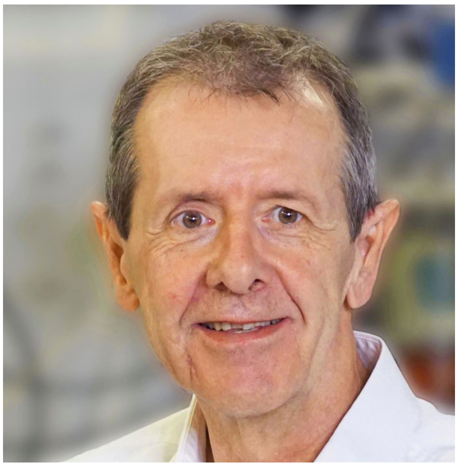
University of Basel

Swiss Nanoscience Institute

SNI update July 2017



Dear colleagues,

It's summer vacation time in Basel. The Department of Physics is much quieter than it was a few weeks ago, quite a few doors are closed, and my diary is much freer. Those who have returned from or are still looking forward to their vacations are using the calmer, lecture-free period to write applications, proposals, and publications.

The last few weeks have shown that this pays off. Our vice director, Professor Daniel Loss from the Department of Physics at the University of Basel, will lead the "Quantum Science and Quantum Computing" project at the University of Basel and the Albert Ludwig University of Freiburg. This collaboration will receive up to CHF 10 million in funding from the Georg H. Endress Foundation for the next ten years. One of the project's key aims is to train outstanding doctoral students and postdocs to prepare the workforce of the future for the emerging market in quantum technologies. Congratulations!

Over the last ten years, the SNI has invested a great deal more than CHF 10 million in applied research within the Nano Argovia program. I am delighted that the quality and number of submitted projects has grown significantly over the years, enabling us to select truly innovative and excellent applied projects. To give you some insights into the topics addressed, we'll present the new projects in this and the next issue of *SNI update*. Don't forget that you have until September 30, 2017 to submit new proposals.

Our title story introduces Elise Aeby, a highly dedicated nanostudies graduate who has been awarded the prize for the best nanostudies master's thesis in 2016. This will be presented at the Annual Meeting in September 2017. Meanwhile, the *SNI update* portrait presents another success story: Qnami, a start-up founded last year by Professor Patrick Maletinsky and Dr. Mathieu Munsch. Qnami produces quantum sensors based on nitrogen-vacancy centers in monocrystalline diamonds.

I wish you all happy reading and a relaxing summer. I'm already looking forward to stimulating discussions at the end of the summer during September's Annual Meeting at the Lenzerheide resort.

Kind regards,

Christian Schönenberger
SNI Director, University of Basel

Elise Aeby wins award for best master's thesis in nanoscience 2016

Elise Aeby's design for a new microfluidic platform to study tissue cells has earned her this year's award for the best master's thesis in nanoscience at the University of Basel. The young researcher looks back on a fulfilling time in Basel in which she learnt a great deal and played an active role in various SNI activities promoting the nanosciences. She began her doctorate at ETH Zurich in May.

Elise Aeby wrote an excellent master's thesis in nanoscience and looks back on a fulfilling time in Basel.

Insights from hanging drops

For the award-winning thesis, Elise Aeby developed a microfluidic platform designed to overcome certain limitations in an earlier model, working in the group led by Dr Andreas Hierlemann of the ETH Zurich Department of Biosystems Science and Engineering in Basel. The existing platform can be used to create microtissues that are excellently suited to studying communication between different tissue types and the effect of drugs. Cells from a cell culture are first of all suspended in a nutrient solution, and then arranged in a structure known as a hanging drop network to form a microtissue. The drops are held together by the solution's surface tension. The cells inside this three-dimensional microtissue – also known as a spheroid – are able to communicate with each other, and behave in a similar fashion to natural tissue. Thanks to a microfluidic system consisting of minute channels, the cells in the hanging drops can be brought into contact with spheroids in a different tissue, and with active substances. The resulting effects on the different microtissues can be observed using a microscope or by analyzing the nutrient solution. Further information is obtained by examining the microtissue at the end of the experiment.

The platform developed in Hierlemann's laboratory has the advantage of closely mirroring conditions in the human body, in contrast to two-dimensional propagation in a culture dish. However, the open system is sensitive, and depends on specific computer programs. What is more, the movement of the hanging drops prevents tracking of specific cells within the microtissue, or the use of confocal microscopes.

Tweaking the platform

For her master's thesis, Elise Aeby converted this platform to a half-closed system, which is more robust and provides better images for evaluation of the results. She achieved this by "packaging" the spheroids in hydrogel, limiting their mobility without restricting the exchange of nutrients, waste products or oxygen. The platform is made from polydimethylsiloxane (PDMS), in which tiny channels and culture chambers are molded using soft lithography. These channels and chambers are open, and can be easily filled by researchers. In order to reversibly seal the structures, Aeby attached a thin glass plate to the PDMS platform using a vacuum line.

SNI Annual Meeting

The SNI Annual Meeting takes place on September 7–8 in the Hotel Schweizerhof at the Lenzerheide resort. All SNI members are invited to this annual academic exchange.

If you have any questions, please contact Kerstin Beyer-Hans (kerstin.beyer-hans@unibas.ch).

“The platform works really well,” remarks Elise Aeby. “The images we can now capture with a confocal microscope are significantly better, and provide much more information.”

“The new platform combines microfluidic 3D tissue culture with high-resolution microscopy in a very robust manner, enabling us to take long-term measurements over periods of more than 10 days which would not have been possible using the previous system,” confirms Dr Olivier Frey, her supervisor and formerly a senior researcher in Hierlemann’s team. The platform has since been used by a doctoral candidate from another research group to study communication between different tissue cell types. Other researchers in the team are also starting to use the new system.

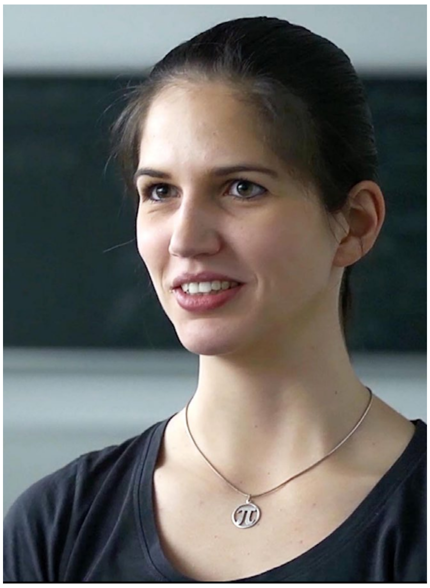
Doctoral dissertation at ETH Zurich

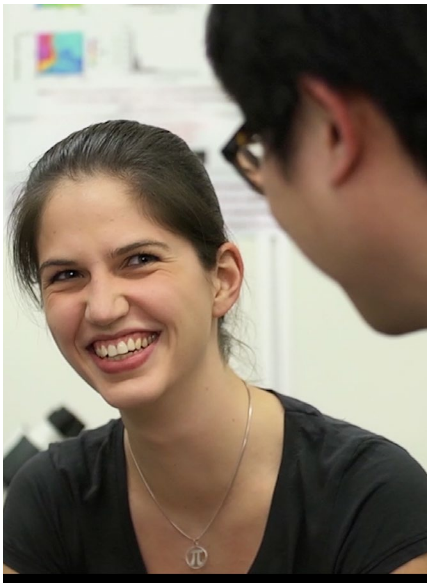
Elise Aeby found her work with cell cultures so fascinating and motivating that she had originally chosen tissue engineering as the focus of her doctoral thesis. Accordingly, she applied for positions including one in the group led by Dr Viola Vogel at ETH Zurich. The team, which works in the field of applied mechanobiology, was immediately taken with the young nanoresearcher from Basel, and suggested she write her doctoral dissertation on a project funded by the CTI (Commission for Technology and Innovation). Even though this meant a departure from the topic of tissue engineering, Elise was instantly drawn to the idea, and turned down her other offers. “This project is about the application of a newly developed device able to guide a tiny robot using eight electromagnets with five different degrees of freedom.” The apparatus, dubbed NanoMag, was developed by an ETHZ spin-off company, and will be the focus of Elise Aeby’s doctoral dissertation that she started in May 2017.

Fond memories of the nanoscience program

As a result, Aeby’s time as a nanoscience student in Basel is finally at an end. She looks back on the course as a deeply fulfilling experience, and is happy she chose to study nanosciences back in 2010. She first acquired a taste for nanotechnology while writing her Matura thesis on artificial muscles. Each block course, each assignment, and ultimately her master's thesis strengthened her conviction that she had chosen the right path. “The nano study program wasn’t easy,” she recalls. “But we always had a great team spirit, and we supported and helped each other.” Her positive experiences and enthusiasm meant the young researcher was always happy to help out with various SNI activities and act as an ambassador for the nanoscience program. Besides appearing in SNI videos, Elise Aeby spoke to numerous future nanosciences students at open days, served on the INASCON 2015 organizing committee, and supported the SNI stand at events such as tunBasel.

We would like to thank Elise for the excellent collaboration during her time at the SNI, and congratulate her on her best master's thesis award. We wish her every success in the future.





Elise Aeby participated in the production of the SNI videos and introduced the nanostudy program.
https://www.youtube.com/watch?v=B_nkPd84ufU

Diamonds help create precise images

On the fourth floor of the Department of Physics, the Swiss Nanoscience Institute has a new neighbor. Qnami, a start-up led by Dr. Mathieu Munsch and the Georg H. Endress Professor Patrick Maletinsky, has moved in opposite the SNI's general manager, Claudia Wirth. In this portrait, we introduce the young company, which manufactures quantum sensors and supports customers with all aspects of their use.

Fresh impetus in Arosa

Start-up company Qnami began its short history at the General Meeting of the National Center of Competence in Research (NCCR) QSIT in Arosa in February 2016. An inspiring talk about entrepreneurship was followed by a journey home together for Patrick Maletinsky and Mathieu Munsch – and the idea of founding a company was born.

It was soon to become more than just an idea. In March 2016, the two young physicists began setting up Qnami with support from the NCCR QSIT. Mathieu Munsch, then a postdoc in Professor Richard Warburton's group at the Department of Physics, was to take on the role of CEO and would be in charge of running the business. Patrick Maletinsky, as a professor and leader of the "quantum sensing" group, was to provide the scientific input. Qnami's business model is to use diamonds as precise and sensitive quantum sensors and to supply these sensors as probes for analyses using atomic force microscopes.

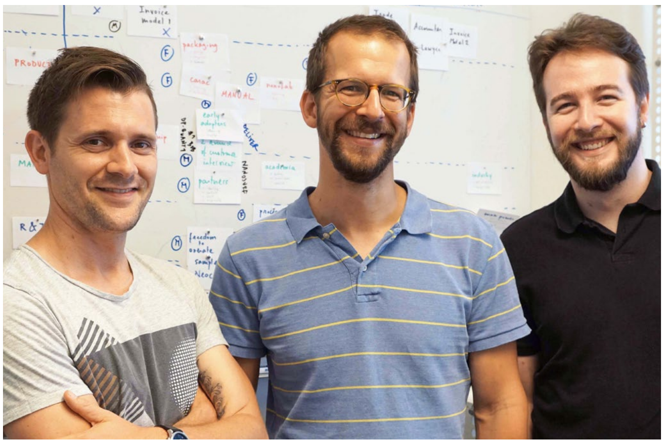
Useful defects

The tiny diamonds used for this have defects in their crystal lattice, where a carbon atom has been swapped for a nitrogen atom and there is a vacant site immediately alongside. These defects are known as nitrogen-vacancy centers (NV centers) and can also occur in natural diamonds, where they impart a reddish color to the precious stones. At Qnami, the team produces these defects in their diamonds deliberately, taking advantage of the fact that the NV centers host individual electrons that can be excited and manipulated. The intrinsic angular momentum (spin) of these electrons, and their electric dipole, are extremely sensitive to tiny magnetic and electric fields. If the diamond sensor is exposed to a magnetic or electric field, this results in a measurable change in the NV center luminescence, which can be detected using a standard optical device.

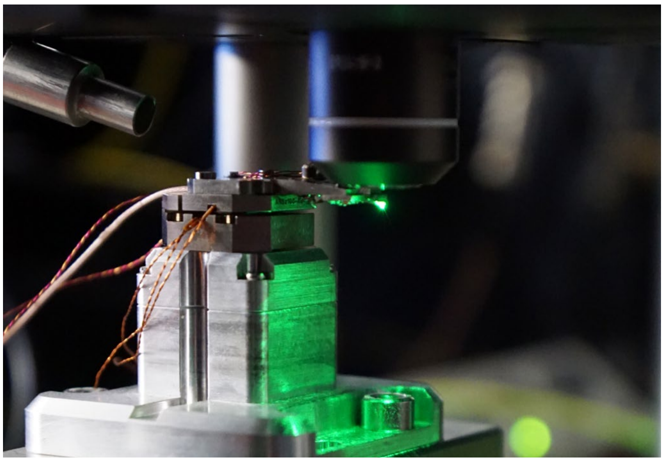
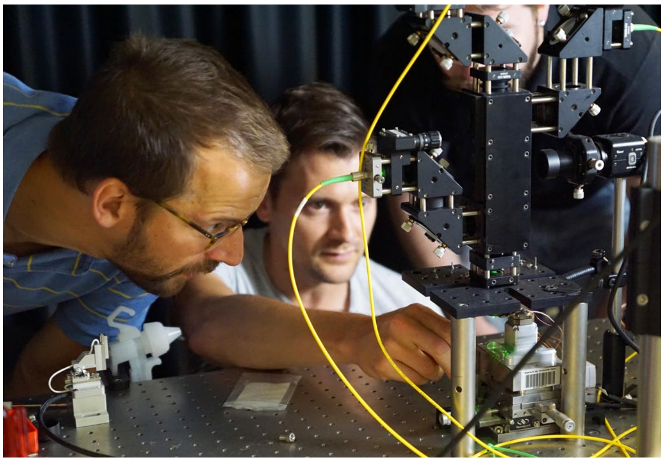
Each Qnami diamond is just a few micrometers long and contains a single quantum sensor of this kind. The diamonds are attached to a tiny cantilever probe and incorporated into an atomic force microscope, allowing images to be generated with nanometer resolution. Furthermore, since the sensors operate just as well at room temperature as they do at temperatures close to absolute zero, they can be used to analyze a wide range of materials and create precise images of electric or magnetic fields. As diamonds do not interact with the examined material, they are also suitable for analyzing biological samples.

Sophisticated technology

Over the past few years, Patrick Maletinsky and his group have been working on the development of these



The SNI has new neighbors – Qnami stands for quantum, nano, and micro, and the three-person team comprises Mathieu Munsch, Patrick Maletinsky, and Felipe Favaro.

Inside a tiny diamond, electrons in nitrogen-vacancy centers are excited so that they emit a light signal. Qnami uses this optical signal to generate high-resolution images of electric and magnetic fields.

quantum sensors, which take advantage of the highly distinct laws of the quantum world. Now, the technology has matured to such an extent that more and more colleagues are persuaded both of the quality of the data, as well as the broad applications. They also wish to involve the sensors in their work. “It was foreseeable that there would soon be so much demand, so founding a start-up actually seemed like an obvious step,” Patrick Maletinsky says in the interview. Thanks to Qnami, all interested parties now have the support of a small, dedicated team that is not only able to supply quantum sensors but also plans to offer a complete microscope in the future. Above all, however, what customers receive is individual advice. The team searches for solutions to a wide variety of problems and tests ideas proposed by users.

Expanding the network

CEO Mathieu Munsch is currently focusing on developing a network of potential customers, investors, and other start-ups. “We’re entering a completely new market for quantum products,” he says. “This is uncharted territory for almost everyone involved, so finding investors isn’t easy.” Qnami has been supported by the NCCR QSIT up to now, but it will need further financial backers if it wants to expand its range to include a complete microscope.

Initial milestones

Patrick and Mathieu have already notched up a series of milestones. They have identified a number of academic partners, with whom they are now collaborating during this initial phase. “We’re pleased that these partners also include working groups that we weren’t in contact with before and that will examine completely new applications,” Patrick Maletinsky tells us.

On 1 June, Felipe Favaro joined the team as Qnami’s first employee. In the past, he has worked with NV centers in diamonds – and their production – as part of his doctoral dissertation at the University of Stuttgart, and he is now responsible for fabrication and further research and development in his role as CTO. He is currently manufacturing the first sensors for existing partners and customers – a technique that begins with the production, testing, and characterization of a whole series of these tiny diamonds. Every single diamond tip must then be manipulated in a process that takes about a day per tip. By the end of 2017, it is expected that all customers who have already expressed an interest will have received their quantum sensors and put them to use. By the end of the year, progress is also expected in the development of a complete microscope, so this will also be available to customers in the near future.

Correct decision

Mathieu, Felipe, and Patrick tackle the challenges they face with enthusiasm, and they are convinced that founding a company was the right move. “I can recommend taking this step to anybody, provided that the idea is good,” Patrick Maletinsky confirms. “You actually only stand to win.” Mathieu Munsch adds: “In some ways, the work is no different from any other job, but we’re able to have a much more direct impact on society.”

The Qnami team still have a lot of work to do. The SNI wishes them the best of luck and will keep its fingers crossed for the exciting months ahead, as well as keeping a close eye on and supporting the development of both the quantum sensors and Qnami.

Additional information at: https://qnami.ch and on YouTube: https://www.youtube.com/watch?v=-lIDpw8DOxI&feature=youtu.be

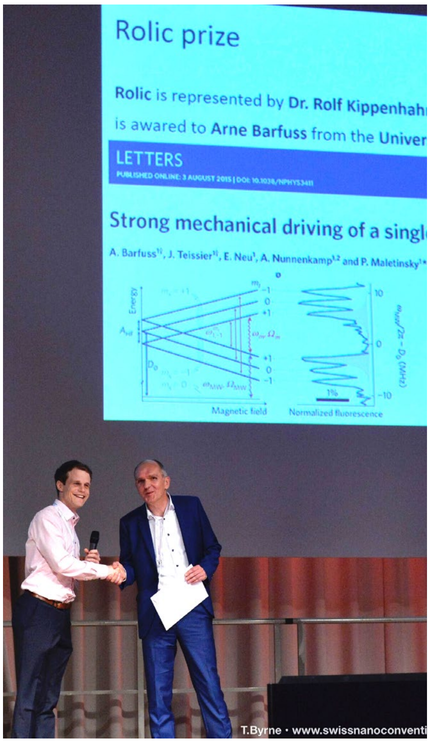
Awards and prizes

Awards for two doctoral students from the SNI network

Arne Barfuss, a doctoral student in Professor Patrick Maletinsky's group at the SNI PhD School, has won the Swiss Nanotechnology Award sponsored by Rolic Technologies Ltd. Nicola Rossi, a doctoral student in Argovia Professor Martino Poggio's team, has received the Swiss Nanotechnology Award sponsored by ABB Ltd.

For the first time, the Swiss MNT Network presented five Swiss Nanotechnology Awards to outstanding publications by doctoral students at Swiss research institutions who are listed as the lead author. The awards are funded by various Swiss companies.

Arne Barfuss received his award during the SNC2017 for his paper in *Nature Physics* (Arne Barfuss, Jean Teissier, Elke Neu, Andreas Nunnenkamp, and Patrick Maletinsky, *Nature Physics* 11, 820 (2015)). Nicola Rossi was recognized for his publication in *Nature Nanotechnology* (Nicola Rossi, Floris R. Braakman, Davide Cadeddu, Denis Vasyukov, Gözde Tütüncüoglu, Anna Fontcuberta i Morral, and Martino Poggio; *Nature Nanotechnology* 12, 150 (2017)).
Congratulations!



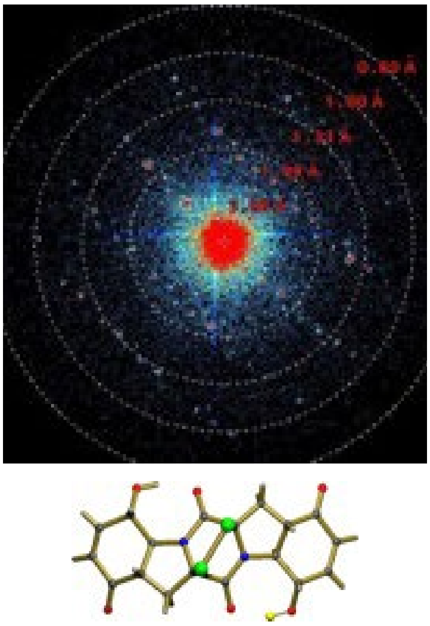
Arne Barfuss received the Swiss Nanotechnology Award 2017 sponsored by Rolic Technologies Ltd. (Foto: T. Byrne).

New Argovia projects

In early 2017, the Argovia committee selected new projects to be funded through the Nano Argovia program. Here and in the next issue of *SNI update*, we present the new projects launched on April 1, 2017.

A3EDPI – Structural analysis with diffracted electrons

In the A3EDPI Argovia project, an interdisciplinary team of scientists from the Paul Scherrer Institute (PSI), C-CINA (Biozentrum, University of Basel), Novartis Pharma AG, F. Hoffmann-La Roche AG, and Dectris AG is investigating whether electron nanocrystallography can be used in pharma research to clarify the three-dimensional structure of organic agents. Dr. Tim Grüne from the PSI is leading the project, which aims to improve data collection and processing in electron nanocrystallography and clarify its relevance for developing pharmaceutical agents.



Diffraction pattern of a 400 nm crystal of the antibiotic Epicorazine A. The data quality is so high that all hydrogen atoms apart from one (yellow atom) have been allocated automatically and correctly – something that cannot be taken for granted even in X-ray structures with much larger crystals.
(Image: T. Grüne, PSI).

To efficiently develop new active pharmaceutical ingredients and obtain approval, researchers require the exact three-dimensional structure of the substances. If they consist of individual crystals, the spatial structure can be determined using X-ray structural analysis. In many cases, however, scientists have access only to powder, blends of crystalline grains between 10–500 nanometers in size.

The A3EDPI project is now investigating whether electron nanocrystallography can be used efficiently to clarify the spatial structure of the different molecules. To do so, the samples are exposed to a high-energy electron beam. The electrons have wave properties; depending on how the atoms are arranged, a very specific diffraction pattern is produced for each molecule that provides insights into their atomic structure.

Initial experiments using a few model substances have already returned data of outstanding quality. The team is now investigating whether electron nanocrystallography can be further developed into an attractive standard for the pharma and chemical industry, and whether performance and quality requirements for industrial applications can be fulfilled.

AntibakVlies – Less bacteria on non-woven materials

In the AntibakVlies Argovia project, scientists at the School of Engineering (FHNW), the School of Life Sciences (FHNW), and Jakob Härdi AG are developing a new procedure to equip non-woven material with antibacterial and hydrophilic properties. The researchers are also working on an efficient testing method to analyze the antibacterial efficiency of the material.

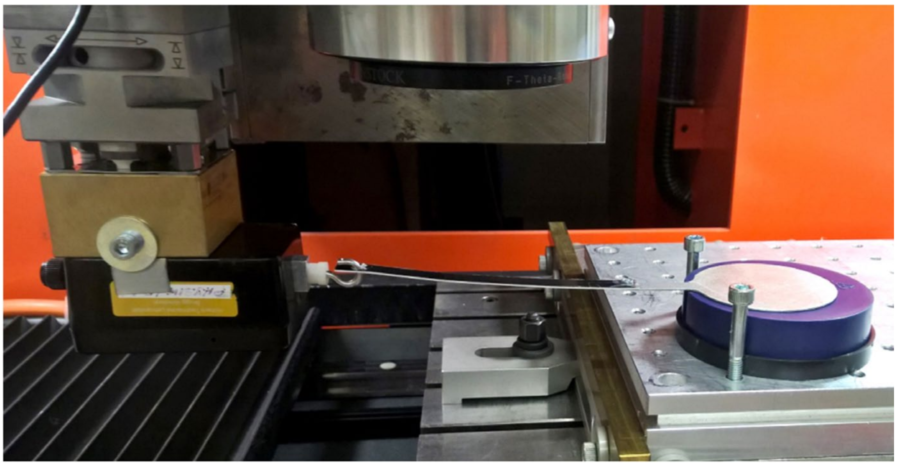
There are currently no materials with the desired combination of properties, which is why the project team led by Dr. Sonja Neuhaus from the Institute of Polymer Nanotechnology (INKA, School of Engineering) is aiming to modify existing non-woven materials.

From previous projects, the researchers know that functionalized synthetic surfaces can be produced via e-grafting. This method involves impregnating the material with various compounds and then irradiating it with low-energy electrons. If the conditions are right, this can create a covalent and thus permanent bond. In the AntibakVlies project, different combinations of antibacterial polymers are now being examined to prevent a wide range of bacteria from growing.

Microslide – snakeskin inspires reduced friction

In the Microslide Argovia project, scientists from the University of Applied Sciences and Arts Northwestern Switzerland (FHNW) and the Paul Scherrer Institute (PSI) are working with Brugg Drahtseil AG (a company based in Birr) to improve the anti-friction and anti-wear properties of flat belts, as used in elevators, for example. The researchers are taking inspiration from nature; the animal kingdom offers numerous examples of special surface structures that enable gliding movement with little friction.

The team, led by Dr. Christian Rytka from the Institute of Polymer Nanotechnology (INKA), plans to apply a scale-like structure, as seen in snakes, for example, to the surface of polyurethane bands used for lifting. This structure will permanently improve anti-friction properties and therefore reduce the wear on the bands. Initially, a testing facility is to be constructed that will allow bands of various structures to be compared with those used today. The properties of different surface structures will then be examined on small areas embossed using a roll-to-roll process. Subsequently, the researchers plan to produce the first prototypes.



A testing facility is needed to measure friction forces of bands and to allow comparisons of various structures (Foto: C. Rytka, FHNW).

MiPIS – Quick protein processing for analysis

In the MiPIS project, scientists from C-CINA (Biozentrum, University of Basel) and the School of Life Sciences (FHNW) are working with their industrial partner leadXpro AG (based in Villigen) on a microfluidic system to process proteins and prepare samples for analysis using cryo-electron microscopy. The project is led by Dr. Thomas Braun (C-CINA) and builds on previous work supported by the SNI.

Cryo-electron microscopy (cryo-EM) is now an established standard method for clarifying the atomic structure of complex proteins, for example to develop new active ingredients for drugs. Compared with other processes, cryo-EM requires much lower quantities of protein – just a few nanoliters – while providing precise images at atomic resolution. The traditional methods of processing proteins do not always meet the requirements of cryo-EM because they are time-consuming, require larger quantities of protein, and sometimes corrupt the spatial arrangement of the protein complexes. The scientists in the MiPIS project are now using microfluidic systems to prepare samples and hope to see major advantages over the traditional methods.

A microfluidic system has already been developed at C-CINA in which a sample is placed directly on a slide required for electron microscopy. This system is now to be further developed within the MiPIS Argovia project so that proteins can be cleaned, stabilized, and prepared for cryo-EM analysis within two hours without losing their spatial structure.

Events

Broad scope user event in the Nano Imaging Lab

On June 28, the SNI's Nano Imaging Lab (NI Lab) invited current customers and interested colleagues to its first information event. Around 40 people took the opportunity to gain an insight into the work of the NI Lab, which has been part of the Swiss Nanoscience Institute since 2016.

Five scientific talks reflected the variety and value of the services provided by the NI Lab's five-person team and the importance of their images and analyses to various projects. For example, the NI Lab supports the work of Dr. Laurent Marot (Department of Physics, University of Basel) on the mirrors for the planned ITER fusion reactor. Würth Elektronik has also been using the outstanding services of the NI Lab for around ten years to examine printed circuit boards. Dr. Lothar Weitzel from Würth Elektronik praised the excellent facilities and co-

Interested participants listen to the talks during the first user event of the Nano Imaging Lab (NI Lab) and gain an insight into the valueable and diverse services of the NI Lab.

operation that enable his company to conduct analyses together with the NI Lab team. Dr. Hanns-Heinz Kassemeyer of the State Viticulture Institute in Freiburg (WBI) used impressive images of the microfungus that infects vines to show that the NI Lab is also ideally equipped to analyze biological samples. Dr. Juanita Rausch of Particle Vision GmbH in Fribourg explained how spectroscopic analyses from the NI Lab allow them to determine the quality and quantity of the smallest particles in air samples. Finally, Timothy Camenzind from the Department of Physics stated how the magnetic force microscope can be used to analyze nanomagnets.

The NI Lab provides electron microscope and scanning electron microscope images and analyses to industrial customers and research institutions within and outside the SNI network. As Dr. Markus Dürrenberger (head of the NI Lab) stated, it has a wide range of excellent facilities that it aims to constantly improve and expand. For larger acquisitions like a new transmission electron microscope, however, working groups within the university had to band together and formulate specific requests.

For more information on the NI Lab and its services, visit the SNI website at:
www.nanoscience.ch/de/services/nano-imaging-lab-1/
or send your enquiries directly to Dr. Markus Dürrenberger (markus.duerrenberger@unibas.ch).

An apéro offered ideal opportunities to discuss future projects with members of the NI Lab.

Mammoth program at tunBasel

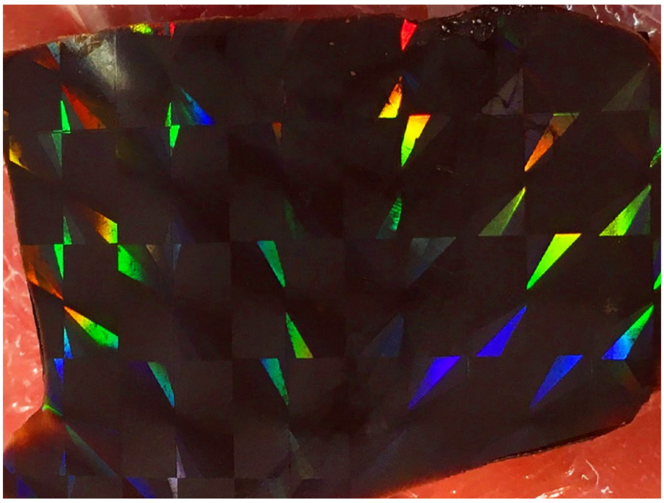
In May, around 14,000 people visited tunBasel, ten action-packed days as part of the Mustermesse Basel trade fair. The SNI also answered the call to provide an exciting program of events for children and young people to tinker, experiment, and experience. Dr Kerstin Beyer-Hans (SNI) and Dr Giovanni Nisato and Giorgio Quaranta (CSEM Muttenz) compiled a fascinating program on the subject of light that offered the many visitors a whole new perspective on the topic:

Sunlight and artificial light don't just brighten dark rooms – the white light can also be broken down into its spectral colors, making the world much more vivid. The dedicated SNI/CSEM team demonstrated this with the aid of a spectrometer. Visitors of all ages then made their own spectrometers in just a short time. Kerstin, Giorgio, and their many helpers were met with wide eyes and surprised expressions as they made chocolate gleam in

The joint stand of SNI and CSEM raised a lot of interest.

rainbow colors. A nanostructure imprinted into lightly melted chocolate created the same effects seen on butterfly wings. The experiments with polarization film, which were open to everyone, were just as fascinating and showed the crowds of children, young people, and adults how bees and ants orient themselves without sunlight and how the Vikings used the polarization of light for orientation and navigation. Another highlight of the joint SNI/CSEM stand was the laser game, in which players had to guide a laser to a specific target using various mirrors. An impressive experiment also showed how laser light is used to transmit information.

This year's tunBasel ran over ten days, each lasting nine hours. The University of Basel was represented by the Department of Physics for the first five days, after which the SNI and CSEM took over the stand. For Kerstin Beyer-Hans and her assistants, this meant a few long days of explaining, helping to build, and answering questions with very few breaks. We couldn't possibly take part in events like tunBasel without the fantastic support of the students and doctoral students. Thank you!



Kerstin Beyer-Hans demonstrates how the Vikings used the polarization of light for orientation and navigation and how chocolate gleams in rainbow colors.

Nano Argovia program

Do you have an idea for an applied research project in collaboration with a company in Northwestern Switzerland? The SNI's Nano Argovia program supports applied research projects in the nanosciences. Project proposals can be submitted until September 30, 2017.

For general conditions, see:
https://nanoscience.ch/en/research/applied-research/

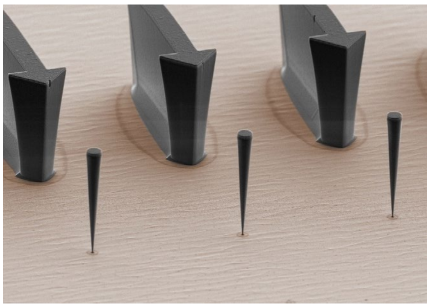
Prix Schläfli – submit proposals

PIs of the SNI PhD School can submit proposals for the Prix Schläfli before October 31, 2017. The Prix Schläfli will be awarded by the Swiss Academy of Sciences (SCNAT) for excellent scientific articles resulting from PhDs.

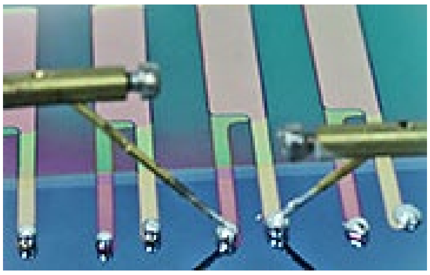
More information at:
www.scnat.ch/prixschlaefli

Media releases and Uni News from SNI members

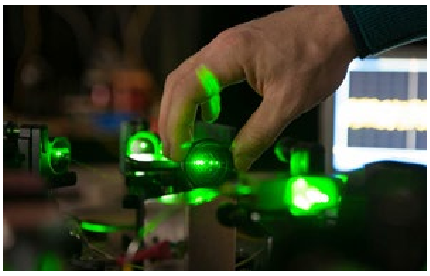
University of Basel, July 14, 2017. Coupling a Nano-trumpet With a Quantum Dot Enables Precise Position Determination
Scientists from the Swiss Nanoscience Institute and the University of Basel have succeeded in coupling an extremely small quantum dot with 1,000 times larger trumpet-shaped nanowire. The movement of the nanowire can be detected with a sensitivity of 100 femtometers via the wavelength of the light emitted by the quantum dot. Conversely, the oscillation of the nanowire can be influenced by excitation of the quantum dot with a laser. Nature Communications published the results.



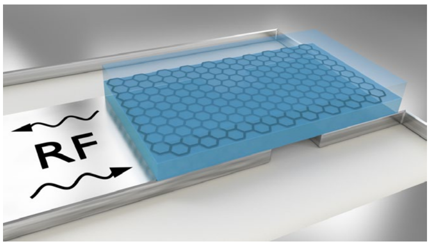
University of Basel, June 13, 2017. Active Implants: How Gold Binds to Silicone Rubber
Flexible electronic parts could significantly improve medical implants. However, electroconductive gold atoms usually hardly bind to silicones. Researchers from the University of Basel have now been able to modify short-chain silicones in a way, that they build strong bonds to gold atoms. The results have been published in the journal *Advanced Electronic Materials*.

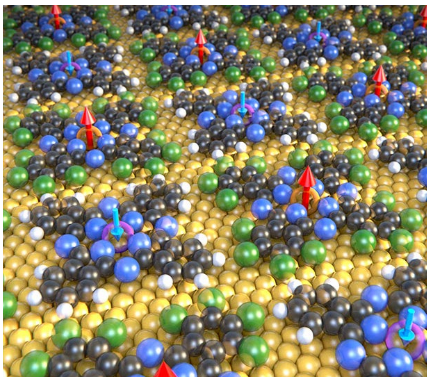


University of Basel, May 31, 2017. Generous Support for New Center of Excellence in Quantum Physics
The Georg H. Endress Foundation is to support the "Quantum Science and Quantum Computing" project at the University of Basel and Albert Ludwig University of Freiburg with funding of up to CHF 10 million over ten years. The new center of excellence under the auspices of Eucor – The European Campus will strengthen the pioneering role both universities play in the field of quantum physics.



University of Basel, May 30, 2017. New Method of Characterizing Graphene
Scientists have developed a new method of characterizing graphene's properties without applying disruptive electrical contacts, allowing them to investigate both the resistance and quantum capacitance of graphene and other two-dimensional materials. Researchers from the Swiss Nanoscience Institute and the University of Basel's Department of Physics reported their findings in the journal *Physical Review Applied*.





University of Basel, May 22, 2017. Wafer-thin Magnetic Materials Developed for Future Quantum Technologies
Two-dimensional magnetic structures are regarded as a promising material for new types of data storage, since the magnetic properties of individual molecular building blocks can be investigated and modified. For the first time, researchers have now produced a wafer-thin ferrimagnet, in which molecules with different magnetic centers arrange themselves on a gold surface to form a checkerboard pattern. Scientists at the Swiss Nanoscience Institute at the University of Basel and the Paul Scherrer Institute published their findings in the journal *Nature Communications*.

All media releases can be found at:
https://nanoscience.ch/de/media-2/aktuelle-medienmitteilungen/

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