated that blocking-oriented Tus–Ter forms a tight lock in the absence of replicative proteins with an efficiency that exceeds reported in vivo observations, showing that – contrary to existing models – protein–protein interactions might actually hinder rather than promote lock formation.



B.A. Berghuis, D. Dulin, Z. Xu, T. van Laar, B. Cross, R. Janissen, S. Jergic, N.E. Dixon, M. Depken and N.H. Dekker.
Nature Chemical Biology 11, 579–585 (2015)

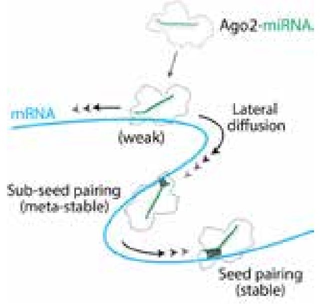
Symmetry and scale orient Min protein patterns in shaped bacterial sculptures

This study uncovers how proteins sense boundary geometry to guide cell division. We use nanofabricated chambers to sculpt living bacterial cells into defined shapes with volumes ranging from 2 μm¬3 to 60 μm¬3, in which diverse protein patterns emerge. These patterns align to the symmetry axes of the cells and scale their concentration gradients with cell lengths. Aided by computer simulations, we for the first time show that spatial boundary can induce simple reaction-diffusion mechanisms to result in such complex adaptation behaviors.

F. Wu, B.G.C. van Schie, J.E. Keymer and C. Dekker.
Nature Nanotechnology 10, 719-726 (2015)

MicroRNA Caught in the Act

MicroRNAs are regulatory molecules with essential functions in diverse physiological processes. Argonaute proteins mediate the interaction between microRNAs and their targets. We found that Argonaute identifies microRNA targets by scanning potential target RNAs using one-dimensional diffusion while probing for sites complementary to a small segment of the microRNA (Chandradoss et al). We also revealed a mechanism for modulation of miR-

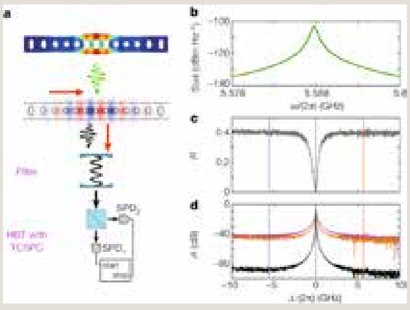


S. D. Chandradoss, N. T. Schirle, M. Szczepaniak, I. J. MacRae*, & C. Joo*, (2015) "A Dynamic Search Process Underlies MicroRNA Targeting" Cell, July 2015

N. T. Schirle, J. Sheu-Gruttadauria, S. D. Chandradoss, C. Joo*, & I. J. MacRae* (2015) "Water-mediated recognition of t1-adenosine anchors Argonaute2 to microRNA targets." eLife, September 2015

Phonon counting and intensity interferometry of a nanomechanical resonator

In the publication we perform a Hanbury Brown and Twiss type experiment with phonons (mechanical excitations). We demonstrate how the phonons have different statistical properties depending on how strongly the mechanical oscillator is driven with a laser. The mechanical motion changes from a thermal state to a displaced thermal state, which is very similar to the state of a laser (coherent state). The read-out is done by mapping the mechanical oscillations onto a laser and measure the statistics of the photons - a novel method that paves the way to observe non-classical mechanical behavior in the near future.

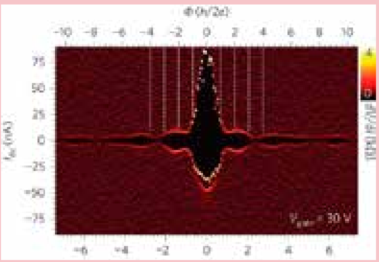


J. D. Cohen*, S. M. Meenehan*, G. S. MacCabe, S. Gröblacher, A. H. Safavi-Naeini, F. Marsili, M. D. Shaw, and O. Painter
Nature 520, 522-525 (2015)

Ballistic Josephson junctions in edge-contacted graphene

Scientists at TU Delft and Leiden University have observed supercurrents in graphene that bounce back and forth between the edges of the graphene without scattering along the way. Supercurrents are electrical currents that flow even when there is no voltage applied. They can be induced in graphene by bringing it in contact with a superconducting material. The ability to create such ballistic superconductor-graphene hybrids makes it possible to study the unique properties of supercurrents carried by relativistic particles in an unexplored regime.

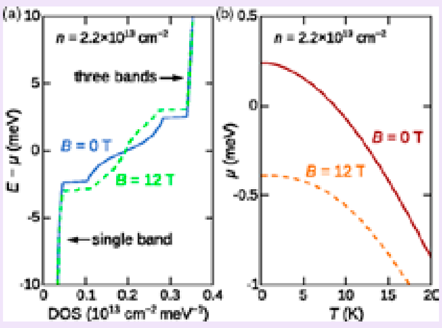
Zie ook www.tudelft.nl/en/current/latest-news/article/detail/superstroom-in-grafeen-gaat-uit-zijn-dak/ waar plaatjes bij staan.



V.E. Calado, S.Goswami, G. Nanda, M. Diez, A.R. Akhmerov, K. Watanabe, T. Taniguchi, T.M. Klapwijk, L.M.K. Vandersypen
Nature Nanotechnology 10, 761–764 (2015)

Giant negative magnetoresistance driven by spin-orbit coupling at the LaAlO3/SrTiO3 interface

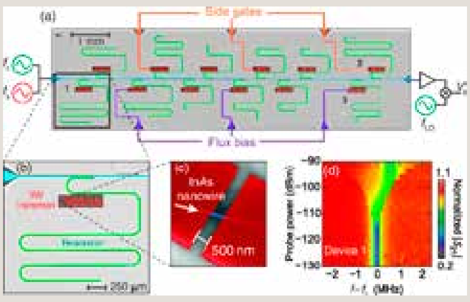
About a decade ago, researchers discovered that at the interface between two insulating oxides, LaAlO3 and SrTiO3, a two dimensional electron liquid is formed. This thin layer of interacting electrons shows fascinating properties, including superconductivity and magnetism. In this study we discover that in this system, spin-orbit coupling is responsible for surprisingly large changes of conductivity in response to magnetic fields.



M. Diez, A.M.R.V.L. Monteiro, G. Mattoni, E. Cobanera, T. Hyart, E. Mulazimoglu, N. Bovenzi, C.W.J. Beenakker, and A.D. Caviglia
Physical Review Letters 115, 016803 (2015).

Realization of Microwave Quantum Circuits Using Hybrid Superconducting-Semiconducting Nanowire Josephson Elements

First realization of superconducting quantum microwave circuits using proximitized InAs nanowires as SNS Josephson elements, replacing the conventional Al/AlOx/Al junctions. These circuits offer the possibility to study non-sinusoidal current phase relations at microwave frequencies and to electrically control the Josephson effect in superconducting qubits. They also promise compatibility with the magnetic fields required for Majorana experiments.



G. de Lange, B. van Heck, A. Bruno, D. J. van Woerkom, A. Geresdi, S. R. Plissard,
E. P. A. M. Bakkers, A. R. Akhmerov and L. DiCarlo
Physical Review Letters 115, 127002 (2015)

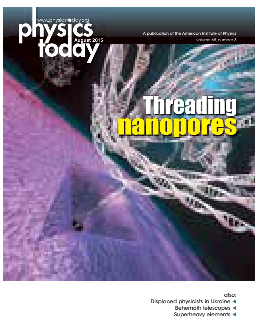
VACANCY COLUMNIST QN

SEE YOUR TEXT HERE IN THE NEXT ISSUE?

We have a vacancy for a columnist for our Kavli newsletter. After many excellent and thought-provoking columns by Yuli Nazarov and Miriam Blaauwboer, we now look forward to contributions from a new columnist from the Department of Quantum Nanoscience. If you are interested to share your thoughts about topics such as science, university life, or other aspects that relate to our Kavli Institute in some way, you are very welcome to apply. Your column will be published in this newsletter three times per year. Please contact Amanda van der Vlist or Cees Dekker.

Single-molecule sensing with nanopores

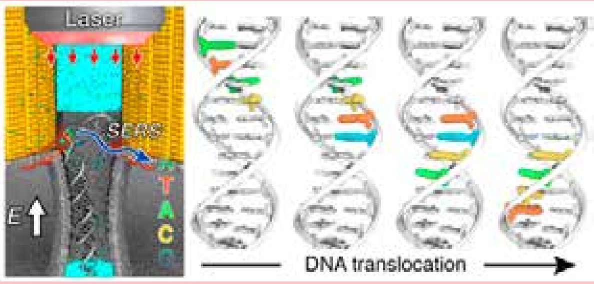
This review summarizes the history, current state, and outlook for the field of nanopore sensing and describes the important physical concepts in the process of biopolymer translocation.



Murugappan Muthukumar, Calin Plesa, Cees Dekker
Physics Today 68 (8) 40, 2015

Plasmonic Nanopores for Trapping, Controlling Displacement, and Sequencing of DNA

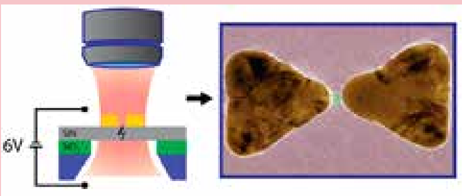
Using molecular dynamics simulations, we demonstrate theoretically that the plasmonic hot spot provided by a bowtie nanoantenna may enable controlled step-wise translocation of a DNA molecule through a nanopore, and simultaneous optical read-out of the DNA sequence via surface-enhanced Raman scattering. The presented concept may potentially be developed into a novel me-



M. Belkin, S.Chao, M.P. Jonsson, C.Dekker, and A. Aksimentiev
ACS Nano, September 24, 2015, DOI: 10.1021/acsnano.5b04173

Self-Aligned Plasmonic Nanopores by Optically Controlled Dielectric Breakdown

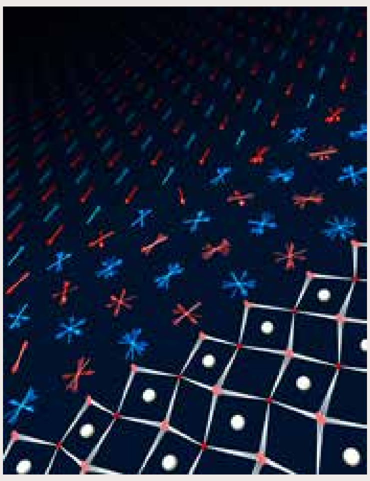
The paper presents a novel cost-efficient method for the fabrication of high-quality self-aligned plasmonic nanopores by means of an optically controlled dielectric breakdown. The described fabrication process guarantees alignment of the nanopore with the optical hotspot of the nanoantenna, thus ensuring that pore-translocating biomolecules interact with the concentrated optical field that can be used for detection and manipulation of analytes.



S.Pud, D.Verschueren, N.Vukovic, C.Plesa, M.P. Jonsson, and C. Dekker
Nanoletters, 3 september 2015 DOI: 10.1021/acs.nanolett.5b03239

Spatially resolved ultrafast magnetic dynamics initiated at a complex oxide heterointerface

A new study discovers how the sudden excitation of lattice vibrations in a crystal can trigger a change of the magnetic properties of an atomically-thin layer that lies on its surface. The research team used extremely short X-ray pulses to discover that melting of magnetic order in the thin layer is initiated at its interface with the substrate and progressively moves into the interior of the film in a ultra-short time.



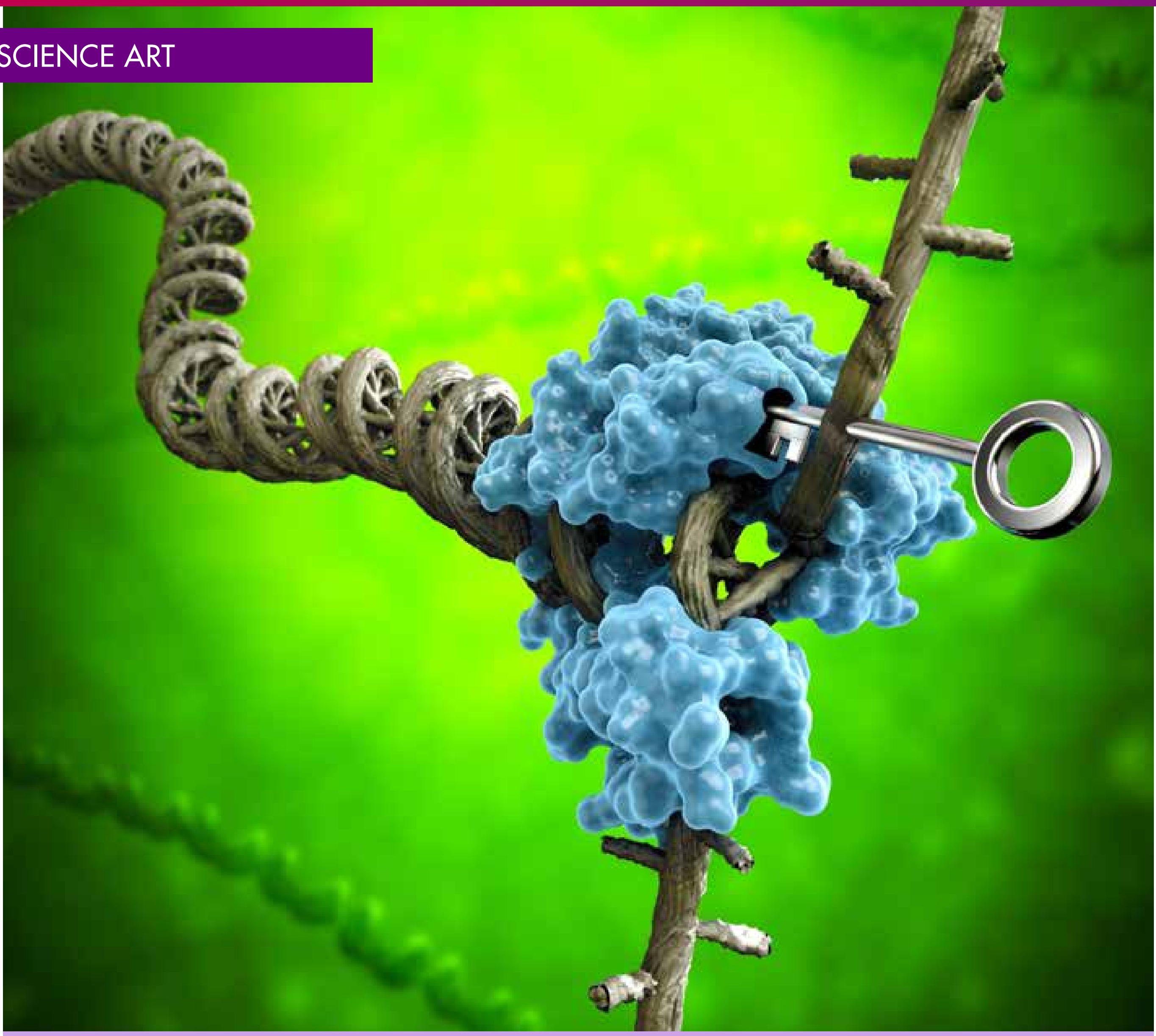
M. Forst et al.
Nature Materials 14, 883 (2015)

Second-harmonic coherent driving of a spin qubit in a Si/SiGe quantum dot

An electron spin quantum bit could be driven coherently by applying microwave excitation at half its resonance frequency. This was made possible by a strongly nonlinear response. Driving a qubit using lower excitation frequencies considerably simplifies future control electronics.

P. Scarlino, E. Kawakami, D. R. Ward, D. E. Savage, M. G. Lagally, Mark Friesen, S. N. Coppersmith, M. A. Eriksson and L. M. K. Vandersypen
Physical Review Letters 115, 106802 (2015)

SCIENCE ART



Artist's impression of the Tus-Ter experiment, where the protein-mediated strand separation that normally accompanies E.coli DNA replication is mimicked through mechanical unzipping of a DNA hairpin in magnetic tweezers.
Nature Chemical Biology 11, 579–585 (2015)

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

UPCOMING KAVLI COLLOQUIA

Kathryn Ann Moler
February 3, 2016
Stanford University

Charles Kane
June 30, 2016
University of Pennsylvania

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

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