



University  
of Basel

Swiss Nanoscience Institute



## SNI update December 2016



Dear colleagues

Word will undoubtedly have spread that our director, Professor Christian Schönenberger, sustained a very serious cycling accident in early November. We are happy to announce that he is on the road to recovery, although it will be some time until he is back on his feet. We continue to wish him strength and a speedy recovery, and hope to have him back in our midst as soon as possible.

Shortly before Christian's accident, we celebrated the SNI's 10<sup>th</sup> anniversary

sary together. The celebration was intended to round off an eventful and successful year for the SNI, in which we organized the resoundingly successful Swiss NanoConvention 2016 in Basel and celebrated the award of the Kavli Prize to our Vice-Director Christoph Gerber. The 10<sup>th</sup> anniversary was also a fitting opportunity to look back at the successes achieved by the SNI so far and thank a number of SNI members – on behalf of so many others – who made it all possible.

A new addition to the SNI this year is the Nano Imaging Lab, combining parts of the former Center for Microscopy Basel with the Nanotech Service Lab. Thanks to the Nano Imaging Lab (or NI Lab for short), the SNI is now able to offer a comprehensive imaging service. Read this edition's lead story to find out more about the activities of the NI Lab and the people working there.

At the Future Day held in November, the NI Lab and the SNI communications team once again joined forces

with the Department of Physics to devise an exciting program for young researchers. As in previous years, the event gave the children of university employees a glimpse into the world of nano research. In line with its goal of arousing interest in scientific research among young people, the SNI was once again involved in the TecDay and TecNight events at Wohlen cantonal high school in early December.

For now, we wish you a pleasant end to the year, a restful festive season with your family and loved ones, and a good start to a healthy and successful new year in which Christian Schönenberger will hopefully be here to greet you himself.

Kind regards,

*Andreas Baumgartner, Wolfgang Meier, Christel Möller, Katrin Spieler, Michèle Wegmann and Claudia Wirth*

# Making the invisible visible

## The SNI's Nano Imaging Lab unlocks the secrets of the nanoworld

In early 2016, the SNI welcomed four new members. Evi Bieler, Susanne Erpel, Daniel Mathys and group leader Dr. Markus Dürrenberger of the former Center for Microscopy Basel (ZMB) joined Dr. Monica Schönenberger, previously of the Nanotech Service Lab, to form the new Nano Imaging Lab (NI Lab). The five specialists bring together decades of experience in imaging minute structures. Drawing on their unique expertise and extensive technical resources, they offer a comprehensive imaging service to clients in the SNI Network and external partners alike.

### A varied toolkit

The stunningly detailed images captured by electron microscopes never fail to catch the eye. However, the work of the five members of the Nano Imaging Lab is about more than simply showcasing the beauty of the nanoworld. Their microscopic images help researchers examine structures, analyze particles and solve problems. Depending on the nature of the sample and the client's needs, the NI Lab has a range of microscopes at its disposal.

For instance, the team uses scanning electron microscopes (SEM) to examine how different bone replacement materials are colonized by cells. The project, led by Professor Ivan Martin of University Hospital Basel, has a twofold aim: to assess how well body cells respond to implants, and to determine how certain materials affect unwanted bacterial growth. The detailed im-



The team of the Nano Imaging Lab offers a comprehensive imaging service to internal and external clients.

ages provided by the NI Lab help the researchers choose the most appropriate surface structures and materials.

### Keeping it cool

While the researchers working on bone replacement materials want to see as few bacteria as possible, in other projects these tiny single-celled organisms are the primary focus. Delicate microorganisms are best viewed using a cold-field-emission SEM, a low-energy device which is particularly gentle on the sample. Examples of research issues where this procedure is particularly useful include the way in which bacteria are attacked and infected by viruses, or how bacteria attach themselves to surfaces and other bacteria by means of thread-like appendages known as pili.

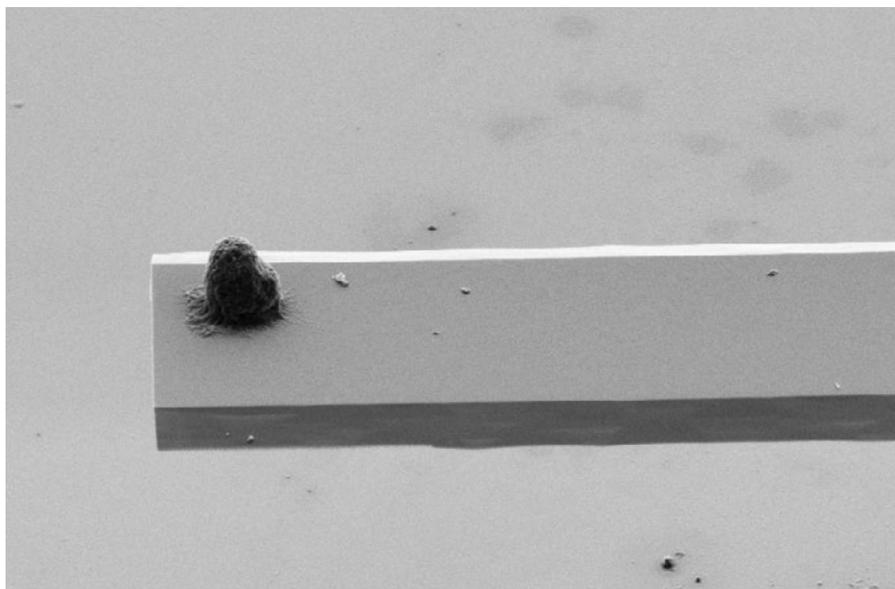
### Fragile mirrors

The applications of the cold-field-emission microscope are not limited to delicate organic structures: the NI Lab team also uses the device to examine special mirrors for use in the planned ITER fusion reactor. The team working on the project, led by Dr. Laurent Marot of the University of Basel's Department of Physics, has developed a method for cleaning the light-reflecting mirror surfaces inside the reactor. These extremely sensitive mirrors must be examined at very high resolution while avoiding radiation damage, making the cold-field-emission microscope an obvious choice.

### Possibility of nanofabrication

The NI Lab also has a scanning electron microscope equipped with a focused ion beam (FIB), which can be used to manipulate minute structures. The FIB has been used to cut solar cell wafers and examine their layer structure in collaboration with Professor Edwin Constable of the Department of Chemistry, for example. For a project led by Profes-

sors Christoph Gerber (Department of Physics) and Daniel Müller (D-BSSE), special silicon cantilevers were produced in a painstaking process lasting hours. These cantilevers enable the researchers to examine the mechanics of cell division. They discovered that the cell division of human cells can be controlled using these cantilevers.



Using the focused ion beam, the NI Lab produced special silicon cantilevers that are used to examine the mechanics of cell division (Image: Daniel Mathys).

berger, became a part of the NI Lab, where Monica Schönenberger continues to offer a wide range of analyses using atomic force microscopy. Among other tasks, she is currently working on the Argovia



Biological samples, as this hatching mite, often require special sample preparation methods. (Image: Evi Bieler).

### Examining pests

For other research issues involving organic matter, the NI Lab team uses a scanning electron microscope with the ability to plunge-freeze samples. An examination temperature of  $-150^{\circ}\text{C}$  makes it possible to obtain largely artifact-free specimens from organic materials. The process, known as cryo-SEM, is currently being used in a project involving the State Viticultural Institute in Freiburg (Germany) to find out how the micro- and nanostructure of different vine varieties affects the susceptibility of leaves and grapes to pests.

### More than just images

However, images are not the only way in which SEMs can help solve research problems. Spectroscopic analysis can also be used to obtain a qualitative and quantitative description of most of the elements contained in the material being examined. In a project for the company Particle Vision GmbH, for instance, the NI Lab analyzed air samples on newly developed boron substrates to support the analysis and services provided by Particle Vision.

The lab also investigates a wide range of nanoparticles. Using a transmission electron microscope, which allows researchers to image a sample's internal structure, a group led by Professor Wolfgang Meier of the Department of Chemistry is exploring the possibilities offered by nanocontainers. The focus of the research is on the size distribution of the vesicles, which can be filled with a variety of substances, as well as the contents themselves.

### AFM also among the lab's resources

At the start of 2016, the former Nanotech Service Lab, led by Monica Schönen-

berger, became a part of the NI Lab, where Monica Schönenberger continues to offer a wide range of analyses using atomic force microscopy. Among other tasks, she is currently working on the Argovia

### A wealth of experience at the service of clients

A complete description of the services offered by the Nano Imaging Lab's accomplished team is beyond the scope of this brief outline. Clients interested in a specific analysis will be competently advised by any of the NI Lab's five members. Where desired, the team can take charge of the entire process, from sample preparation to documentation. However, certain clients, such as colleagues in the fields of environmental sciences or geology, prefer to conduct the analyses themselves using the NI Lab's equipment. These customers also receive full professional support from the lab's experienced team.

Besides providing tailored services

to clients, the NI Lab is also involved in teaching and in the outreach activities of the Biozentrum and SNI. For years, students at the Biozentrum or enrolled in the nanoscience study program have been praising the block courses offered by the NI Lab as a highlight of their studies, while visitors to the university's open events are invariably fascinated by its extraordinary images of the nano- and microworlds.



The block courses of the NI Lab are highlights for many students (Image: Susanne Erpel).

## Contributions to the annual report



Please submit reports on Argovia and PhD projects along with the information requested by **December 20, 2016**, so that we can compile the overall annual report.

Thank you!

## We introduce...

### The Nano Imaging Lab team

**Evi Bieler** trained as an academic technical assistant under Professor Guggenheim in the SEM Lab, and studied English and German. She has been on Markus Dürrenberger's team for 9 years, and is primarily responsible for SEM analyses. She is fascinated by this technology's potential, and has a gift for inspiring the same enthusiasm in students and clients. She is also involved in the NI Lab's public outreach activities, offering children and other visitors a taste of the marvels the microworld has to offer.



**Susanne Erpel** trained as a biology technical assistant, and has a degree in technical biology. After completing her degree, she worked at the University of California, San Francisco, overseeing microscopy services. Following a period of family leave, Susanne Erpel joined C-CINA in 2014, and has been a part of the NI Lab since March 2016. Her time is mostly occupied with SEM analyses – particularly in the field of life sciences – and she takes great pleasure in making the invisible visible.



force microscopy. She also trains post-graduate students in the use of the various different atomic force microscopes, and always takes great pleasure in getting to grips with exciting new research projects.

**Dr. Markus Dürrenberger** is the leader of the NI Lab and the first port of call for clients and prospective projects. He studied power engineering in Muttenz and molecular biology at the Biozentrum in Basel. Early on in his career, he

**Daniel Mathys** trained as a biology lab technician in Bern before working in the chemical industry in Basel for 3 years. He then joined the University of Basel's Biozentrum as a member of Professor U. A. Meyer's research group, switching to the Scanning Electron Microscopy Laboratory (as it was then called) in 1987. In collaboration with industry partners, he made a decisive contribution to the development and establishment of the cryo-SEM method. Nowadays, he is primarily occupied with the focused ion beam microscope, which uses electron and ion beams to cut and modify samples or create entirely new structures. With 30 years of experience in electron microscopy under his belt, Daniel Mathys is the go-to expert for a wide range of research issues, as demonstrated by his co-authorship of more than 60 publications. He readily and enthusiastically shares his knowledge with all who show an interest, and has a unique gift for colorizing the lab's breathtaking images of the nanoworld.



specialized in a variety of different forms of microscopy including TEM, SEM, optical and confocal. He no longer spends much time at the microscope himself, but is always on hand for repairs or adaptations. He finds just as much motivation in his dealings with machines and processes as in his interactions with students, unreservedly sharing with them the joy he takes in his work and the wealth of experience he has accumulated over the years. Throughout his career, Markus Dürrenberger has contributed to several major innovations in the field, such as the widely used embedding resin Lowi-cryl developed in collaboration with several colleagues, and a cryo procedure for plunge-freezing samples for transmission electron and scanning electron microscopy used by a number of leading manufacturers.

**Dr. Monica Schönenberger** studied pharmacy in Basel, gaining her first experience with atomic force microscopy during her doctorate at Hoffmann-La Roche under the supervision of Professor Hans-Joachim Güntherodt. After completing her doctoral thesis she took a job as a project leader at Mepha AG, before joining Professor Ernst Meyer's group at the Department of Physics. After a year at Nanosurf, she took charge of the SNI's newly founded Nanotech Service Lab in 2010. In the intervening years, Monica Schönenberger has built up a versatile and professional service unit for atomic



# Events

## A memorable anniversary

On 28 October, the SNI's 10<sup>th</sup> anniversary was celebrated by SNI members and numerous guests who have supported the Institute over the years or who played a key role in its foundation. Some 150 attendees gathered in Gundeldinger Feld's Hall 7 to toast the anniversary, catch up with contacts and enjoy the varied entertainment program.

Stefan Verra got the party started with an energetic and humorous demonstration of how body language can affect our perception. In a performance perfectly pitched to his audience, he used numerous examples backed up by scientific research to show just how entertain-

ing the presentation of scientific findings can be. Slammers Kishan Thodkar and Meropi Karakioulaki carried on in the same vein, with a lively and accessible presentation of their research pared down to just a few minutes.



Things got even louder when Argovia-Professor Roderick Lim and his Postdoc Philipp Oertle used an amplifier to combine the sound of an atomic force microscope with that



## Another successful Future Day

Once again this year, the SNI was involved in the Future Day held on 9 November to give children and young people a playful introduction to research in the natural sciences. In collaboration with the Department of Physics, Dr. Michèle Wegmann prepared a varied program on the topic of energy. Dr. Thilo Glatzel kicked things off with a presentation and a series of experiments demonstrating different forms of energy generation. Dr. Reimann then took the 20 children on a tour of some of the laboratories and workshops to give them an idea of where the employees of the Department of Physics work. Finally, it was time for some hands-on action, and with the help of the workshops and the SNI the young researchers built a solar flower and a wind turbine from PET bottles and soldered together an electronic game.

Another group of enthusiastic children were given a tour of the nanoworld by the members of the SNI's Nano Imaging Lab. After learning about different types of microscopes they had the chance to use some themselves, and were given photos of what they had seen to take home as a souvenir.



## PhD students visit Roche



The decisions faced by some of the PhD students at the SNI's PhD school about what comes next are becoming increasingly pressing as their doctorates approach completion. In late November, 16 PhD students paid a visit to Roche Pharma AG in Basel to gain some insights into starting a career in the pharma industry. The visit included a lecture on molography by Dr. Christoph Fattinger illustrating how Roche employs nanotechnology in its research.

Dr. Volker Herdtweck of Roche Human Resources, who is in charge of contact with universities and prepared the program for the visit, advised the attendees to acquire industry experience before completing their PhD and to start networking early on. He then added that it is crucial to tailor applications to the advertised position and focus on key aspects. With the aim of giving candidates a clearer picture of the different fields of activity, Roche offers a careers blog in which employees in a wide range of positions share their personal impressions and experience.

Attendees also heard a first-hand account of work in pharma research from a post-doc and a trainee, who described how it differs from university work and highlighted the pros and cons of their temporary positions in the global pharma company. The two young researchers along with Volker Herdtweck then fielded questions from the PhD students during an informal lunch.

"The visit to Roche was a valuable experience. It gave us an idea of the potential opportunities on offer at Roche specifically and in the industry in general. We also received information which will help us make a decision about the next step in our career," summed up Michael Gerspach.

## Awards

### Christoph Gerber received honorary doctorate



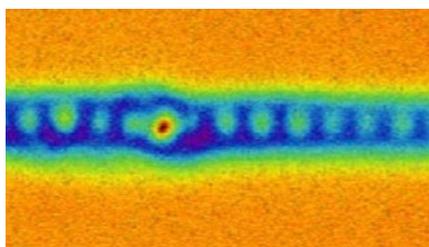
On November 25<sup>th</sup> 2016, Professor Christoph Gerber received the honorary doctorate from the University of Twente.

He was portrayed in the University's newsletter:

[www.utnieuws.nl/english/63453/Dare\\_to\\_live\\_your\\_wildest\\_dreams](http://www.utnieuws.nl/english/63453/Dare_to_live_your_wildest_dreams)

## Media releases and uni news from SNI members

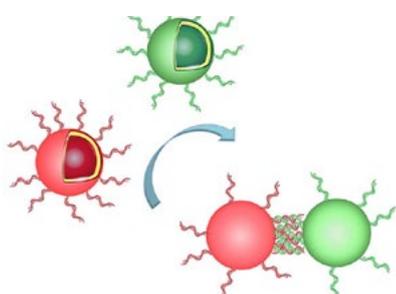
### University of Basel, 01 December 2016. Researchers Take First Look into the "Eye" of Majoranas



Majorana fermions are particles that could potentially be used as information units for a quantum computer. An experiment by physicists at the Swiss Nanoscience Institute and the University of Basel's Department of Physics has confirmed

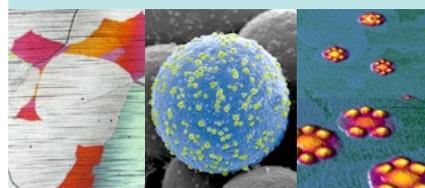
their theory that Majorana fermions can be generated and measured on a superconductor at the end of wires made from single iron atoms. The researchers also succeeded in observing the wave properties of Majoranas and, therefore, in making the interior of a Majorana visible for the first time. The results were published in the Nature journal npj Quantum Information.

### University of Basel, 02 November 2016. Chemists Create Clusters of Organelles by Mimicking Nature



Scientists from the University of Basel have succeeded in organizing spherical compartments into clusters mimicking the way natural organelles would create complex structures. They managed to connect the synthetic compartments by creating bridges made of DNA

## Scientific image competition



The Swiss National Science Foundation has launched a competition for scientific images and videos. The competition, which is open to researchers working in Switzerland, aims to showcase the hidden beauty of science. As amply illustrated by our Nano Image Award, the nanoworld is a rich source of beautiful images which undoubtedly merit submission.

Find out more at:

[www.snf.ch/en/researchinFocus/newsroom](http://www.snf.ch/en/researchinFocus/newsroom)

## Successful careers with antelope

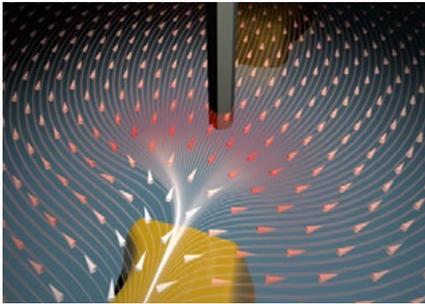
The career program of the University of Basel for female doctoral students and postdoctoral researchers launches the next call for applications.

More information at:

[www.unibas.ch/en/Research/Graduate-Center/antelope-Programs0.html](http://www.unibas.ch/en/Research/Graduate-Center/antelope-Programs0.html)

between them. This represents an important step towards the realization of so-called molecular factories. The journal Nano Letters has published their results.

**University of Basel, 17 October 2016. Nanowires as Sensors in New Type of Atomic Force Microscope**



A new type of atomic force microscope (AFM) uses nanowires as tiny sensors. Unlike standard AFM, the device with a nanowire sensor enables measurements of both the size and direction of forces. Physicists at the University of Basel and at the EPF Lausanne have described these results in the recent issue of Nature Nanotechnology.

All media releases and coverage in media can be found at: [www.nanoscience.ch/nccr/media](http://www.nanoscience.ch/nccr/media)

Please provide feedback

Please send information for SNI update and feedback to [c.moeller@unibas.ch](mailto:c.moeller@unibas.ch).