University of Basel

Swiss Nanoscience Institute

SNI SWISS NANOSCIENCE INSTITUTE

EINE INITIATIVE DER UNIVERSITÄT BASEL UND DES KANTONS AARGAU

SNI INSight

Showcasing research and activities of the Swiss Nanoscience Institute

May 2019

Nuonex
A new start-up with roots at the SNI

Watt d'Or
Award winners from the SNI network

From the nanoworld to outer space
Former nano student Florian Kehl's search for life beyond Earth at NASA

Nano-Argovia
New projects have started in January 2019

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Editorial

Dear colleagues and nanoscience enthusiasts,

The SNI is increasingly taking advantage of social media channels like Twitter, LinkedIn and Instagram, as well as the SNI website, to publish news of its activities. This allows us to react quickly, and get the latest developments to you right away. In this context, the traditional newsletter is becoming an outdated format.

Nevertheless, as many of you have come to treasure the news round-up provided by our *SNI update*, we have decided not to do away with our regular bulletins altogether. From now on, we will publish *SNI INSight* three times a year.

SNI INSight is a digital magazine in which we report on SNI activities and provide more detailed coverage of our research projects than you will find in our regular news updates.

In this inaugural issue, you can read about the approach adopted by the recent start-up NUONEX, and discover why the SNI is proudly following the growth of this young firm. NUONEX brings together a number of strands that are key to the SNI's mission: training of dedicated young researchers in the nanoscience program, basic research in the PhD school, and applied research in the Nano Argovia program.

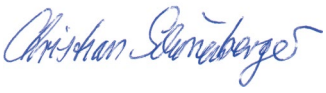
Besides founding start-ups, the career options open to graduates of the nanoscience program also include research in space – as demonstrated by a visit from alumnus Florian Kehl, who gave this year's SNI lecture, in which he told us all about his exciting research at NASA.

For many years, the SNI has supported the workshops at the University of Basel's Department of Physics, which play a crucial part in the success of our research activities. The electronics workshop contributed decisively to a project initiated by Professor emeritus Peter Oelhafen that was awarded the Watt d'Or energy prize earlier this year.

It is still early days for the Nano Argovia projects that began in the new year. This applied research program is enjoying growing popularity, and this year we were able to select six ambitious projects involving collaboration with companies in Northwestern Switzerland. The first three of these exciting projects are presented in this issue of *SNI INSight*.

I hope you enjoy these insights into the SNI. We look forward to receiving your feedback, as well as any information from the network that we can pass on to all our readers in future issues.

Kind regards,



Prof. Dr. Christian Schönenberger, SNI director

NUONEX
A new start-up with roots at the SNI

Thomas Stohler and Silvan Häfeli founded their start-up, NUONEX, in March 2019. The two young entrepreneurs plan to launch a device known as the CryoWriter, which allows optimum sample preparation for cryo-electron microscopy. The CryoWriter was developed over many years at the laboratory of Dr. Thomas Braun, a member of the research group led by Professor Henning Stahlberg (C-CINA, Biozentrum, University of Basel) and was largely funded by the Swiss Nanoscience Institute (SNI).

As they found their start-up, NUONEX, Thomas Stohler and Silvan Häfeli are approaching the diverse set of challenges with considerable enthusiasm and confidence. (Photo: NUONEX)

"We hope we'll soon be able to persuade customers that NUONEX is a forward-looking and worthwhile investment."

Thomas Stohler and Silvan Häfeli, founders of NUONEX

Adaptation to cryo-electron microscopy

Since Professor Jacques Dubochet was awarded the Nobel Prize for the development of cryo-electron microscopy (cryo-EM), everyone has been talking about this new technique. Thanks to a shock-freezing process, the atomic structures of complex proteins can be depicted and determined in precise detail within their natural environment. Cryo-electron microscopy has long been the focus of research in the group led by Professor Henning Stahlberg, who earned his doctorate under Dubochet.

As conventional sample preparation methods are not tailored to the cryo-EM technique, Dr. Thomas Braun's team has spent a number of years adapting the sample work-up to meet the needs of cryo-EM.

Numerous students from the nanosciences degree program, as well as doctoral students from the SNI PhD School and collaborators on the Nano Argovia projects SCeNA and MiPIS, have already put a great deal of time, energy and passion into this task. They have developed a device – known as the CryoWriter – that allows tiny sample quantities (less than 100 nanoliters) to be applied to an EM grating in a fully automated process under controlled, adjustable conditions. This grating can then be immersed in liquid ethane in order to shock-freeze the sample.

Fascinated by the CryoWriter even as a student

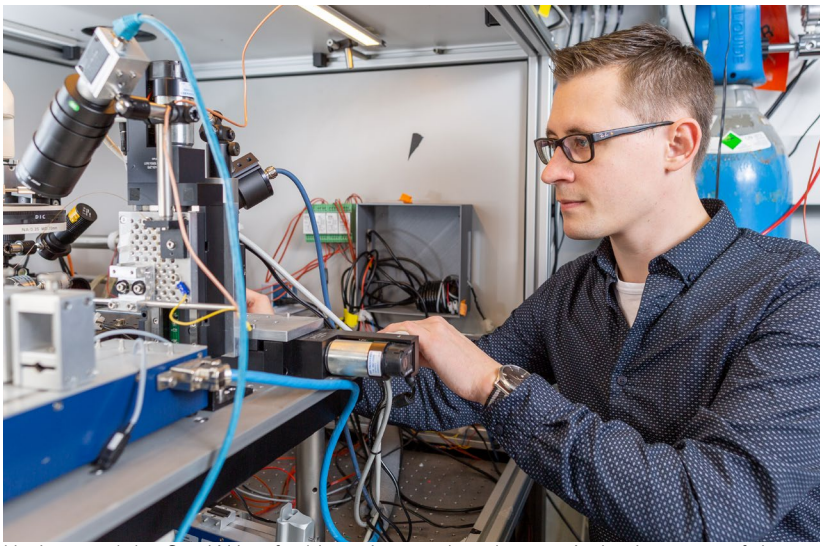
Another person to have worked on the CryoWriter was Thomas Stohler, who joined the C-CINA team for a project as part of his nanosciences degree. "Among the students, word got around that Thomas Braun's group does some really exciting R&D work and has a great working atmosphere," he recalls. After completing his project on single-cell analysis using cryo-EM, Thomas Stohler also worked with the CryoWriter for his master's thesis, where he applied it to single-cell analysis in proteomics. "I was immediately fascinated by the device's capabilities," says Thomas. "There are so many areas of application that, even during my master's project, I was already thinking about founding a start-up in order to market the instrument."

Thomas Braun supported this idea from the outset: "The CryoWriter is now at such an advanced stage that we're able to use it on a routine basis. On the other hand, we also want to continue with its development. Ideally, we'd have a second device available for our day-to-day work. Other research groups have also shown an interest."

From the idea to NUONEX

In order to commercialize the CryoWriter, it was necessary to grow the idea into a start-up. A significant part of this task fell to Silvan Häfeli, who was the first partner and launched the project together with Thomas Stohler. When Silvan came on board, he had just completed a master's degree in business administration alongside his job as an engineer specializing in laboratory equipment and was therefore an ideal team partner.

"I was really attracted to the idea of co-founding a start-up, because I'd like to take on a position of responsibility," says Silvan Häfeli in our interview. Accordingly, the team made all necessary preparations with a view to founding NUONEX in March 2019.



Having used the CryoWriter for his project work and master's thesis as part of the nanosciences degree program, Thomas Stohler knows the device inside and out. (Photo: NUONEX)

A thrilling and intense time

The two young entrepreneurs describe it as an exciting time. The tasks at a start-up touch on a wide range of areas, but the top priority is the product. This is vital to the survival of NUONEX: “We had to take a step back and consider not only what the CryoWriter can do, but also the needs and expectations of potential customers,” they say.

In order to develop the CryoWriter quickly and to a high standard, Thomas and Silvan decided against developing the device in-house and will instead work with professional service providers, who will assemble a perfect laboratory instrument in the shortest possible time. Having spoken to numerous companies that are interested in cooperation, they have now begun developing the device with the most appropriate partners.

At their newly established joint stock company, they are currently dealing with three main tasks: “At the moment, the main focus and the vast majority of our work lies in device development, scientific projects and customer interaction.”

Outstanding support from the university

The two young entrepreneurs are keen to praise the excellent support provided by the Innovation Office at the University of Basel throughout the process. “We receive some truly outstanding coaching and support from Christian Elias Schneider and his team. On top of that, our contacts at Innosuisse and BaselArea.swiss are a great help.”

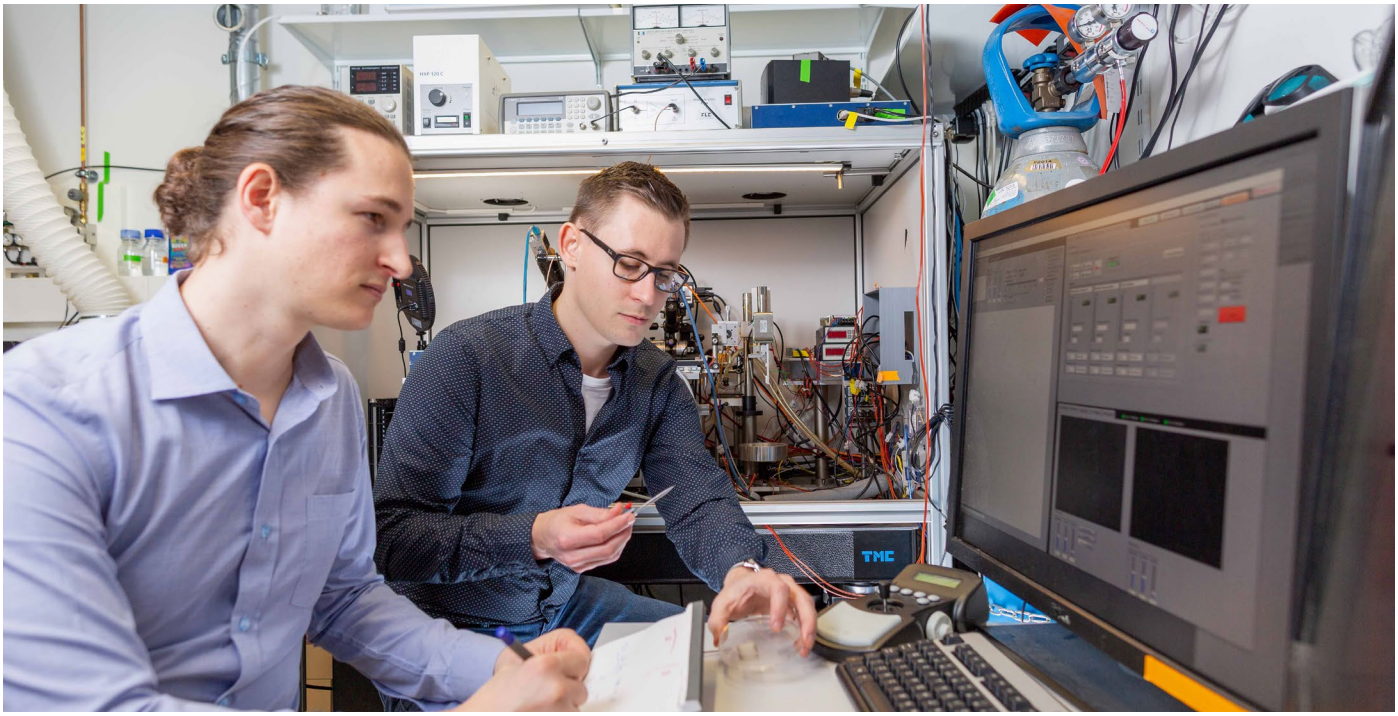
In founding NUONEX, Thomas and Silvan have taken the first step in a long process. It will be some time before they know the answer to the big question: how their scientific target audience will respond to the CryoWriter once development is complete. However, they are both confident that the device will enjoy a positive reception: “We have a major advantage because we can demonstrate that the prototype works extremely well at the Braun lab – and there are numerous scientific publications to prove it. Accordingly, we hope we’ll soon be able to persuade customers that NUONEX is a forward-looking and worthwhile investment.”

More information about NUONEX and the Nano Argovia projects that have contributed to the development of the CryoWriter.

NUONEX:
https://nuonex.com

Nano-Argovia-Projekt MiPIS:
https://nanoscience.ch/en/2018/04/10/faster-analysis-with-tiny-quantities/

Nano-Argovia-Projekt SCeNA:
https://nanoscience.ch/en/2018/03/08/working-as-a-team-to-track-down-single-cells/



Work with the CryoWriter involves a combination of scientific and technical challenges and requires a great deal of teamwork. (Photo: NUONEX)

Founded on accurate data

Prizewinning project on energy efficiency in railway vehicles

In January 2019, a project by the Department of Physics at the University of Basel, in collaboration with the railway company BLS, received the Watt d'Or energy prize from the Swiss Federal Office of Energy. Initiated by Professor emeritus Peter Oelhafen, the project paves the way for energy savings in railway vehicles. Andreas Tonin from the Electronics Lab of the Department of Physics – which the SNI has supported for many years – played a key part in the project, and Andreas Tonin now finds himself at the heart of a follow-up project in collaboration with the operators of the Lausanne metro system.

Exploring potential for savings

Public transport is another area in which energy can be saved, but it is important to determine which subsystems are worth modernizing before measures are implemented. Professor emeritus Peter Oelhafen, from the Department of Physics at the University of Basel, proposed doing precisely that. In a collaboration with the railway company BLS, sensors were fitted to a "NINA" low-floor suburban railway train in 2011. Since then, the sensors have been recording the exact energy consumption of a range of devices and systems, as well as climate data, and storing these readings on a data server.

Targeted modernization saves energy

It turned out that about a third of the energy was needed for heating, ventilation and cooling, and that the trains used approximately another third while stationary, because many of their systems were not switched off. The precise measurements paved the way for targeted innovations that helped reduce the overall energy consumption by around 20%. These measures included the introduction of a standby mode and needs-based regulation of the fresh air supply. Moreover, the trains have been fitted with modern lighting technology and nanocoated windows that offer improved

Andreas Tonin and Peter Oelhafen during the award ceremony (Photo: Andreas Tonin)

"We take continuous measurements of the energy consumption of various subsystems."

Andreas Tonin and Professor emeritus Peter Oelhafen, Department of Physics, University of Basel

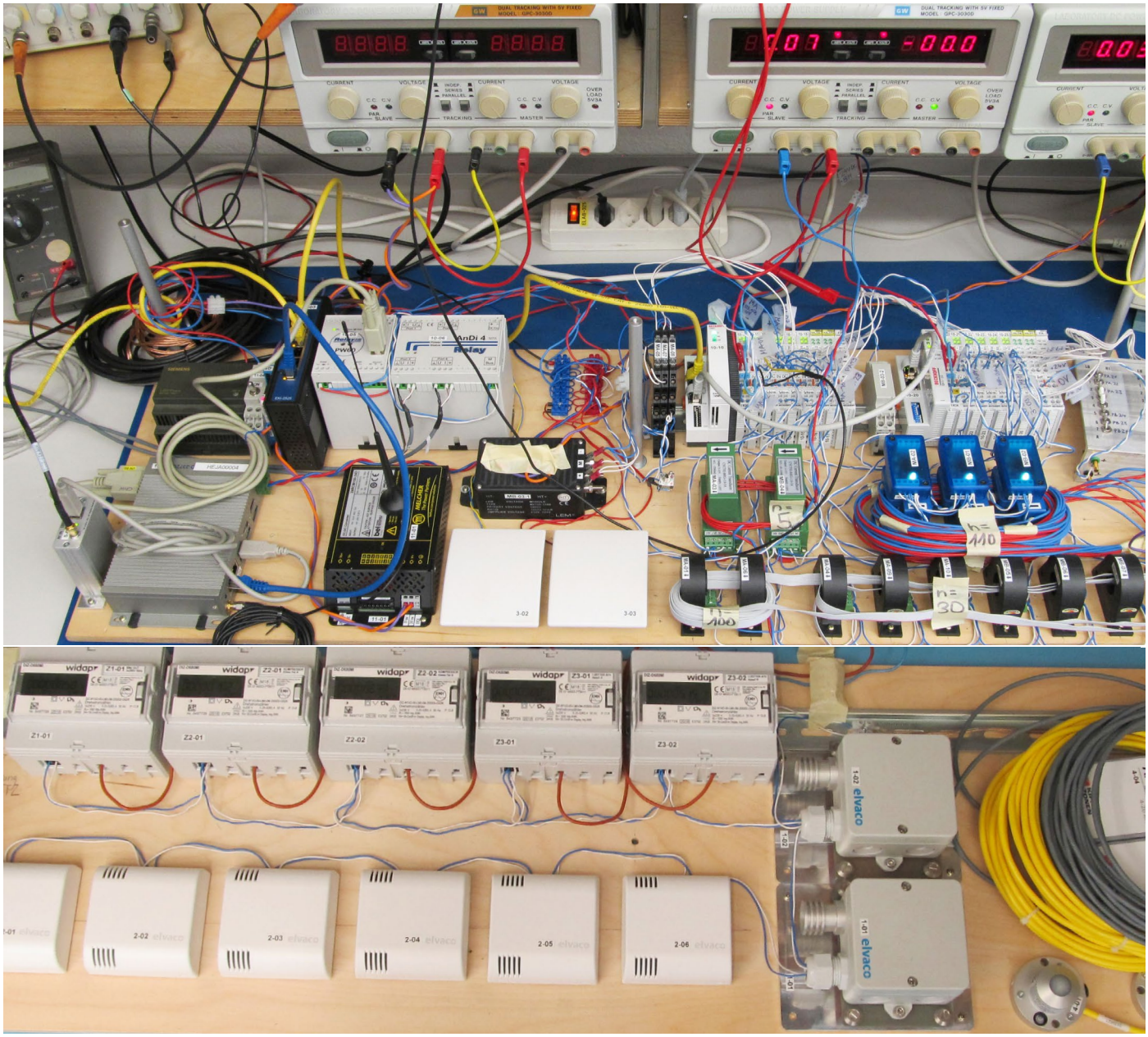
thermal insulation but that are nevertheless transparent to mobile phone signals.

The project was a complete success for everyone involved and was ultimately awarded the Watt d'Or by the Swiss Federal Office of Energy in January 2019.

Follow-up projects launched

Further transport companies are now involved in projects aimed at recording consumption and climate data in passenger trains in collaboration with the University of Basel and other Swiss research institutions (Lucerne University of Applied Sciences and Arts, Empa, EPFL, Bern University of Applied Sciences, University of Applied Sciences and Arts of Southern Switzerland). These initiatives are supported by Swiss electric research and the Swiss Federal Offices of Energy and Transport.

For example, another collaboration with Lausanne's transport operators (tl) has been underway since November 2018. This involves taking measurements on a metro and follows on from a trolley-bus study that has been running in the city since 2015. Having made a key contribution to the prizewinning project with BLS, Andreas Tonin from the Department of Physics in Basel also plays a central role in this collaboration. In April 2019, mea-



The required components are first tested in the lab so that they can then be installed as quickly as possible. (Photo: Andres Tonin, Department of Physics, University of Basel)

surements have begun: “In Lausanne too, we’re continuously measuring the energy consumption of various subsystems, as well as recording climate data.”

Numerous coordinated components

Although this sounds simple at first, it is actually quite a complex undertaking. The temperature, humidity and CO_2 level are detected at various locations in the passenger compartment as well as in the two driver’s cabs of this two-car commuter train. Solar irradiation is also measured, as are the outdoor temperature and the opening times of the doors. As the metro mostly travels above ground, it is possible to determine its precise location using GPS, and sensors also measure the energy consumption of the engines, heating, lighting, information systems and cooling system, which is only present in the driver’s cabs. The energy recovered during braking is also recorded. In the metro, it is essential to find suitable locations to install all the equipment, and the measuring system must not hinder the train’s operation in any way. All the measuring instruments are therefore electrically insulated from the vehicle system and supplied exclusively from the vehicle battery, which is protected against excessive discharge.

Since November 2018, Andreas Tonin has been planning, building and documenting the system and preparing the installation of the various sensors and measurement systems, which he must adapt to local circumstances. “Since Lausanne’s metro system runs mainly on direct current (750V, 24V), the measurements are significantly more difficult than in the NINA project,” he says. Each of the current and voltage values must be measured separately and multiplied together to determine the power. This is done around 30 times a second. Using a special system, the individual power values are used to calculate the total amount of energy used on an ongoing basis. Consumption meters, such as those found in the home, are designed for alternating current and are therefore only used for the air-conditioning units, which are powered by an inverter.

Started in April

As planned, mobile technology is used since April to automatically send all the readings to a data server on a daily basis. Data can then be retrieved from the server.

Andreas Tonin acts as the data manager. He delivers data to the other project partners and analyzes some of the data himself. Everyone involved is excited to see what conclusions can be drawn from this wealth of data and which of the findings can then be implemented in the form of energy-saving measures, as with the NINA trains operated by BLS.

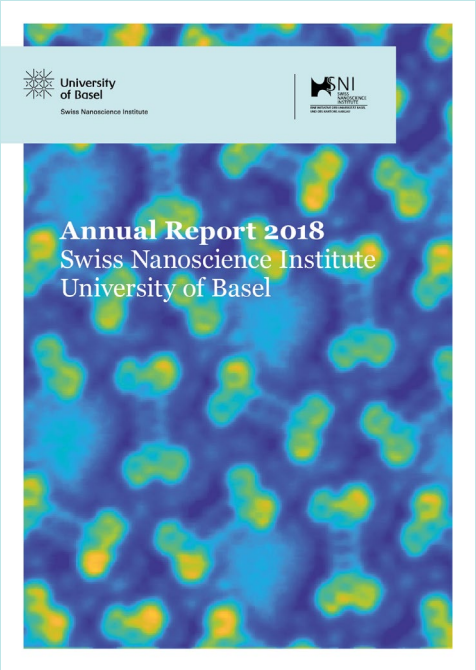
More information about the prizewinning project:

Watt d’Or 2019: Step by step to greater energy efficiency:
https://www.youtube.com/watch?v=38U4ln-Vrb84watch?v=38U4ln-Vrb84

https://www.newsd.admin.ch/newsd/message/attachments/55329.pdf

SNI Annual Report

Have you had a chance to look at the SNI Annual Report 2018?



It provides a complete overview of the SNI's wide-ranging activities in the areas of education, research, knowledge and technology transfer, services, and communication.

In a supplement to the report, all project leaders involved in the PhD School and the Nano Argovia program describe the scientific successes achieved in the respective projects.

You can find the Annual Report at:
https://nanoscience.ch/en/2019/04/01/annual-report-2018/.

New applied research projects in the Nano Argovia program

Every year, the SNI invests around CHF 1.5 million in supporting knowledge and technology transfer. A key part of this centers on the Nano Argovia program, in which applied research projects are funded in collaboration with companies in Northwestern Switzerland. At the beginning of 2019, six new projects were launched within the SNI's Nano Argovia program, and seven projects were extended – two of them without additional funding. In this *SNI INSight*, we present the first three of the six new projects.

First concentrated, then analyzed

Nano Argovia project DeePest researchers are developing a portable system for drinking water analysis

In the Nano Argovia project DeePest, scientists from the Schools of Life Sciences and Engineering at the University of Applied Sciences Northwestern Switzerland (FHNW) are working alongside industry partner Mems AG (Birmenstorf) to develop a fully automatic sensor for detecting pesticides in drinking water. The system is intended to offer a cost-effective extension for existing analysis methods and to continuously detect the presence of a wide range of pesticides in drinking water systems.

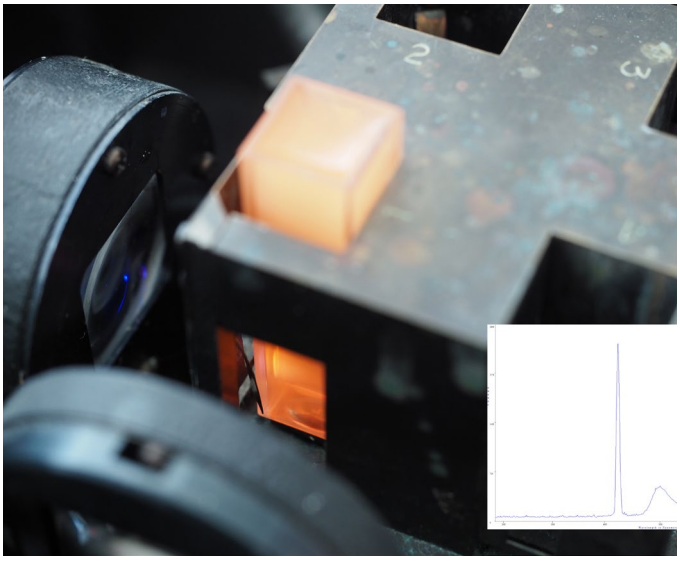
Two different sensors

In the first step, the pesticides are concentrated by several orders of magnitude so that, in the subsequent analysis, the researchers can use cost-effective methods whose sensitivity is tailored to the expected substrate concentrations. Working under project leader Professor Dr. Joris Pascal (FHNW), the interdisciplinary team bases its analysis on two different sensors, which exploit different physical properties and can therefore detect different classes of substance.

Initially, the scientists are focusing their efforts on detecting the pesticides glyphosate, atrazine and naphthalene. They are studying various nanostructured plastics that could be used to accumulate specific pesticides in a filter system. In parallel, they are developing cost-effective sensors that detect the presence of the three aforementioned pesticides.

Extension of existing systems

If the development process is a success, it will also be easy to extend the system to other classes of pollutant by fitting the filter cartridges with different absorbent plastics. The device could then conceivably be integrated into the drinking water cycle to ensure continuous monitoring.



Among other things, the DeePest project studies the fluorescent characteristics of pollutant molecules in water. (Image: J. Pascal, FHNW)

"We're optimistic that we can expand our product range with the Nano Argovia project DeePest and provide a cheap, fully automatic pollutant sensor to monitor the drinking water cycle."

Dr. Daniel Matter, Mems AG (Birmenstorf, AG)

Tiny structures for security

Nano Argovia project LASTRUPOL researchers are developing a new fabrication process for security features

In the Nano Argovia project LASTRUPOL, researchers from the FHNW School of Engineering, the Paul Scherrer Institute (PSI) and the company Gemalto AG (Aarau) are working together to develop a new fabrication process for security features on identity documents. The aim of the project is to produce three-dimensional optical structures with high precision and surface quality using the most economical process possible.

First structured, then smoothed

The team working under project leader Professor Dr. Per Magnus Kristiansen begins by using ultrashort laser pulses to remove material from a plastic surface in a targeted manner. Once engraved with these microscale structures, the surface is then smoothed to a roughness of less than 100 nanometers in a process that leaves the fine structures unaffected.

To do this, the scientists use a contactless method that was investigated in the Nano Argovia project SurfFlow and that reduces the glass transition temperature (the temperature at which the polymers change from a solid state into a thick molten mass) on the surface. If the sample is heated gently following this preliminary treatment, only the treated uppermost layers reach their glass transition temperature and become smooth, while the underlying structure and deeper layers remain virtually unchanged. In the LASTRUPOL project, this method must now be adapted to new materials and larger structures – an apparently simple proposition that actually presents a considerable challenge.

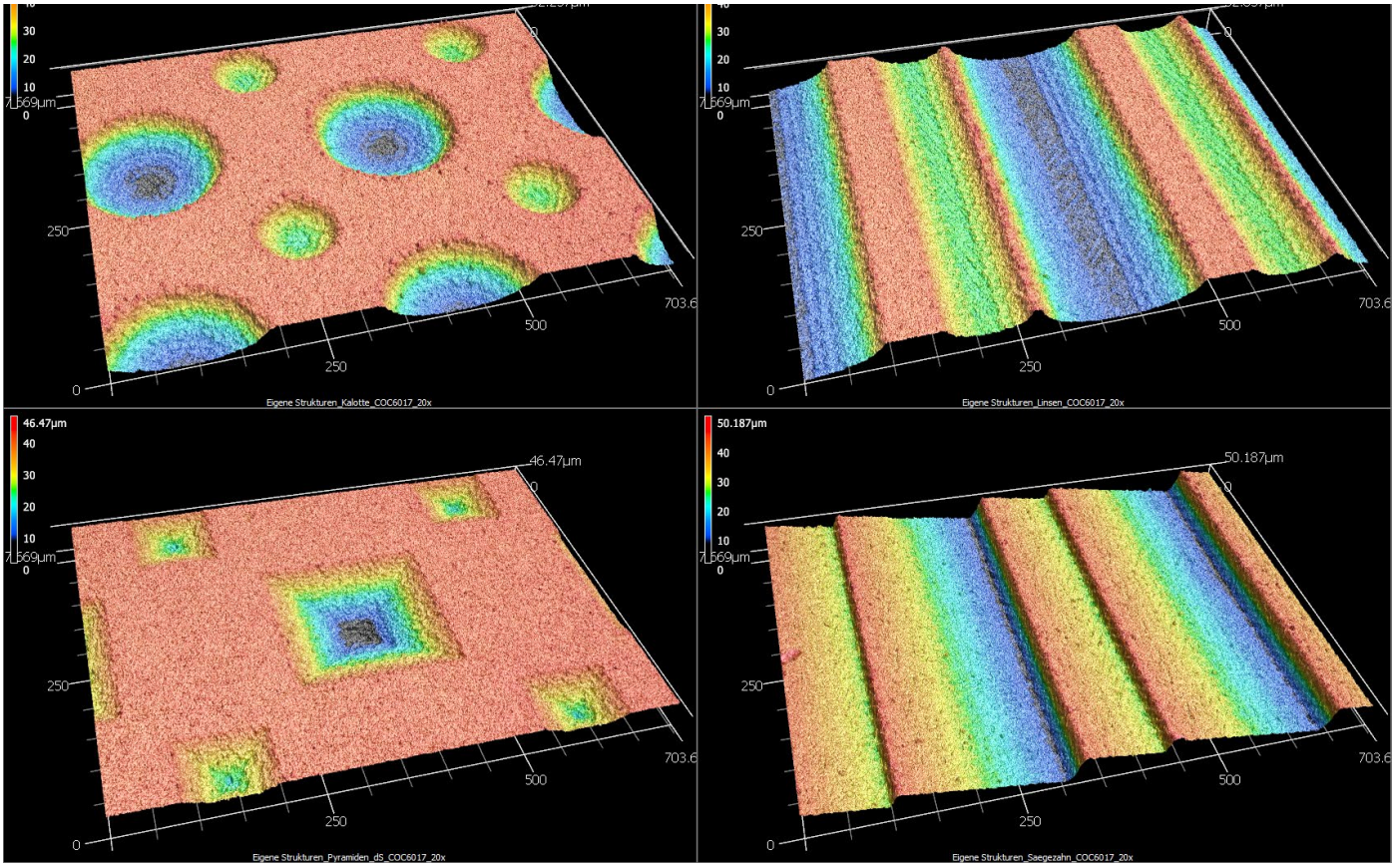
The combination of the two techniques should then lead to the production of templates that allow various security features to be reproduced easily. To begin with, the researchers are applying this method to two different types of security features: Firstly, to optical features produced by differences in diffraction on the structures; and secondly, to those created by tiny lenticular and spherical plastic lenses.

New technologies are key

"We're a leading company in the area of digital and physical identity solutions," explains Dr. Christian Sailer, Head of Physical Document Security R&D Switzerland at the project's industry partner, Gemalto AG. "It's vital for us to invest in new technologies aimed at producing security products in order to maintain this leading position. The Nano Argovia project LASTRUPOL is an excellent opportunity to benefit from the expertise of plastics processing specialists at the School of Engineering and the PSI."

"The Nano Argovia project LASTRUPOL is an excellent opportunity to benefit from the expertise of plastics processing specialists at the School of Engineering and the PSI»

Dr. Christian Sailer, Gemalto AG (Aarau, AG)



Lasered test structures in polymers need to be smoothed. (Image: M. Kristiansen, School of Engineering, FHNW)

Creating a heart model inspired by origami

In the Nano Argovia project KOKORO, scientists are using nanostructured cellulose as a scaffold for cell cultures

In the Nano Argovia project KOKORO (Japanese for "heart"), a team of researchers from the School of Life Sciences at the University of Applied Sciences Northwestern Switzerland (FHNW), the Department of Biomedicine (DBM) at the University of Basel, and Omya International AG are developing a novel, three-dimensional heart model.

Cellulose as cell culture scaffold

The team led by Dr. Joachim Schoelkopf (Omya) is developing a suitable cellulose paper whose nanostructures provide an ideal culture scaffold for myocardial cells. Using a 3D bioprinting process, the research group working under Dr. Maurizio Gullo (FHNW) and Dr. Joachim Köser (FHNW) applies thin coatings of myocardial cells onto a cellulose layer and thereby build the cardiac tissue. The research group led by Dr. Andrea Banfi (DBM) develops a vascular cell network which will ensure an optimal nutrient supply of the cardiac tissue.

The miniaturized artificial heart model is then created by folding the resulting tissue layers similar to paper origami. In a custom bioreactor developed by the research group of Dr. Anna Marsano (DBM), the heart model is cultured while being mechani-

In the Nano Argovia project KOKORO (Japanese for "heart"), an interdisciplinary project team is developing a novel, three-dimensional heart model, whose nanostructure provides an ideal culture scaffold for myocardial cells. (Image: M. Gullo, FHNW)

cally and electrically stimulated. Such physiological stimuli are similar to those experienced by native cardiac tissue and will help to achieve optimum tissue maturation before the heart models undergo in-depth characterization and physiological assessment.

An ideal way to test therapies

Using the model, the interdisciplinary team of researchers working under project leader Maurizio Gullo intend to investigate various tissue parameters, as well as the contractility, volume changes and functionality of the "paper heart." An artificial heart model of this kind provides ideal means to test therapeutic approaches for treating heart strokes and other forms of cardiovascular disease. In future, the project findings will doubtlessly serve as base for developing tissue patches aimed for cardiac tissue regeneration.

Suitable cell culture scaffold

"The folding technique is an elegant way to overcome the complexity of the 3D bioprinting process as well as to enable the manufacturing of larger sample quantities. Inspired by origami, the cellulose-based cell culture scaffold enables the creation of 3D heart models," explains Maurizio Gullo.

"Cellulose-based fiber networks are increasingly being used as cell cultures scaffolds. Careful selection of the fiber dimensions and their spatial arrangement facilitates the building of artificial tissues."

Dr. Joachim Schoelkopf, Head of Fundamental Research at Omya International (Oftringen, AG)

SNI on social media

Besides LinkedIn, the Swiss Nanoscience Institute is now also on Twitter, where we announce the latest scientific findings and activities from the SNI network. The SNI's most impressive images can be found on Instagram.

Follow us, and feel free to share any content that might be of interest to your network.

https://www.linkedin.com/company/swiss-nanoscience-institute/?viewAsMember=true

https://twitter.com/SNIunibas

https://www.instagram.com/nano_study_sni/

Swiss NanoConvention 2019

This year's Swiss NanoConvention will be held on 6 and 7 June in Lausanne. Entry is free for SNI members registering with the code we recently sent out.

Read more about the SNC 2019 at:
http://swissnanoconvention.ch/2019/

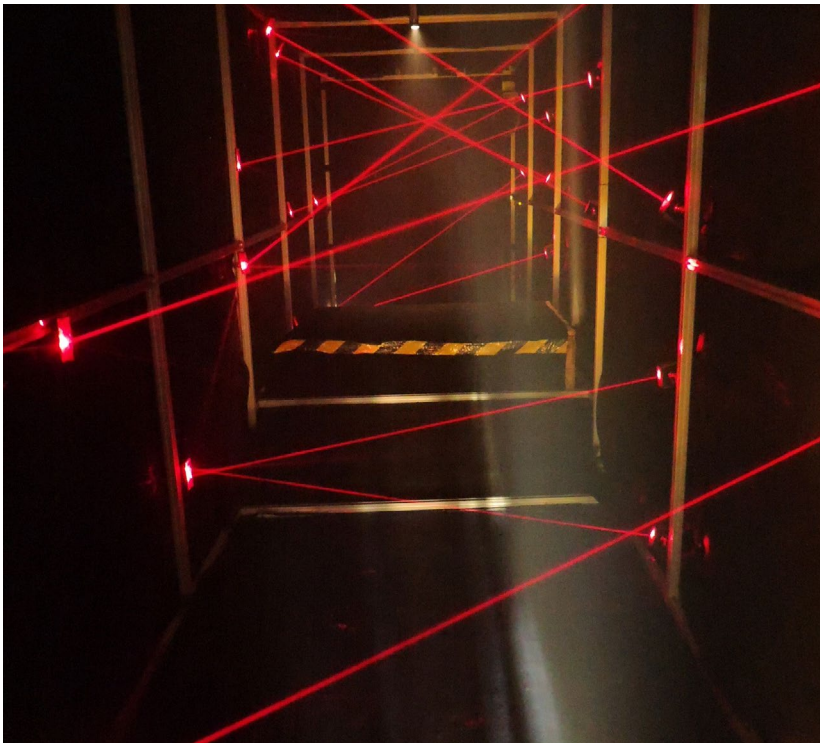
Laser labyrinth draws crowds
Science meets fun at tunBasel

The outreach team and other SNI members started the year with a busy few months, taking part in numerous events aimed at students. One of the highlights was tunBasel, which took place from 8 to 17 February, 2019, as part of the recent Mustermesse Basel trade fair.

Four partners

The joint stand at tunBasel, shared by the SNI, the Department of Physics, the Department of Chemistry and CSEM Muttenz was visited by a steady stream of children and young people. The main attraction was the laser labyrinth, put together a few years ago by the electronics lab of the Department of Physics at the suggestion of SNI outreach manager Dr. Kerstin Beyer-Hans.

In addition to the labyrinth, for the first five days of the event the Department of Chemistry set up a fluorescence room – an illuminating experience making use of various chemical fluorescence reactions.



Visitors to the labyrinth had to steer clear of fifteen laser beam obstacles, a challenge requiring considerable skill and dexterity (Photo: M. Steinacher, Department of Physics, University of Basel)

Long lines often formed outside the labyrinth.

For the second half of tunBasel, the stand was taken over by the SNI and CSEM Muttenz. Visitors of all ages had a chance to build their own spectrometer, and marvel at chocolate laced with nanostructures that made it shimmer in rainbow hues.

Well worth the wait

Throughout the tunBasel event, the laser labyrinth attracted thousands of youngsters who were quite happy to stand in line for up to 30 minutes waiting for their turn to weave their way through the laser beams crisscrossing the dark passageway. The smallest and most nimble visitors were at a clear advantage, giving them the best chance of successfully negotiating the fifteen obstacles without touching the laser beams.

Also popular was the SNI's hands-on stand, where children and adults alike could build their own spectrometer. The fact that white light is made up of numerous different colors came as a revelation to many visitors.

"A huge thank you to all the nanoscience students and SNI doctoral students who made this fantastic effort possible.

According to the organizers, this year's event was attended by half of all elementary school classes in the Cantons of Basel-Stadt and Basel-Landschaft, and the SNI and its helpers spent over 200 hours at the highly popular stand over the course of five days."

Dr. Michèle Wegmann, SNI outreach managerin

From the nanoworld to outer space

Former nano student Florian Kehl's search for life beyond Earth at NASA

In late April, the SNI hosted Dr. Florian Kehl, a Life Detection Technologist at NASA's Jet Propulsion Laboratory (JPL). In the lunch talk and the SNI lecture, he shared some fascinating stories about his work and career so far.

A chat with students

To begin with, Florian Kehl met with over 30 students from the nanoscience program for the lunch talk. He told them about fulfilling his childhood dream of working for NASA, where he now has a permanent job after three years as a post-doc. "The nanoscience degree, with its interdisciplinary approach, was an ideal foundation for my current job," he says. "My knowledge of biology, chemistry and physics and my joined-up thinking often put me in a position to build bridges between scientists and engineers."

He also received a boost from the industrial experience he gained during a placement at CSEM, and writing his master's thesis on microrocket technology at the University of California in Berkeley.

"Diversification is important in education," he told his audience. Kehl himself has always abided by this principle: while writing his doctoral dissertation on the development of a biochemical analysis device, alongside his research at ETH Zurich he also worked at CSEM and the company Optics Balzer, where he picked up the electronics skills that are now second nature to him: at the Jet Propulsion Laboratory in Pasadena, he develops and builds devices able to search for signs of life in our solar system.

A journey into space

In the early evening, in an event open to the public, Kehl took his audience on a research expedition into space. With the aid of some spectacular images, he vividly explained how life might have evolved on Mars or some of the moons orbiting Jupiter and Saturn. Whether or not this has actually happened, or what these life forms might look like, remains unknown.

"I would go back to Basel to study nanoscience any time."

Dr. Florian Kehl, Life Detection Technologist, JPL, NASA

Florian Kehl discusses how studying nanoscience helped prepare him to search for life in space during the lunch talk.

SNI director Christian Schönenberger welcomes Florian Kehl, who gave this year's SNI lecture.

In any case, amino or carboxylic acids and complex biomolecules would be indicators of life that could have developed in water beneath massive ice sheets. "Whereas amino and carboxylic acids have been found on meteorites in the past, the frequency of the different acids varies according to whether they are of biotic or abiotic origin," he explains. "The handedness (chirality) of amino acids also depends on whether or not they were produced by living beings." In nature, left-handed amino acids are much more common than right-handed ones. However, among amino acids created by abiotic process, the distribution is evenly balanced.

The instruments developed by Kehl are designed to detect the presence of biological molecules in the harsh conditions of space. However, before that can happen, the devices must be tested here on Earth. The audience of over 250 was treated to a memorable demonstration of how Kehl tests his instruments under extreme climate conditions in Chile's Atacama desert or the Arctic.

A fascination for diversity

For Kehl, the most exciting thing about his work is the variety it offers. "No two days are the same. Like the nanosciences program, it is extremely interdisciplinary and varied. I don't just develop instruments with electronics and software – I also have to understand the underlying biology and chemistry," Kehl explains in an interview.

His reputation has even made it as far as Hollywood – he was hired as a "rocketry consultant" by the producers of the CBS television series "Strange Angels", which tells the bizarre life story of Jack Parson, one of the founders of Jet Propulsion Laboratories where Florian now works.

Even as a small boy, Kehl was already giving presentations on Mars robots. Today, he is involved in equipping them to successfully complete their mission. The first step on the road to this fascinating job was a nanoscience degree at the University of Basel, and it is great to hear that he would return to Basel to study nanoscience again in a heartbeat.

Watch an interview with Florian Kehl in which he talks about what he likes most about his job at NASA, how his studies helped prepare him for what he does, and his favorite part of studying nanoscience in Basel (only in German).

Heute bei der NASA – gestern Nanostudent

https://www.youtube.com/watch?v=m-KOYNbDBbPw

News from the network

Data storage using individual molecules

Researchers from the University of Basel have reported a new method that allows the physical state of just a few atoms or molecules within a network to be controlled. It is based on the spontaneous self-organization of molecules into extensive networks with pores about one nanometer in size. In the journal *small*, the physicists reported on their investigations, which could be of particular importance for the development of new storage devices.

https://doi.org/10.1002/smll.201803169

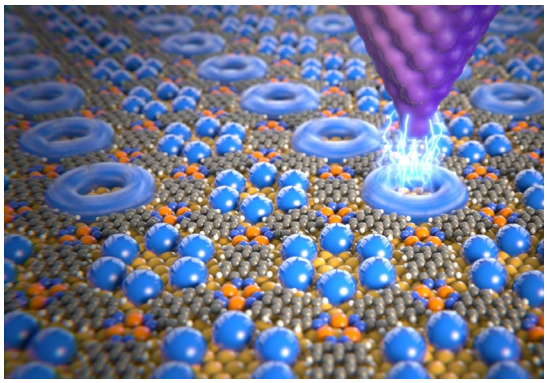


Image: Department of Physics, University of Basel

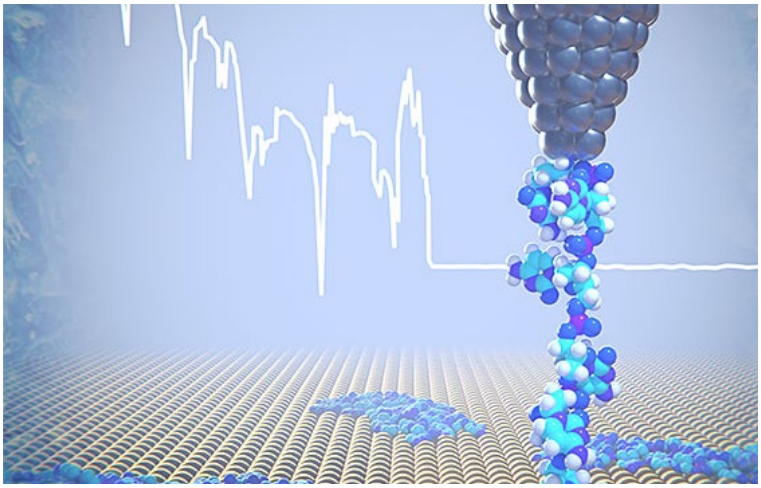


Image: Department of Physics, University of Basel

Cryo-force spectroscopy reveals the mechanical properties of DNA components

Physicists from the University of Basel have developed a new method to examine the elasticity and binding properties of DNA molecules on a surface at extremely low temperatures. With a combination of cryo-force spectroscopy and computer simulations, they were able to show that DNA molecules behave like a chain of small coil springs. The researchers reported their findings in *Nature Communications*.

https://www.nature.com/articles/s41467-019-08531-4

Super superlattices: The moiré patterns of three layers change the electronic properties of graphene

Combining an atomically thin graphene and a boron nitride layer at a slightly rotated angle changes their electrical properties. Physicists at the University of Basel have now shown for the first time the combination with a third layer can result in new material properties also in a three-layer sandwich of carbon and boron nitride. This significantly increases the number of potential synthetic materials, report the researchers in the scientific journal *Nano Letters*.

https://doi.org/10.1021/acs.nanolett.8b05061

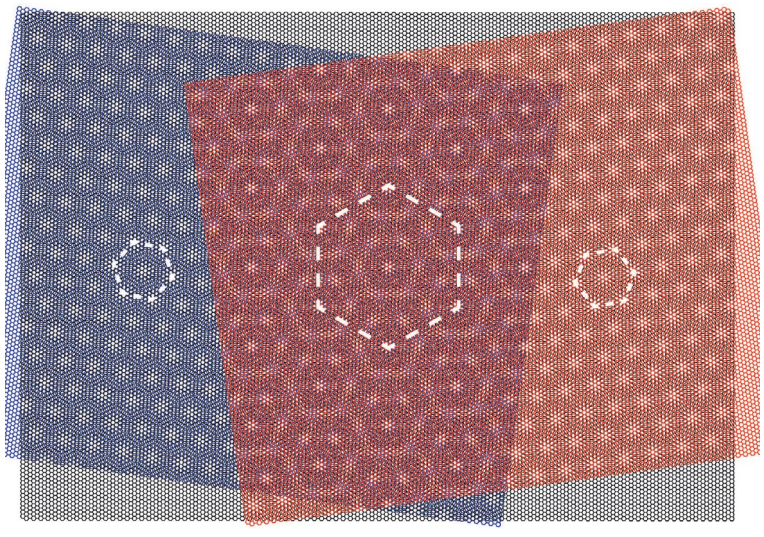


Image: Department of Physics, University of Basel

Spontaneous spin polarization demonstrated in a two-dimensional material

Physicists from the University of Basel have demonstrated spin alignment of free electrons within a two-dimensional material. Writing in the latest edition of *Nature Nanotechnology*, they described their observation of spontaneous spin polarization, which cannot occur in ideal two-dimensional materials according to a well-known theorem from the 1960s.

https://www.nature.com/articles/s41565-019-0397-y

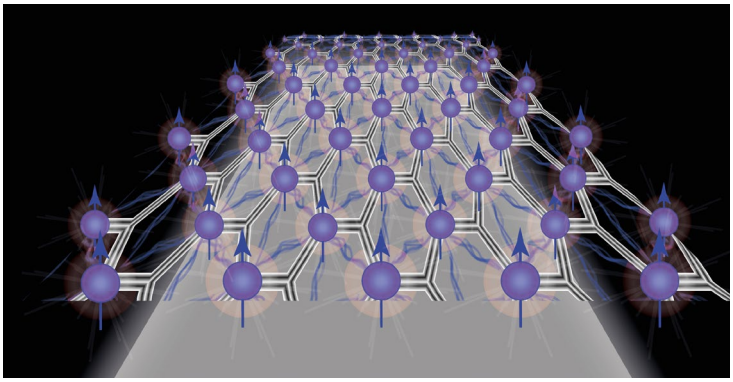


Image: Department of Physics, University of Basel

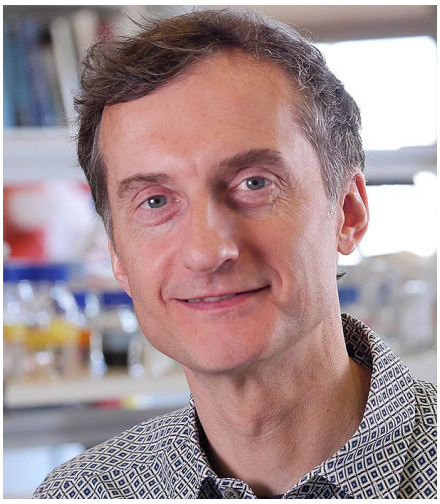


Image: Biozentrum, University of Basel

Image: SNI, University of Basel

EU research funding for two SNI Board members Alex Schier and Ernst Meyer

The European Research Council has awarded two University of Basel scientists each a generously endowed ERC Advanced Grant. Biologist Professor Alex Schier and physicist Professor Ernst Meyer will each receive funding in the six figures for their innovative research projects.

9.1 million euros for trinational quantum research

The project *Quantum Science and Technologies at the European Campus* (QUSTEC) has been selected by the European Commission as a joint international and interdisciplinary doctoral program in quantum sciences and technologies. Led by Eucor – The European Campus, it will bring together the Universities of Basel, Freiburg and Strasbourg, Karlsruhe Institute of Technology and IBM Research Zurich.

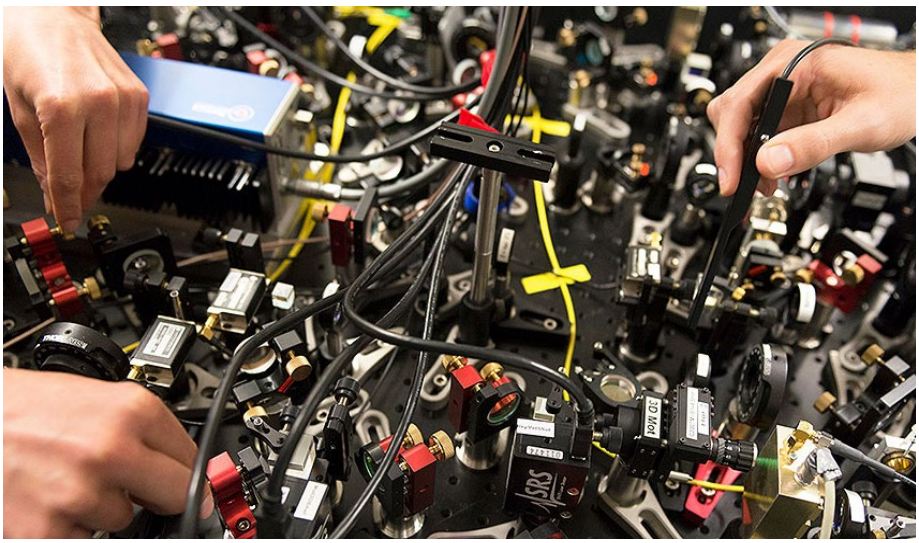


Image: Department of Physics, University of Basel

Unprecedented insight into two-dimensional magnets using diamond quantum sensors

For the first time, physicists at the University of Basel have succeeded in measuring the magnetic properties of atomically thin van der Waals materials on the nanoscale. They used diamond quantum sensors to determine the strength of the magnetization of individual atomic layers of the material chromium triiodide. In addition, they found a long-sought explanation for the unusual magnetic properties of the material. The journal *Science* has published the findings.

https://science.sciencemag.org/lookup/doi/10.1126/science.aav6926

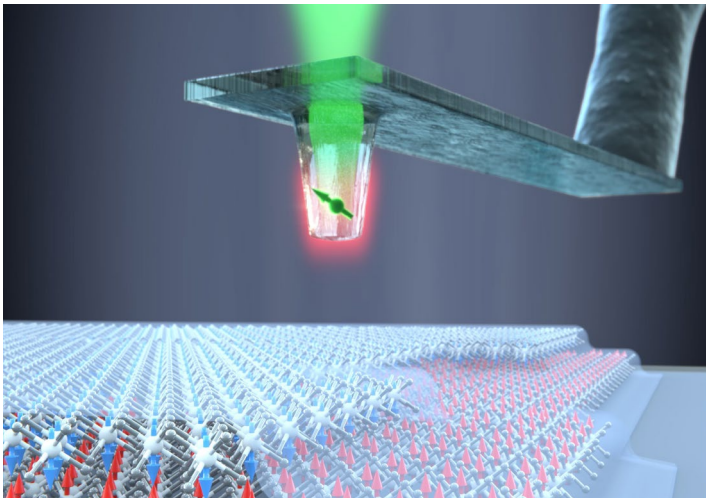


Image: Department of Physics, University of Basel

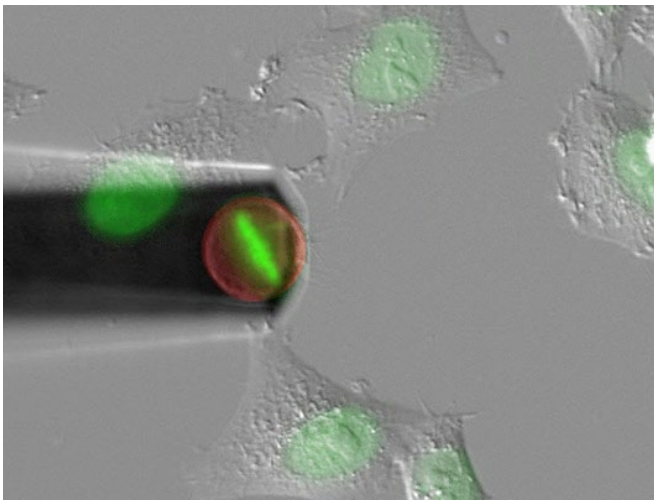


Image: D-BSSE, ETH Zurich

Mechanobiology based on atomic force microscopy

Over the last three decades, atomic force microscopy (AFM) has become a key platform for the characterization of morphological and mechanical properties of living biological systems. An interdisciplinary team of researchers from the SNI network has summarized the pros and cons of atomic force microscopy in the journal *Nature Reviews Physics*, describing how AFM technology can be combined with other methods. The researchers also discuss how mechanical properties can be directly linked to function.

https://www.nature.com/articles/s42254-018-0001-7

Decoupled graphene thanks to potassium bromide

The use of potassium bromide in the production of graphene on a copper surface can lead to better results. When potassium bromide molecules arrange themselves between graphene and copper, it results in electronic decoupling. This alters the electrical properties of the graphene produced, bringing them closer to pure graphene, as reported by physicists from the universities of Basel, Modena and Munich in the journal *ACS Nano*.

http://dx.doi.org/10.1021/acsnano.9b00278

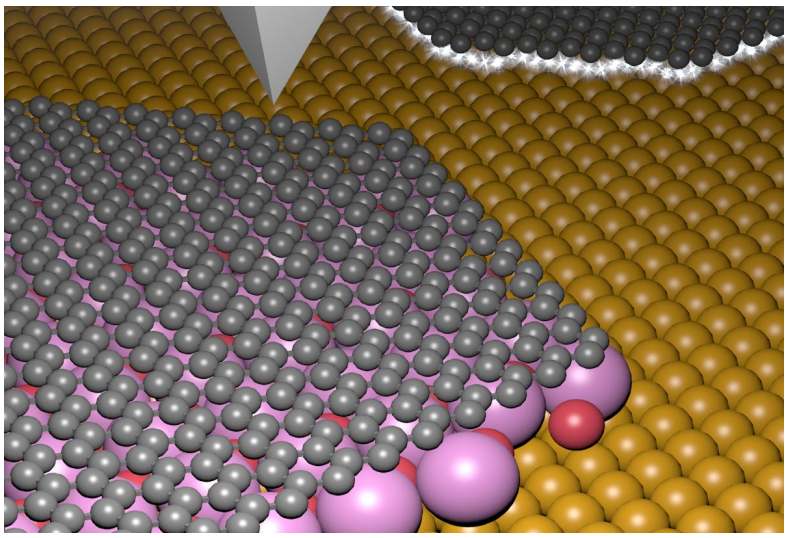


Image: Department of Physics, University of Basel

The combination is key

Scientists from the SNI network have described how electron diffraction can be used to determine crystal structures efficiently. As part of the Nano Argovia project A3EDPI, the researchers combined an EIGER hybrid pixel detector with a classical electron microscope and calibrated the system to allow the quick and reliable calculation of diffraction data.

Writing in the journal *Acta Crystallographica*, they describe the results of this interdisciplinary collaboration by researchers from the Paul Scherrer Institute (PSI), the Universities of Basel and Dortmund, ETH Zurich, and Dectris (Baden-Daettwil).
https://doi.org/10.1107/S2059798319003942

Short summaries of these papers can be found at: https://nanoscience.ch/en/media-2/aktuelle-medienmitteilungen/

Nano Imaging Lab User Event

The SNI's Nano Imaging Lab invites everybody interested to its second User Events.

By short talks the wide spectrum of applications done in the NI Lab lab will be presented and the event offers plenty of opportunityies for discussions with NI Lab members and other users.

After the talks you are welcome to an Apéro riche and a tour through the labs.

Please register until 31 May 2019!
(nanoimaging@unibas.ch)

13 June 2019
4 – 6 pm
Department of Physics
St. Johanns-Ring 25,
4056 Basel
Neuer Hörsaal 1 (Foyer EG)

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