University of Basel

Swiss Nanoscience Institute

SNI SWISS NANOSCIENCE INSTITUTE

EINE INITIATIVE DER UNIVERSITÄT BASEL UND DES KANTONS AARGAU

Annual Report 2021
Swiss Nanoscience Institute

Scientific supplement
Scientific reports from all the Nano Argovia and SNI PhD School projects from 2021 can be found on our website www.nanoscience.ch or by scanning the QR code.

www.nanoscience.ch
Follow us:

Dear colleagues and interested parties,

Given the enormous quantity of information we receive on a daily basis, we have decided to restructure the SNI Annual Report. Although we will continue to produce a scientific supplement with information on the progress achieved in each SNI research project, the general section has been significantly shortened in order to provide you with a quick overview of key topics for the SNI over the past year. We have also produced a video, in which we summarize some of the highlights of the last 12 months. We hope this will be an entertaining way of informing a wide audience about what the SNI does and where our strengths lie.

The year 2021 was the second to be dominated by the coronavirus pandemic. It was also a year in which we benefited hugely from the achievements of science. Working at an unprecedented pace, researchers developed vaccines that allowed us to regain some of our freedoms in 2021. For our students, it was particularly important to be able to return to university and continue with their education as planned. We were therefore delighted to be able to hold the SmallTalk conference with the bachelor students in summer – and to hold a ceremony to present master's degree certificates and prizes to outstanding early career researchers at the end of the year.

After a few delays, normal operation also resumed in the laboratories, allowing us to publish fascinating research findings and enabling our doctoral students to complete their dissertations. At the SNI, the vast majority of this work relates to questions of basic science, through which we develop the basis for potential applications. These are then further explored in collaboration with industry as part of the Nano Argovia program, among others. In this report, you will learn about the innovative approaches taken to addressing a variety of issues. We also provide some examples of how the SNI's Nano Imaging Lab contributes to various projects through its imaging services and how it is expanding its customer base through new technologies and partnerships.

In 2021, the SNI team was once again tasked with organizing the Swiss NanoConvention, which was scheduled to be held in June. Given the uncertainty surrounding the COVID-19 pandemic, we took the decision at the start of the year to hold the conference online. As a result, we were able to enable the attendance of leading international speakers so that they could present and explain their varied research approaches to a wider audience. The virtual conference attracted nanoscientists from around the world and was a huge success.

Although our experiences over recent months have shown that exchanging information online works excellently, networking is nevertheless reliant on face-to-face encounters. I'm therefore delighted that, as we entered the last months of the year, we were once again able to hold a Nano-Tech Apéro and our Annual Event. These meetings are vitally important for the SNI network, as they bring together researchers who don't necessarily work with one another on an everyday basis – thereby paving the way for an interdisciplinary exchange of ideas across institutional boundaries.

Without further ado, I hope you enjoy reading our new-look Annual Report. We would be delighted to hear any feedback or suggestions you may have.

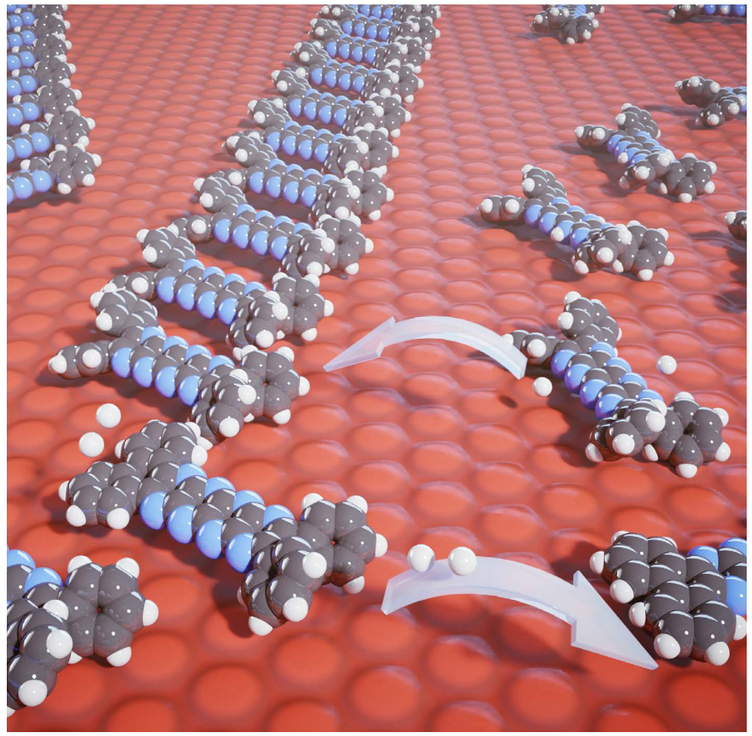
Kind regards,

Professor Christian Schönenberger

2021 in brief

Two prizewinners
In 2021, the two young scientists Charlotte Kress and Anna Leder received the prize for the best master's thesis in nanosciences at the University of Basel. The researchers impressed the selection committee with their theses on the synthesis of a complex organic compound and the characterization of a helper protein using nuclear magnetic resonance (NMR) spectroscopy. Page 13

Medical nanosciences as a specialization
In 2021, the SNI expanded the nanosciences master's degree program by adding a specialization in medical nanosciences. This means that early career researchers can now choose to specialize in physics, chemistry, molecular biology or medical nanosciences. By expanding the course in this way, the SNI has responded to a growing interest in nanomedicine. As before, the degree program remains highly interdisciplinary and continues to provide engaged students with broad, scientific and practice-oriented training. Page 14



Pyrazinacenes are simple, stable compounds that can be reversibly oxidized and reduced.

Innovation workshop for doctoral students
The "From Lab to Startup" innovation workshop for doctoral students from the SNI PhD School was held for the first time in 2021. Under the guidance of the team from the Innovation Office of the University of Basel, the doctoral students prepared professional presentations in which they developed business ideas based on their own research projects. The workshop provided the researchers with a successful introduction to the world of startups. Page 21

Virtual conference as a successful alternative
One highlight of 2021 was the successful Swiss NanoConvention Online (SNC). In what was a challenging year due to the COVID-19 pandemic, this first virtual SNC paved the way for a safe and seamless interdisciplinary exchange of ideas between researchers from academia and industry across national borders. Page 48

In 2021, former SNI PhD student Thomas Karg won the Swiss MNT PhD Award.

New applied research approaches
The SNI's Nano Argovia program celebrated its 15th anniversary in 2021. In this anniversary year, nine new applied research projects were approved and three projects from the previous year were extended. Seven of the industry partners came from the Canton of Aargau, and five were from one of the two Basel half cantons. Two of the interdisciplinary research approaches benefited from the participation of the ANAXAM technology transfer center. Page 34

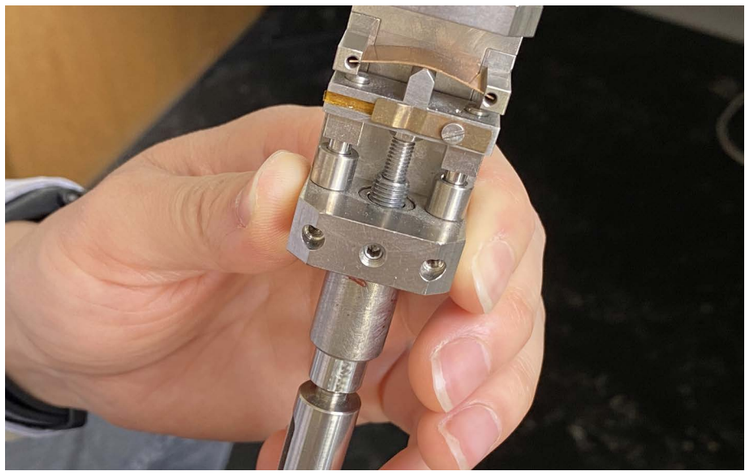
Kagome graphene promises exciting properties
For the first time, physicists from the SNI network have produced a graphene compound consisting of carbon atoms and a small number of nitrogen atoms in a regular grid of hexagons and triangles. This honeycomb-structured "kagome lattice" behaves as a semiconductor and may also have unusual electrical properties. Page 25

Ultra-thin semiconductors connected to superconductor electrically for the first time
Researchers from the SNI network have equipped an atomically thin semiconductor with superconducting contacts for the first time. These extremely thin components with novel electronic and optical properties could pave the way for previously unimagined applications. The hope is that, in combination with superconductors, they will generate new quantum phenomena and have applications in quantum technology. Page 27

Artificial membranes for various applications
Researchers from the SNI network have optimized a method that can be used to produce artificial membranes on a solid substrate and to anchor various biomolecules within them. In this way, it's possible to produce membranes with tailor-made properties and functions that can be used in areas such as biosensor technology or the screening of active substances. Page 27

New class of substances for redox reactions
An interdisciplinary team of researchers from the SNI network has presented a new class of chemical compounds that can be reversibly oxidized and reduced. These compounds, known as pyrazinacenes, are simple, stable compounds made up of a series of nitrogen-containing carbon rings. They are suitable for applications in electrochemistry or synthesis. Page 28

Stretching causes elongation of a graphene layer embedded in a kind of rack, leading to a change in its electrical properties.



Science meets industry

The transfer of academic findings to industry plays an important role at the SNI and is supported by the Nano Argovia program. **More information on page 34.**

As part of the Nano Argovia project NANO-thru-BBB, researchers are developing a new technological platform for designing nanoparticles with the potential to cross the blood–brain barrier. (Image: Perseo Pharma)

Swiss Nanoscience Institute: The interdisciplinary center of excellence for nanosciences in Northwestern Switzerland

The Swiss Nanoscience Institute (SNI) at the University of Basel is a center of excellence for nanosciences and nanotechnology, founded in 2006 on the initiative of the Canton of Aargau and the University of Basel. In the SNI network, interdisciplinary teams of scientists conduct basic and applied research. Moreover, the SNI actively supports knowledge and technology transfer to industrial companies from Northwestern Switzerland through the Nano Argovia program and is a founding member of the ANAXAM technology transfer center.

For companies and research institutions, the SNI's Nano Imaging Lab offers comprehensive imaging and analysis services for all kinds of samples.

The SNI offers not only a bachelor's and master's degree program but also a PhD School, providing interdisciplinary training to early career researchers. Finally, the SNI is also involved in public relations, specifically supporting initiatives aimed at generating interest in the natural sciences among various target groups and promoting collaboration between academia and industry.

22%

22% of the SNI members are women.

12+14+8

In 2021, 12 students successfully completed their bachelor's program, 14 completed the master's program. Eight PhD students successfully defended their PhD theses.

40

In 2021, 40 PhD students were enrolled in the SNI PhD School.

162

162 members belong to the SNI network. (PIs, PhD students, management and Nano Imaging Lab)

52

The SNI supported 52 research projects, 12 in the applied Nano Argovia programm and 40 in the SNI PhD School.

69

In 2021, 43 students werde enrolled on the bachelor's program and 26 on the master's program.

12

Twelve of the 41 PhD students who had completed their PhDs by the end of 2021 work at a federal or research institution.

53

In 2021, SNI members published 53 peer-reviewed papers with SNI participation in renowned science journals.

27

Twenty-seven of the 41 PhD students who had completed their PhDs by the end of 2021 work in industry.

9

There are nine partner institutions in the SNI network. These include the research institutions University of Basel, the School of Life Sciences and the School of Engineering at the University of Applied Sciences and Arts Northwestern Switzerland (FHNW), the Paul Scherrer Institute PSI, the Centre Suisse d'Electronique et de Microtechnique (CSEM) in Muttenz, the Department of Biosystems Science and Engineering at the ETH Zurich in Basel, and the technology transfer center ANAXAM. The network also includes the Hightech Zentrum Aargau and Basel Area Business & Innovation.

9.4 M

In 2021, the SNI had expenditures of approximately CHF 9.4 million (without building costs) of which 6.6 million were covered by the Canton of Aargau and 2.8 by the University of Basel.

>2,800

The SNI social media channels on LinkedIn, Twitter and YouTube have more than 2,800 followers.

Swiss Nanoscience Institute

Basic sciences carried out by PhD students and SNI professors are the foundation of research work at the SNI.

Commitment from the Canton of Aargau
The SNI was founded in 2006 by the Canton of Aargau and the University of Basel to promote research and training in the nanosciences and nanotechnology in Northwestern Switzerland. Nanotechnologies are highly relevant to research and industry in the heavily industrialized Aargau region. The numerous successful SNI research projects, in which researchers from various disciplines and institutions work together, support the Canton of Aargau's high-tech strategy and offer companies from Aargau and the two Basel half cantons access to new scientific findings and technologies. In 2021, the SNI spent approximately 9.4 million Swiss francs, of which 6.6 million were provided by the Canton of Aargau and 2.8 million by the University of Basel.

A diverse, active network
The success of the SNI is based on the interdisciplinary network that has been built up over the years and is constantly attracting new members through new research projects. This network includes the Departments of Chemistry, Physics, Pharmaceutical Sciences and Biomedicine and the Biozentrum at the University of Basel, as well as research groups from the Schools of Life Sciences and Engineering at the University of Applied Sciences Northwestern Switzerland (FHNW) in Muttenz and Windisch, the Paul Scherrer Institute PSI, the Department of Biosystems Science and Engineering at the Federal Institute of Technology (ETH) Zurich in Basel (D-BSSE), the CSEM (Centre Suisse d'Electronique et de Microtechnique) in Muttenz and the ANAXAM technology transfer center. The wider network also includes the Hightech Zentrum Aargau in Brugg and Basel Area Business & Innovation, which works to promote knowledge and technology transfer.

Excellent education for students
The University of Basel has offered bachelor's and master's programs in nanosciences since 2002. At the end of 2021, there were a total of 43 students enrolled on the bachelor's program and 26 early career researchers enrolled on the master's program. Students on the bachelor's program receive a solid grounding in biology, chemistry, physics and mathematics and can choose from a wide range of practical and theoretical courses as they progress through this demanding program. In this way, they are able to focus on specific topics as well as having the opportunity to participate in various research groups and gain insights into applied research projects within industry at an early stage in their education.

A variety of topics at the PhD School
To promote the further training of young scientists and a broad spectrum of basic scientific research, the SNI launched the PhD School in 2012. Within the SNI PhD School, each doctoral student is supervised by two members of the SNI network.

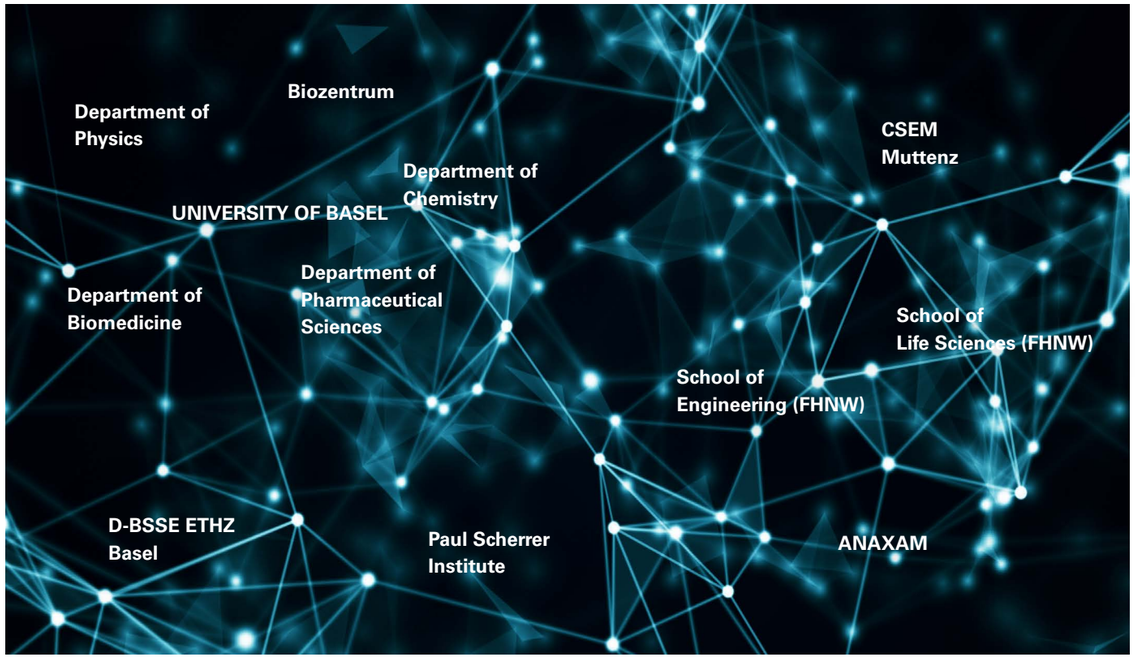
The doctoral students' interdisciplinary education is further enhanced by participation in internal scientific events such as the "Nanoscience in the Snow" Winter School, the Annual Meeting and various courses developed specifically for the PhD School. In 2021, a total of 40 doctoral students were enrolled, eight of whom have completed their doctoral theses. Seven new projects were approved that will start in 2022.

Leaders in their field
Basic sciences are the foundation of research work at the SNI. In addition to the various projects funded as part of the PhD School, the SNI also supports the basic scientific research carried out by the two Argovia Professors Rodrick Lim and Martino Poggio, whose work contributes to the SNI's outstanding international reputation.

In addition to the Argovia professors, the SNI supports three titular professors: Professor Thomas Jung teaches and researches at the Department of Physics at the University of Basel and leads a team at the PSI. Professors Frithjof Nolting and Michel Kenzelmann also lecture at the Department of Physics and head research groups at the PSI.

Strong connections to practical application
The transfer of academic findings to industry plays a critical role at the SNI and is supported by the Nano Argovia program.

In 2021, nine new projects were approved and three projects from 2020 were extended for an additional year. Seven of the partner companies came from the Canton of Aargau, and five were from the two Basel half cantons. Collaboration with industry is also promoted through the new ANAXAM technology transfer center, which provides companies throughout Switzerland with access to state-of-the-art analysis methods.



The interdisciplinary SNI network comprises leading research institutions in Northwestern Switzerland ensuring diverse and exciting nanoscience research. (Image: Shutterstock)

The transfer of academic findings to industry plays a critical role at the SNI and is supported by the Nano Argovia program.

Services in demand
The SNI is also on hand as a provider of various services for partners in academia and industry. At the heart of these services is the Nano Imaging Lab (NI Lab), which has been part of the SNI since 2016. The team at the NI Lab has now grown to six members of staff, who have a wealth of experience in electron and scanning probe microscopy. Thanks to its outstanding equipment and the team's expertise, the NI Lab is able to provide comprehensive imaging services.

In addition, the SNI supports the excellently equipped workshops for technology, electronics and mechanics at the Department of Physics. Research institutions and industrial companies can access both the expert knowledge of the staff and the outstanding technical resources of the SNI and affiliated departments.

Sharing the fascination with others
For the SNI, it is vital to keep the public informed of its activities and to involve them in its fascination with the natural sciences. For example, the SNI team participates in science festivals and exhibitions and provides school classes and groups of interested visitors with insights into everyday laboratory life. In 2021, the SNI further expanded its offering of digital formats in the form of videos. These activities were supplemented by an online magazine, press releases, the website, social media channels and various brochures, all of which provided ample opportunity to report on the outstanding research results and activities of the SNI.

The nanosciences program in Basel: An excellent and demanding course of studies

The University of Basel is the only university in Switzerland that offers not only a master's degree program but a full study including a bachelor's program in nanosciences.

Over the course of this demanding program, students receive a broad grounding in biology, chemistry, physics and mathematics, and can focus on their specific areas of interest through numerous practical courses. At an early stage in their education, the students have the opportunity to participate in various research groups and gain insights into applied research projects within industry.

At the end of 2021, there were a total of 43 students enrolled on the bachelor's program and 26 on the master's program. A total of 12 students successfully completed the bachelor's program, and 14 completed their master's degrees.

In 2021, master's graduates were able to come together for a small event to celebrate the successful completion of their degrees.
(Image: K. Schad)

Excellent master's theses
Two young researchers impressed

In 2021, the SNI presented two young nanoscientists with the prize for the best master's thesis in nanosciences at the University of Basel. Working at the Department of Chemistry, Charlotte Kress synthesized a complex organic compound that could have applications in molecular electronics. At the Biozentrum, Anna Leder characterized a helper protein using nuclear magnetic resonance (NMR) spectroscopy and obtained valuable insights into the folding of the protein.

Report about Anna Leder: https://bit.ly/3LB7OEp
Report about Charlotte Kress: https://bit.ly/34JOB2M
Video: https://youtu.be/HDd-LpAk2CM

Charlotte Kress

"I hope to welcome many more colleagues of Charlotte's caliber to my research group. Aside from her outstanding technical aptitude and unbridled scientific curiosity, what really sets her apart is her boundless enthusiasm and a uniquely cheerful nature that is contagious to everyone around her."
Professor Marcel Mayor
Department of Chemistry,
University of Basel

Anna Leder

"I was utterly astounded by the quality of Anna's work, performed under the challenging conditions imposed by the first COVID-19 lockdown. Her results are outstanding and represent substantial progress for the field as a whole."
Professor Sebastian Hiller
Biozentrum, University of Basel

Medical nanosciences

A new specialization within the master's program

The nanosciences are becoming increasingly significant in the field of medicine – and nanoscience students at the University of Basel are taking notice.

As of fall semester 2021, the specializations available to students on the nanosciences master's program includes not only physics, chemistry and molecular biology but also medical nanosciences. In the fall semester, students can choose from 17 different lecture courses in areas ranging from drug sciences to biomedical engineering. Additional courses will be added in the spring semester.

Nanoscience students can begin preparing for this new specialization during their bachelor's program by enrolling on one of the eight new elective lecture courses on the subject. This allows them to expand their knowledge of pharmaceuticals and pharmaceutical development at an early stage of their studies so that they are prepared for their master's program in this promising new field of research.

Report: https://bit.ly/3uUMLXF

"It's great for the students to learn to present their own research findings at such an early stage of their studies."
Dr. Anja Car
Coordinator of the nanosciences program

SmallTalk

Nanoscience students organize their own conference

Every year, bachelor students from the nanosciences program organize their own small-scale conference, known as "SmallTalk." This event is an opportunity for them to present the results they have obtained as part of the block courses.

The students give a 20-minute talk on a topic of their choice from one of the eight block courses that they complete at the end of the bachelor's program. In addition, they present findings from another of the popular laboratory internships in the form of a poster. Just like at a large-scale conference, the poster session in particular provides an excellent opportunity for scientific discussions with the professors and PIs who led the block courses.

In 2021, the prize for the best talk went to Georg Angehrn. Awards also went to Nevil Goepfert for the best poster and Alexa Dani for the best poster design.

Report: https://bit.ly/3s2rYj7
Video: https://youtu.be/IfrQYaW6nw0

Bachelor students from the nanosciences program organize their own small-scale conference, known as "SmallTalk," and present results they obtained as part of the block courses. (Image: J. Wenner)

In 2021, protective measures meant it was possible to hold "SmallTalk," the conference organized by nanoscience students. (Image: J. Wenner)

SNI PhD School: Specialization and interdisciplinarity combined

Founded in 2012, the SNI PhD School aims to further the training of young scientists. The doctoral students work at various departments and institutions that form part of the SNI network, and they are each supervised by two members of the SNI.

The regular exchange of ideas within the framework of various courses and events ensures that the young researchers not only deal intensively with their special subject area but also gain insights into completely different areas of research.

In 2021, 40 doctoral students were enrolled in the SNI PhD School, eight of whom have successfully completed their dissertations. Seven new projects were approved that will commence in 2022.

Of the 41 SNI doctoral students who have completed their dissertations so far, 66% are employed in industry and 29% continue to pursue an academic career.

Tamara Aderneuer was the first associated doctoral student of the SNI PhD School. She carried out her project at CSEM Muttenz.

Micro-optics for better lighting

For her doctoral dissertation, Dr. Tamara Aderneuer studied optical microstructures that can be used for modern lighting systems. Her work focused on the design and characterization of free-form microstructures that pave the way for numerous improvements in lighting applications and are therefore of particular interest to both research and industry.

For this, Tamara used computer-aided design (CAD) tools to improve and analyze free-form micro-optical arrays (FMOAs) with a view to identifying and adapting critical sections at an early stage and thereby shortening production cycles. Tamara developed CAD tools to modify 3D models so that they are compatible with the production processes. She used a new approach that enables optical functionality to be linked to surface topology. The generated 3D CAD model paves the way for analysis using optical simulation software programs.

Publication: https://bit.ly/3AlnTsH

For his doctoral dissertation, Luc Driencourt worked at CSEM Muttenz. He is now employed in research and development at Axetris.

Sustainable production of hydrogen

Dr. Luc Driencourt's doctoral dissertation focused on the production of hydrogen using solar energy. For this, Luc deployed electrodes that, when immersed in water, can not only catalyze the decomposition of the water molecule but also harvest light, thereby providing the necessary electrical current. He used inexpensive metal oxide semiconductors as light absorbers. To achieve the required performance, however, these semiconductors must be modified with optical effects such as nanostructuring.

In his work, Luc developed a theoretical method that simulates the performance enhancement due to optical effects and therefore allows the development of strategies to determine the optimum parameters. He found that transparent nanoparticles such as titanium dioxide on the surface of the active material are ideally suited to achieving higher efficiencies in the production of hydrogen and therefore to reducing costs.

Publication: https://bit.ly/3u1yojw

For his doctoral dissertation, Stefano Di Leone worked at the Department of Chemistry at the University of Basel. He is now employed as an automation chemist at Chemspeed Technologies.

Artificial bioactive surface

For his doctoral dissertation, Dr. Stefano Di Leone produced artificial hybrid membranes on solid supports by combining different block copolymers with phospholipids and biomolecules. This combination of polymers and lipids enhances the fluidity of the membrane. By anchoring catalytic biomolecules in place, he developed a bioactive platform that is suitable for various applications, including in biosensors or for the screening of medicines.

In a second part of the project, Stefano applied a straightforward and versatile solvent-based method for the preparation of hybrid membranes. Characterization of the membrane morphology revealed that the components can form a patterned membrane that mimics natural membranes.

Publication: https://bit.ly/3ltvbNX

Lukas Gubser completed his doctoral dissertation at the Department of Physics of the University of Basel and is now working as a quantitative analyst in electricity trading at Industrielle Werke Basel (IWB).

Detection of photons by double quantum dots

For his doctoral dissertation, Dr. Lukas Gubser studied phonons – mechanical waves that travel through solids. In the future, the control and manipulation of phonon transport at the quantum level could provide a way of controlling heat flow in electronic components. The first step toward this is the controlled generation and detection of phonons.

As part of his work, Lukas has now investigated whether phonons can be detected using double quantum dots (DQDs). He did so by precisely contacting a DQD component in a nanowire, which could be used to detect acoustic phonons over a wide range of energies. In the tested configuration, Lukas was able to transform the absorption of phonons into a measurable current, thereby demonstrating the feasibility of a phonon detector based on DQDs.

The development of a phonon detector as part of this work represents a step toward the realization of a phonon spectrometer and therefore the possibility of controlling heat transport in the future.

Noah Ritzmann wrote his dissertation at the Department of Biosystems Science and Engineering of ETH Zurich in Basel.

Membrane proteins for artificial cells

For his doctoral dissertation, Dr. Noah Ritzmann produced artificial cells as part of work focusing on the analysis of membrane proteins. These proteins play a vital role in cell function, but their integration into the membrane is a complex and challenging process. With the help of single-molecule force spectroscopy, a technique based on atomic force microscopy, Noah studied the folding and integration of proteins into the membrane using several examples. This involved individually unfolding and extracting proteins in order to identify structural segments that stabilize the protein in question.

Noah also produced new membrane proteins and succeeded in controlling their orientation during integration into the membrane, thereby achieving better control of the production of artificial cells. Initially, he produced simple artificial cells that contained the protein constructs for energy production. He completed his investigations by integrating proton pumps into separate cell compartments (artificial organelles). The resulting artificial cells produced a simplified cytoskeleton when activated by an external light source.

The project demonstrates new ways of producing complex systems and represents an important contribution to the development of artificial cells.

Publication: https://bit.ly/35cveiP

Deepika Sharma carried out research for her doctoral dissertation at the Biozentrum at the University of Basel and at the Paul Scherrer Institute. She now works as an R&D project manager at Schneider Electric in Switzerland.

Trapping single nanoparticles using nanofluidics

For her doctoral dissertation, Dr. Deepika Sharma developed a simple, effective nanofluidic device that can be used to trap charged nanoparticles in an aqueous environment. The system is based on electrostatic traps formed by the selective modification of surfaces in nanostructures. Both positively and negatively charged nanoparticles can be trapped at a high throughput rate and subsequently investigated in relation to different aspects of the particles. This work paves the way for a broader application of geometry-induced electrostatic trapping devices in numerous fields, such as biosensing, disease diagnosis, molecular analysis and fluid quality control.

In addition, Deepika has presented a novel lab-on-a-chip (LoC) platform that allows the preconcentration of substances by trapping nanoparticles at physiological concentrations. The Paul Scherrer Institute has filed a patent application for this principle, as it allows the development of LoC platforms that detect multiple diseases on a single chip.

Publication: https://go.nature.com/3KxVxQq

Shabnam Tarvirdipour completed her doctoral dissertation at the Department of Chemistry at the University of Basel and the Department of Biosystems Science and Engineering at ETH Zurich in Basel. She is now carrying out postdoctoral research at the Department of Chemistry at the University of Basel.

Peptidic transport system for gene therapy

For her doctoral dissertation, Dr. Shabnam Tarvirdipour developed robust non-viral gene vectors that deliver DNA into cells. The system is based on self-assembling peptides that form nanoscale structures with multiple compartments – and these peptide-based carriers can be used to package DNA of up to 100 nucleotides. With the help of a nuclear localization signal that is integrated into the peptide, the peptide assemblies ferry their DNA cargo into the nucleus of specific target cells, where it delivers its therapeutic effects.

Shabnam has carried out a detailed characterization of the physico-chemical properties of the peptidic nanostructures, providing valuable insights for future biomedical applications.

Together with her team, she has successfully established a non-toxic, purely peptidic delivery system that can serve as a cornerstone for the development of gene therapy applications.

Publication: https://bit.ly/33Pjy4N

For a conference paper, Pooja Thakkar won the Shoulders-Gray-Spindt Award, created in honor of the founders of vacuum nanoelectronics with a view to promoting early career researchers.

Component for better resolution

With her doctoral dissertation, Dr. Pooja Thakkar has contributed to the further development of transmission electron microscopes (TEMs).

In an electron microscope, electron lenses perform the task of producing a high magnification image. These lenses are not ideal. They lead to phase errors in the electron wavefront. The phase errors are corrected in Pooja's work by adjustable phase filters. For these components, she used state-of-the-art nanofabrication methods such as electron beam lithography and reactive ion etching. The fabrication process she developed is scalable for the fabrication of an array of such components in a three- and five-layer structural geometry.

These components show great potential for improving the TEM image contrast of transparent objects with no loss of high-resolution information. They can also improve the reconstruction of molecular structures of unknown biological samples.

The application also includes the further development of high-throughput lithography systems.

Publication: https://bit.ly/3tLIswZ

"The SNI PhD program prepared me for the fast-paced and innovative world of industry."
Dr. Deepika Sharma,
former SNI PhD student and now an R&D project manager at Schneider Electric

"The SNI events gave me the opportunity to build up a network of researchers from various disciplines, which has helped me to get an idea of the relationships between the different subject areas."
Dr. Stefano di Leone,
former SNI doctoral student and now an automation chemist at Chemspeed Technologies

We were able to scientifically communicate with a wider audience. For me, the most appealing and engaging part of the SNI PhD program is the annual meeting in the beautiful Lenzerheide region. In this 2-days event, you become aware of the recent scientific topics along with the chance of attending a workshop or participating in variuos group activities which in turn nourish my mind, increase my motivation and shed some light on my abilities and creativities."
Dr. Shabnam Tarvirdipour,
former SNI doctoral student and now postdoctoral researchers at the Department of Chemistry, University of Basel

Excellent
Prizes for SNI doctoral students

Swiss MNT PhD Award
At the Swiss NanoConvention Online 2021, former SNI PhD student Dr. Thomas Karg was presented with the Swiss MNT PhD Award – which was sponsored by IBM Research – for his outstanding publication entitled "Light-mediated strong coupling between a mechanical oscillator and atomic spins 1 meter apart."

Thomas was first author of the award-winning publication. Together with his colleagues, he observed strong coupling between a nanomechanical oscillator and an atomic spin ensemble for the first time. The researchers pursued an innovative approach that uses light to couple the two systems over a macroscopic distance.

One of the three poster prizes at the SNC 2021 was also won by a SNI doctoral student. Mehdi Ramezani convinced the participants with his contribution.

Report: https://bit.ly/3BsMsEt

SGS award
Dr. Pooja Thakkar, who completed her doctoral dissertation at the SNI PhD School in 2021, won the Shoulders-Gray-Spindt (SGS) award at the 34th Vacuum Nanoelectronics Conference for the publication "Voltage-controlled three-electron-beam interference by a three-element Boersch phase shifter with top and bottom shielding electrodes."

With this work, Pooja contributes to the goal of manipulating electron waves to improve the imaging of electron lenses in an electron microscope.

Funded by the SNI, the project is a collaboration between the Paul Scherrer Institute and Forschungszentrum Jülich. The award was created in honor of the founders of vacuum nanoelectronics with a view to promoting early career researchers.

Report: https://bit.ly/3BsMsEt

In 2021, former SNI PhD student Thomas Karg won the Swiss MNT PhD Award.

The SNI doctoral student Mehdi Ramezani won a poster award at SNC 2021.

Former SNI doctoral student Pooja Thakkar won the Shoulders-Gray-Spindt award.

SNI Innovation Workshop
From Lab to Startup

Although doctoral dissertations at the SNI largely revolve around questions of basic science, potential applications are sometimes just around the corner. Topics such as innovation and founding a startup are therefore of great interest to doctoral students.

The "Innovation Workshop: From Lab to Startup" was held for the first time in 2021 in collaboration with the Innovation Office of the University of Basel and provided SNI doctoral students with an opportunity not only to develop ideas for a startup of their own with the support of the Innovation Office, but also to have these ideas evaluated. Three of the ideas were subsequently awarded a prize.

This friendly competition was won by the team led by Thomas Mortelmans along with teammates Antonia Ruffo, Tamara Aderneuer and Shichao Jia. The young researchers presented an imaginary startup that offered a noninvasive method for measuring the temperature inside fuel cells.

The jury also awarded prizes to the presentations by Jann Ungerer and Shabnam Tarvirdipour, whose business ideas centered around the development of electronics for quantum computers and intelligent nanoparticles for gene therapy.

Report: https://bit.ly/3rC41h5
Video: https://youtu.be/DdrpZ_2v7sk

"It was a very valuable experience. Normally we're so immersed in scientific questions that we generally don't give any thought to how our results could be translated into a product."
Thomas Mortelmans, SNI doctoral student and "CEO" of the winning startup

"From the first day onward, the participants showed a great deal of entrepreneurial spirit and were eager to develop their scientific discoveries into workable business ideas. It was a pleasure to work with the doctoral students over the course of the two-day workshop!"
Leonie Kellner, Entrepreneurship Program Manager at the Innovation Office, University of Basel

At the Innovation Workshop, Thomas Mortelmans presented a business idea based on Antonia Ruffo's doctoral thesis. The team won the first prize of the friendly competition.

Ultrathin semiconductors electrically connected to superconductors for the first time

Basic scientific research such as this can result in unexpected applications. (Image: M. Ramezanai, SNI, University of Basel)

Page 27

Research findings: A broad range of topics

Basic research is one of the cornerstones of the SNI's work, and the resulting findings provide the foundation for applied lines of research.

Members of the SNI network cover a wide range of research topics. For example, some of the research groups associated with the SNI are studying new two-dimensional materials that may lead to innovations in various fields. Others focus their research on coupling various quantum systems or on polymers that can be used as containers for medications. The many objects of research also include natural nanomachines that are responsible for transport processes or conversions in the human body, for example.

The COVID-19 pandemic imposed considerable restrictions on research work in 2021. When it comes to research in the area of the nanosciences, it's essential for researchers to work on-site in the laboratory, which wasn't always possible in 2021.

Over the course of 2021, researchers from the SNI network published 53 peer-reviewed papers in leading scientific journals. Here, we look at a series of examples that reflect the diversity of research taking place within the SNI network.

Stretching changes the electronic properties of graphene

The electronic properties of graphene can be specifically modified by stretching the material evenly, as researchers from the SNI network report in the journal *Communication Physics*. These findings open the door to the development of new types of electronic components.

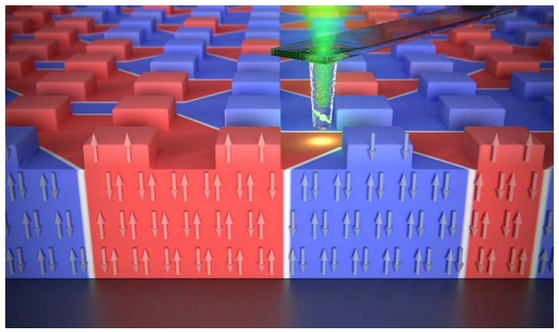
Press release: https://bit.ly/36C9SvX
Video: https://youtu.be/BGF4f9KPPcA

A force from below causes the component to bend, elongating the embedded graphene layer and changing its electronic properties. (Image: Swiss Nanoscience Institute, University of Basel)

Concept for a new storage medium

Physicists from the SNI network, Germany and Ukraine have proposed an innovative new data storage medium. The technique is based on specific properties of antiferromagnetic materials that had previously resisted experimental examination.

Press release: https://bit.ly/3BOmsU8
Video: https://youtu.be/H8mP-wQo5bs

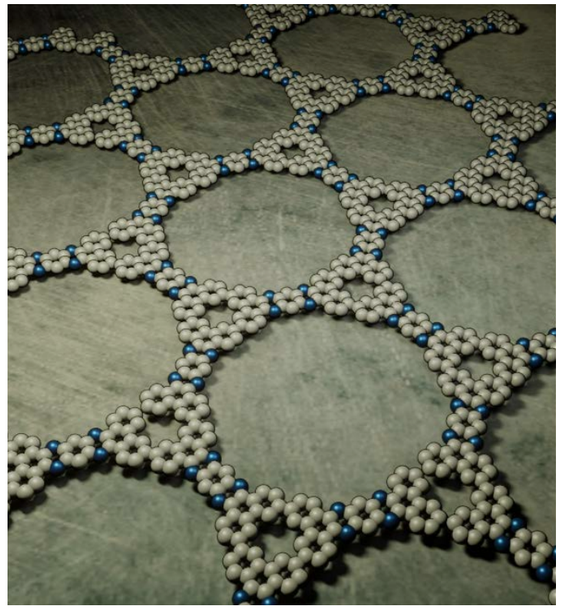


Regions with different orientations of antiferromagnetic ordering (blue and red areas) have been created in an antiferromagnetic single crystal. These regions are separated by a domain wall, and their course can be controlled by structuring the surface. This work forms the basis for a new storage medium concept. (Image: Department of Physics, University of Basel)

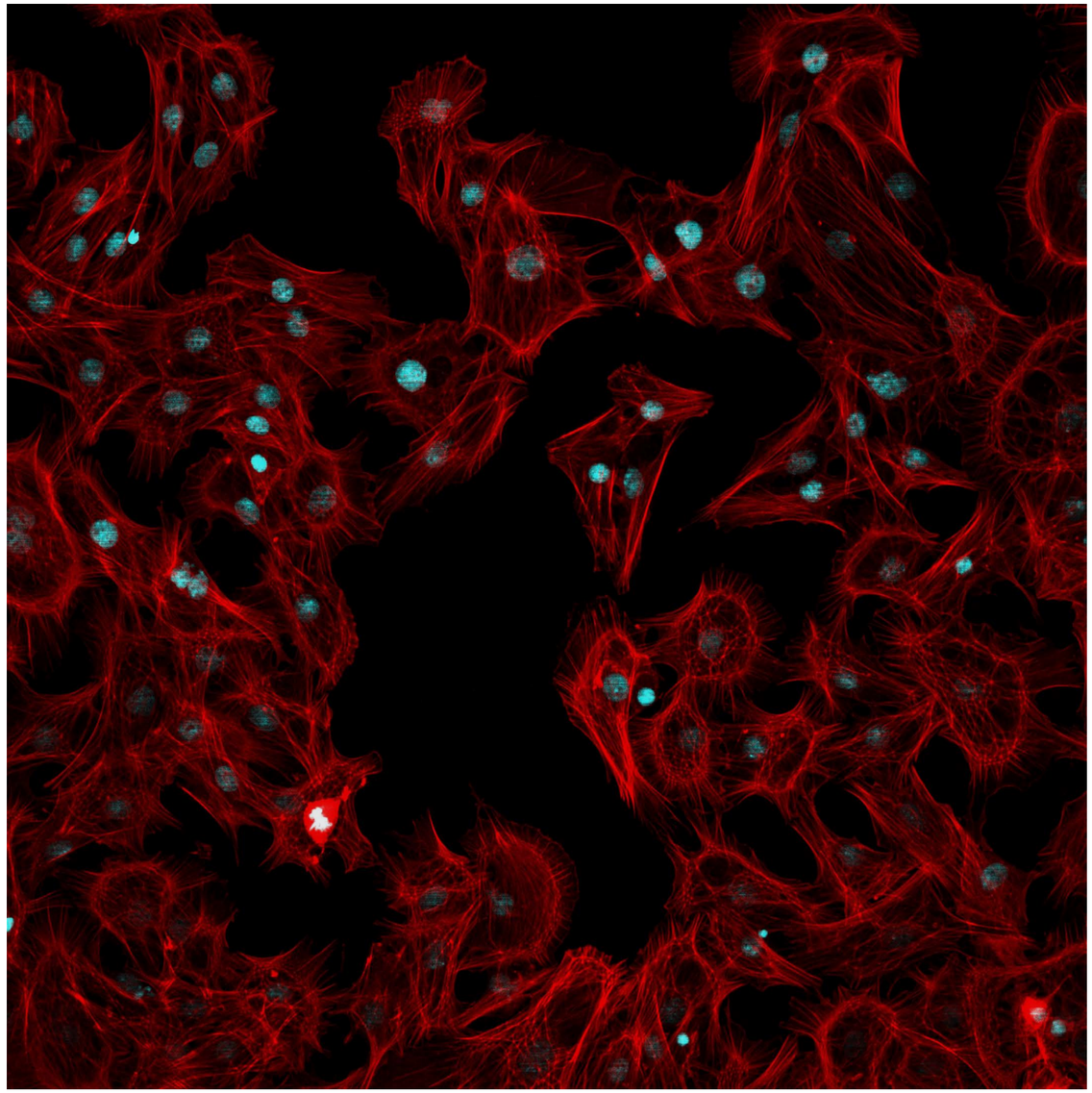
Kagome graphene promises exciting properties

For the first time, physicists from the University of Basel have produced a graphene compound consisting of carbon atoms and a small number of nitrogen atoms in a regular grid of hexagons and triangles. This honeycomb-structured "kagome lattice" behaves as a semiconductor and may also have unusual electrical properties. In the future, it could potentially be used in electronic sensors or quantum computers.

Press release: https://bit.ly/3vdLET5
Video: https://youtu.be/q0gxLKR379s



Kagome graphene is characterized by a regular lattice of hexagons and triangles. It behaves as a semiconductor and may also have unusual electrical properties. (Image: R. Pawlak, Department of Physics, University of Basel)



Electrically conductive nanomaterials in 3D-printable tissue

As part of a project at the SNI PhD School, researchers from the University of Applied Sciences and Arts Northwestern Switzerland (FHNW) and the University of Basel have summarized advances in the field of tissue engineering with nanocomposites. Writing in the journal *Advanced NanoBioMed Research*, they describe how conductive nanocomposites are currently used for the production of printable electrophysiological tissues.

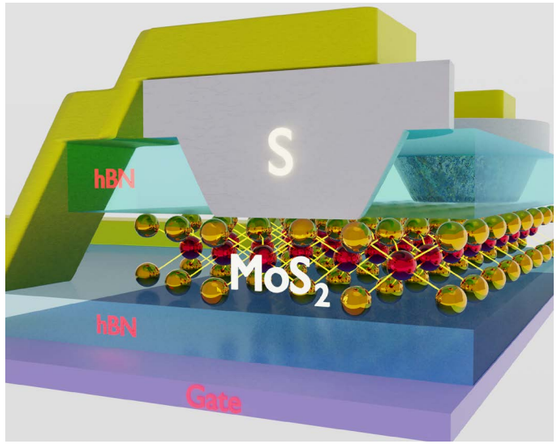
Original article: https://bit.ly/33UUSl6

In his doctoral dissertation, Fabian Züger is investigating how conductive nanocomposites can be used for the 3D biofabrication of functional heart tissue. The image shows heart cells (red) and their nuclei (turquoise). (Image: F. Züger, FHNW and University of Basel)

Ultrathin semiconductors electrically connected to superconductors for the first time

For the first time, researchers from the SNI network have equipped an ultrathin semiconductor with superconducting contacts. These extremely thin materials with novel electronic and optical properties could pave the way for previously unimagined applications. Combined with superconductors, they are expected to give rise to new quantum phenomena and find use in quantum technology.

Press release: https://bit.ly/3pe8eXE
Video: https://youtu.be/CsjOtEsh7qA



The monolayer of molybdenum disulfide (MoS_2) is sandwiched between two protective layers of boron nitride (hBN), with molybdenum-rhenium contacts of the superconductor (S) extending through the upper layer. A layer of graphene (gate) is used for electrical control. (Image: Mehdi Ramezani, Swiss Nanoscience Institute, University of Basel)

Artificial membranes for various applications

Researchers from the University of Basel have optimized a method that can be used to produce artificial membranes on a solid substrate. They have also anchored various biomolecules (enzymes and DNA fragments) within this membrane so that it acquires catalytic properties or is able to interact with biomolecules. The described method allows the production of artificial membranes with tailor-made properties and functions that can be used in areas such as biosensing or the screening of active substances. The researchers have published their findings in the journal *Biomacromolecules*.

Original article: https://bit.ly/3ltvbNX

Capture of individual nanoparticles thanks to nanofluidics

As part of a doctoral dissertation at the SNI PhD School, researchers from the University of Basel and the Paul Scherrer Institute have developed a new method for producing electrostatic traps for nanoparticles within a few hours. To this end, the scientists used polydimethylsiloxane as a material for a surface-modified, geometry-induced electrostatic trapping device.

The paper was published in the journal *Microsystems & Nanoengineering* and paves the way for the broader use of this type of electrostatic trap in the areas of biosensing, disease diagnosis, molecular analysis, fluid quality control and pathogen detection.

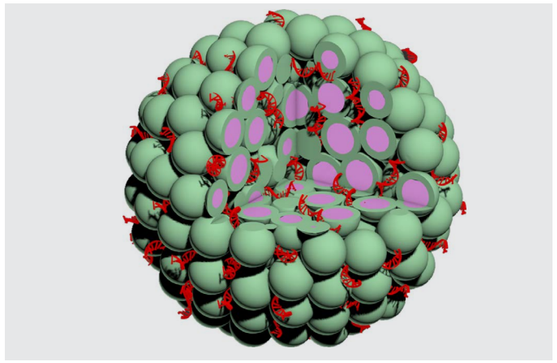
Original article: https://go.nature.com/3KxVxQq

Nanoparticles are trapped in a nano- and microstructure embedded in nanochannels. The depth of the nano/microindentations is 80 nm, and the channel height is 160 nm. (Image: D. Sharma, PSI and University of Basel)

Promising platforms for gene therapy

In a review article, researchers from the University of Basel and ETH Zurich have summarized the latest advances in delivery systems for nucleic acids, in which peptides play a decisive role. Peptide vectors can transport genetic material safely and efficiently and therefore offer considerable potential for the treatment of rare hereditary diseases, neurological disorders, cardiac diseases and cancer. In addition, the researchers addressed the question of how peptide-based nanosystems can overcome cellular barriers and deliver their nucleic acid payloads in a controlled fashion at specific sites.

Original article: https://bit.ly/33Pjy4N

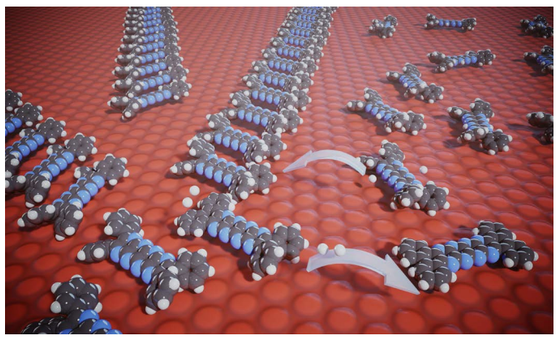


DNA fragments from up to 100 nucleotides can be transported using the new peptide-based transport system. (Image: S. Tarvirdipour, Department of Chemistry, University of Basel, and Department of Biosystems Science and Engineering, ETH Zurich in Basel)

New class of substances for redox reactions

An interdisciplinary research team has presented a new class of chemical compounds that can be reversibly oxidized and reduced. The compounds, known as "pyrazinacenes" are simple, stable compounds that consist of a series of connected nitrogen-containing carbon rings. They are suitable for applications in electrochemistry or synthesis, as the researchers report in the journal *Communications Chemistry*.

Press release: https://bit.ly/3HhgYCs
Video: https://youtu.be/FmhJgpogfi4

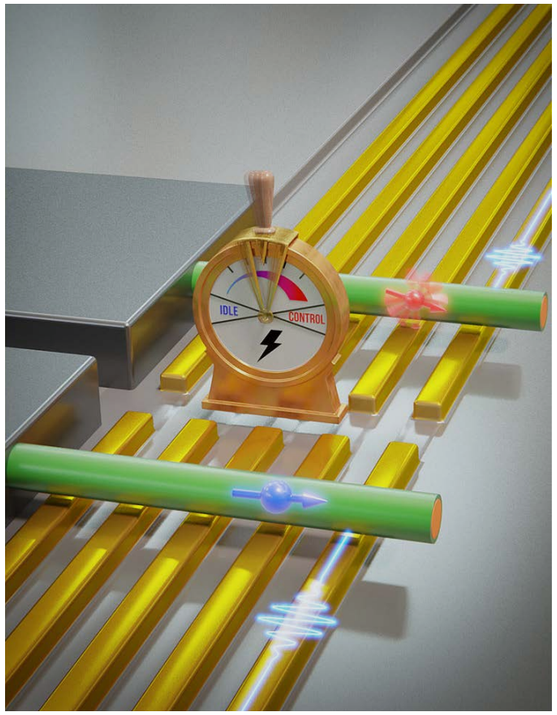


Following synthesis, the pyrazinacenes are present in the reduced form. After a first oxidation step, they form chains. In a second oxidation, they are isolated again but are now completely planar. (Image: Department of Physics, University of Basel)

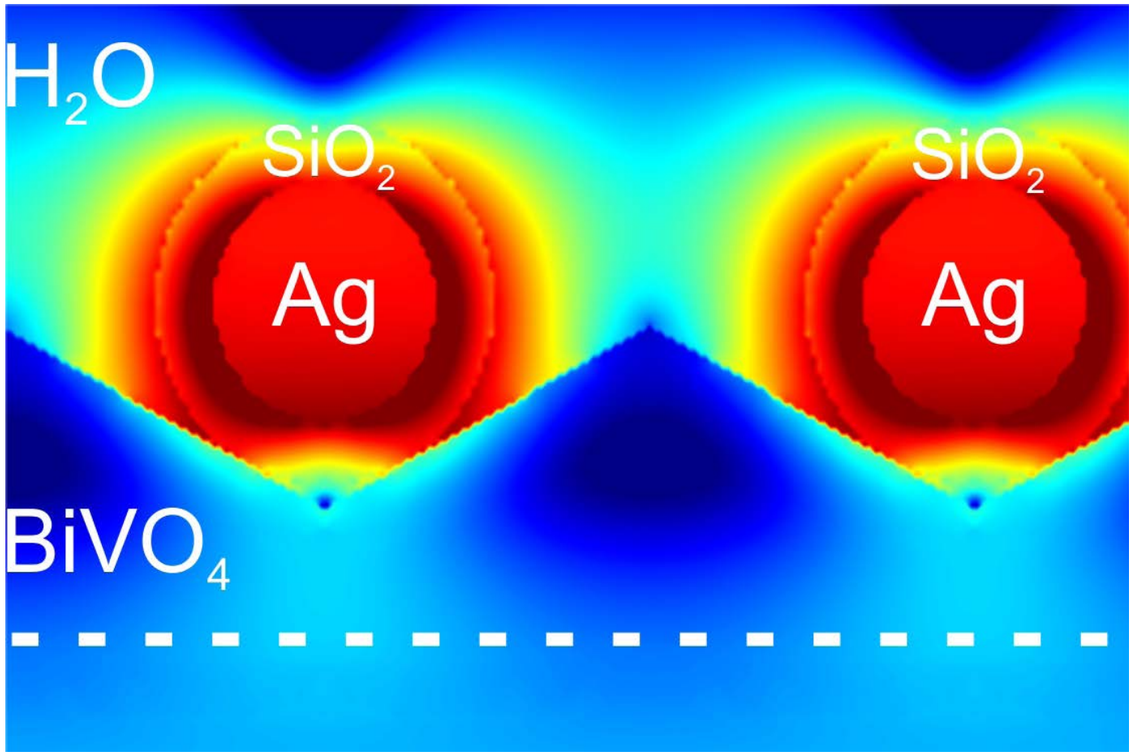
Electrically switchable qubit can tune between storage and fast calculation modes

To perform calculations, quantum computers need qubits to act as elementary building blocks that process and store information. Now, physicists from the SNI network have produced a new type of qubit that can be switched from a stable idle mode to a fast calculation mode. The concept would also allow a large number of qubits to be combined into a powerful quantum computer, as researchers from the University of Basel and TU Eindhoven report in the journal *Nature Nanotechnology*.

Press release: https://bit.ly/3M0RahU



Electrically switchable qubit: A nanowire made of germanium and silicon (blue/green) lies on electrodes known as gates (gold). Voltages applied to the gates lead to the formation of individual spin qubits (blue and red arrows) that can be manipulated by microwave signals (blue pulse). In one mode, the qubit is slow and the quantum information is more stable (blue spin). In the other, the qubit can be changed more quickly (red spin). (Image: University of Basel, Department of Physics)

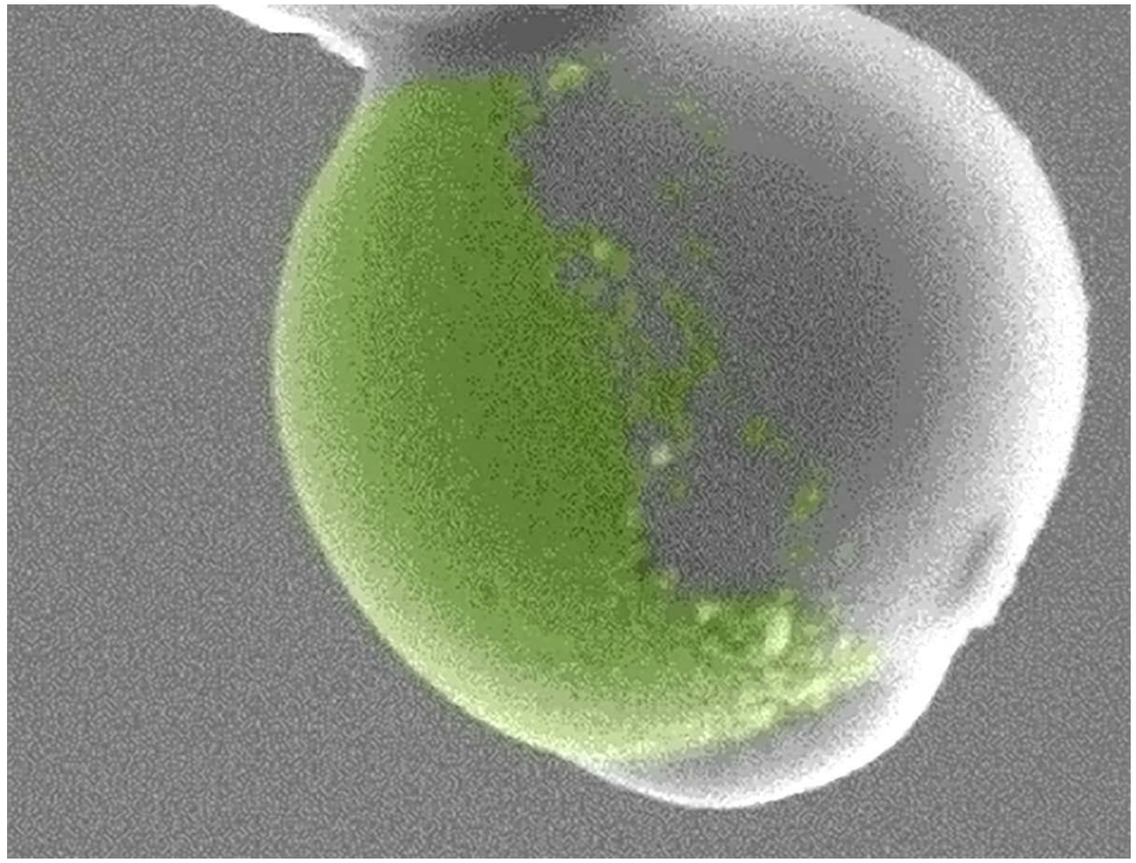


On the way to sustainable hydrogen

Researchers from the SNI network have developed a theoretical method to analyze and optimize water splitting by exploiting optical effects. The work was published in the *Journal of Physical Chemistry C* by scientists from the University of Basel and CSEM Muttenz and will help to advance sustainable hydrogen production without CO_2 emissions.

Original article: https://bit.ly/3FRKkqq

Theoretical calculations were used to calculate the light intensity distribution during the splitting of water. The researchers used a photoelectrode made of bismuth vanadate ($BiVO_4$) that was structured with silver nanoparticles on its surface. These silver nanoparticles help to concentrate more light in the photoelectrode (light-blue areas) and are surrounded with a silica shell to protect the silver from corrosion in water. (Image: L. Driencourt, CSEM Muttenz and Swiss Nanoscience Institute, University of Basel)



Janus particles consist of a silica sphere with a hemispherical cap of magnetic material (green). (Image: Department of Physics, University of Basel)

Analysis of individual curved magnets

Highly sensitive dynamic cantilever magnetometry is suitable for measuring the magnetic characteristics of specific magnetic particles known as Janus particles.

Janus particles consist of hemispherical caps of magnetic material deposited on micrometer-scale silica spheres. The two sides of the Janus particles have different physical or chemical properties. These particles have various potential applications – for example, as stirrers in lab-on-a-chip devices, as transporters for biological cargo, or as biosensors.

Writing in the journal *Applied Physics Letters*, researchers from the University of Basel and the University of Kassel (Germany) describe how the magnetic moment of ferromagnetic Janus particles disappears quickly when an applied magnetic field is removed. By including an additional antiferromagnetic layer, however, the scientists are able to turn magnetic Janus particles into a robust remanent magnet. This appears to pave the way for the mass-production of useful magnetic Janus particles on the nano- and micrometer scale.

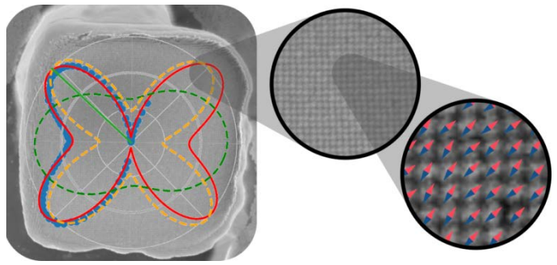
Original article: https://bit.ly/3nXoc86

Magnetization analyzed

In collaboration with an international team of researchers, physicists from the University of Basel have used highly sensitive dynamic cantilever magnetometry to analyze magnetic forces in mesocrystals for the first time. These mesocrystals are made up of magnetic nanoparticles that, under optimum conditions, align themselves into crystalline structures that can measure several micrometers across.

Writing in the journal *Physical Review B*, the researchers describe how they can study the magnetism of both the higher-order crystal structure and the tiny nanoparticles by placing individual mesocrystals on a cantilever and exposing this cantilever to a magnetic field. The measurements revealed that the magnetization of the mesocrystals exhibits cubic anisotropy and depends on the shape of the mesocrystals. Even the individual nanoparticles are tiny cubic crystals that align themselves within the higher-order lattice.

Original article: https://bit.ly/3FYY82y



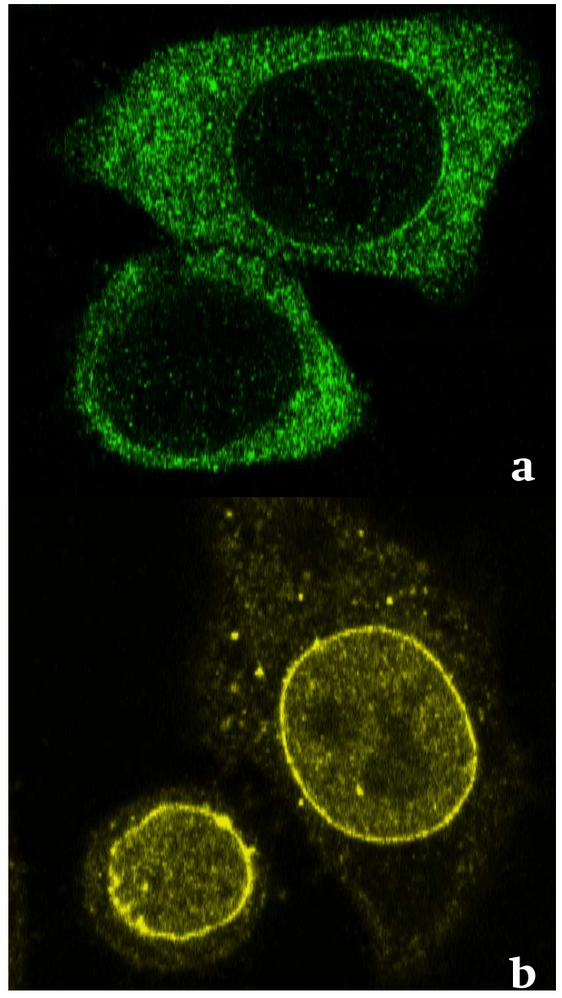
The magnetization of the mesocrystals (image captured using a scanning electron microscope) exhibits anisotropy. (Image: Department of Physics, University of Basel)

Regulation of an asymmetric distribution

Nuclear pore complexes play an elementary role in the transport of macromolecules between the nucleus and the surrounding cytoplasm. This process of nucleocytoplasmic transport (NCT) involves various soluble factors that circulate through the nuclear pore complexes, regulate cargo delivery and maintain differences in macromolecule concentration between the nucleus and cytoplasm.

In a review article, researchers from the Biozentrum and the Swiss Nanoscience Institute of the University of Basel describe the different levels of control during nucleocytoplasmic transport. The team led by Argovia Professor Roderick Lim also compared unsolved features with known aspects of the function of the nuclear pore complex and discussed how the various components work together to establish the asymmetry of nucleocytoplasmic transport.

Original article: https://bit.ly/3lxRhi6



Immunofluorescence reveals that certain soluble receptor proteins are mainly found in the cytoplasm (a), while others are primarily detected in the nucleus (b). (Image: Biozentrum, University of Basel)

New lenses for X-ray investigations

**Researchers working on the Nano Argovia project ACHROMATIX are developing a novel lens system for scientific investigations with X-rays.
(Image: Paul Scherrer Institute PSI)**
Page 35

Within the framework of the SNI's Nano Argovia program, interdisciplinary teams of researchers investigate applied research topics. Each project involves at least one partner from industry.

Nano Argovia program: Working with companies from the region

Since it was founded, the SNI has devoted great importance to the promotion of technology and knowledge transfer to industry. The Nano Argovia program, in which applied research projects are supported on an annual basis, therefore represents another important component of the SNI's activities. In 2021, the SNI funded nine new Nano Argovia projects and extended three projects from the previous year.

In collaboration with industrial companies from Northwestern Switzerland, researchers from the network have worked on a wide range of topics, including everything from medical applications to the improvement of analytical methods or technical equipment.

The industrial partners include not only established companies from the region but also young startups that were founded only a short time ago. Seven of the partner companies came from the Canton of Aargau, and five were from one of the two Basel half cantons. In 2021, the ANAXAM technology transfer center, of which the SNI is a founding member, has participated in two projects as part of the Nano Argovia program.

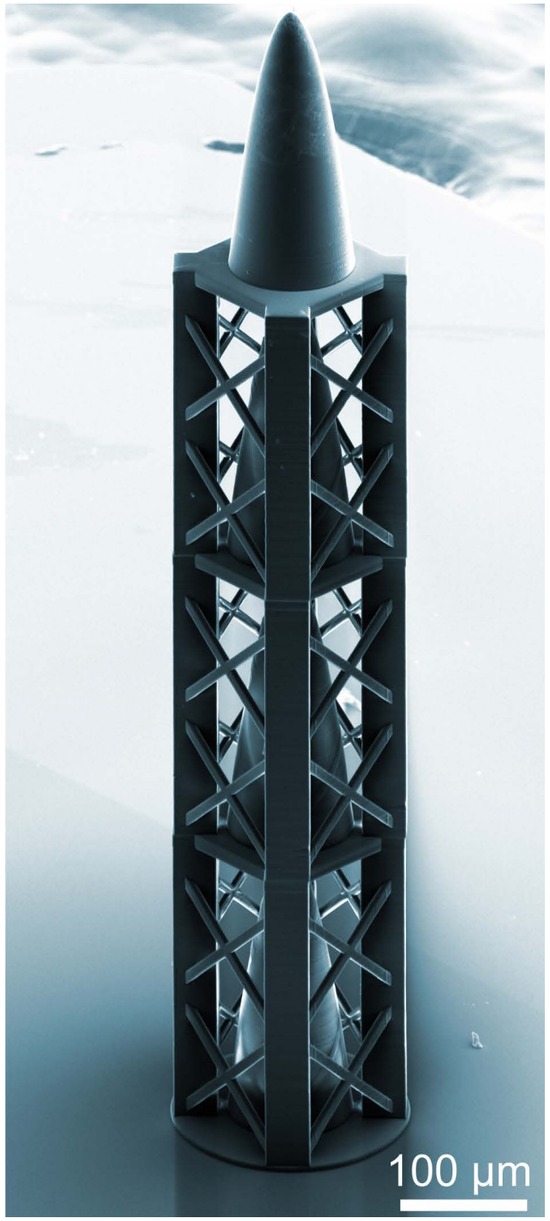
Nano Argovia program: www.nano-argovia.swiss

New lenses for X-ray investigations

In the Nano-Argovia project ACHROMATIX, an interdisciplinary team is developing a novel lens system that can be used for scientific investigations with X-rays. The researchers use state-of-the-art nanofabrication techniques to produce, characterize and test a combination of different X-ray lenses. The new optical device is intended to overcome chromatic aberration, which is a key limitation in applications involving a single lens. It will subsequently be used to improve laboratory transmission X-ray microscopy in biomedical investigations.

Cooperation with: XRnanotech // Paul Scherrer Institute // Biomedical Science Center University of Basel

Project description: https://bit.ly/33PQmLc



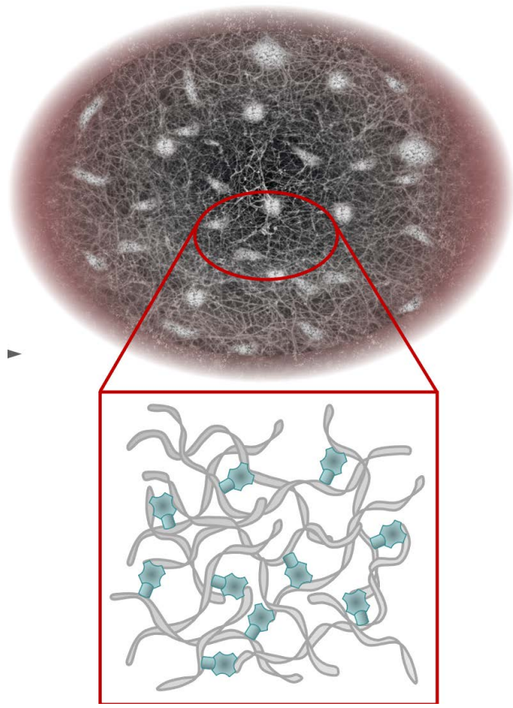
The ACHROMATIX X-ray lenses investigated in the project have two parts, one of which is this 3D-printed refractive lens. In turn, the lens consists of four paraboloids supported by square pillars. (Image: J. Vila Comamala, Paul Scherrer Institute PSI)

Therapy against ulcers in the oral mucosa

In the Nano Argovia project Hydrogel Patch, researchers are developing a plaster for use on nonspecific ulcers in the oral mucosa. Designed to initially cover the affected areas, the patch is also suitable for releasing therapeutic agents. It consists of a self-assembling synthetic peptide hydrogel that adheres to soft, moist tissue and is produced without ingredients of animal origin. The researchers tested various methods and substances that cross-link and therefore stabilize the hydrogel. They also investigated the biocompatibility and integration of nanocapsules that release active substances.

Cooperation with: credentis // FHNW School of Life Sciences // University Center for Dental Medicine Basel (UZB)

Project description: https://bit.ly/3KVUf26

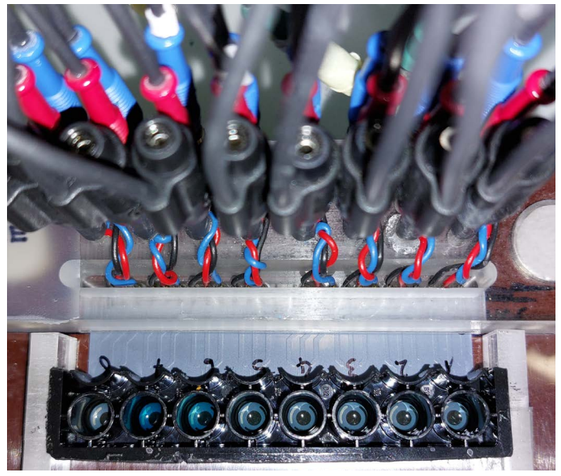


As well as cross-linking and thereby stabilizing the hydrogel, the researchers analyzed the biocompatibility and integration of nanocapsules that release active substances. (Image: L. Kind, FHNW)

Nanocomposite electrodes for clinical diagnostics
Researchers in the Nano Argovia project PEPS are developing a novel diagnostic device for specific biomarkers that is suitable for "near-patient laboratory diagnostics." To this end, they are equipping a digital point-of-care (POC) device with an electrochemical sensor for specific protein biomarkers. These biomarkers provide indications of various diseases, such as pre-eclampsia – a complication of pregnancy also known as toxemia. For their approach, the researchers used conductive, nanocomposite electrodes made from a mixture of carbon nanotubes and a hydrophilic polymer that can be manufactured inexpensively. Thanks to this combination, the electrodes have high conductivity as well as repellent properties that effectively protect against contamination of the sensor surface.

Cooperation with: MOMM Diagnostics // CSEM Muttenz // FHNW School of Life Sciences

Project description: https://bit.ly/3GhsP37



The team behind the Nano Argovia project PEPS is developing a novel diagnostic device that can quickly and reliably detect pre-eclampsia, also known as toxemia of pregnancy. (Image: M. Zinggeler, CSEM Muttenz)

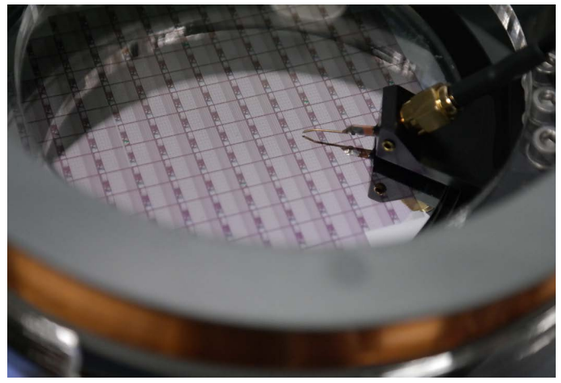
"The PEPS nanocomposite electrodes blend high electrical conductivity with superior antifouling properties. This combination could be the key to producing highly sensitive electrochemical POC tests."
Dr. Mathias Wipf, founder and CEO of MOMM Diagnostics, who holds a master's degree in nanosciences from the University of Basel

"At the Biozentrum, we're investing in cryo-electron microscopy. The Nano Argovia project is an excellent starting point for an effective and long-standing collaboration with DECTRIS."
Professor Timm Maier, Biozentrum, University of Basel

Nanoscale, industrially manufactured magnetic field sensor
In the Nano Argovia project Nanocompass, researchers are developing a novel nanoscale magnetic field sensor that can be manufactured industrially. The aim is for these tiny magnetometers to have applications in numerous fields, such as magnetic cameras, quality control and medical technology. In their approach, the researchers combined the "fluxgate" principle, which has so far been used primarily for macroscopic sensors, with a spintronic component. The magnetic field sensor is tiny, measuring less than 100 x 100 nanometers, and consumes very little power. Accordingly, a large number of these magnetic field sensors can be integrated onto one chip together with their conditioning and processing electronics.

Cooperation with: Camille Bauer Metrawatt // FHNW School of Life Sciences // FHNW School of Engineering

Project description: https://bit.ly/3ISfkc0

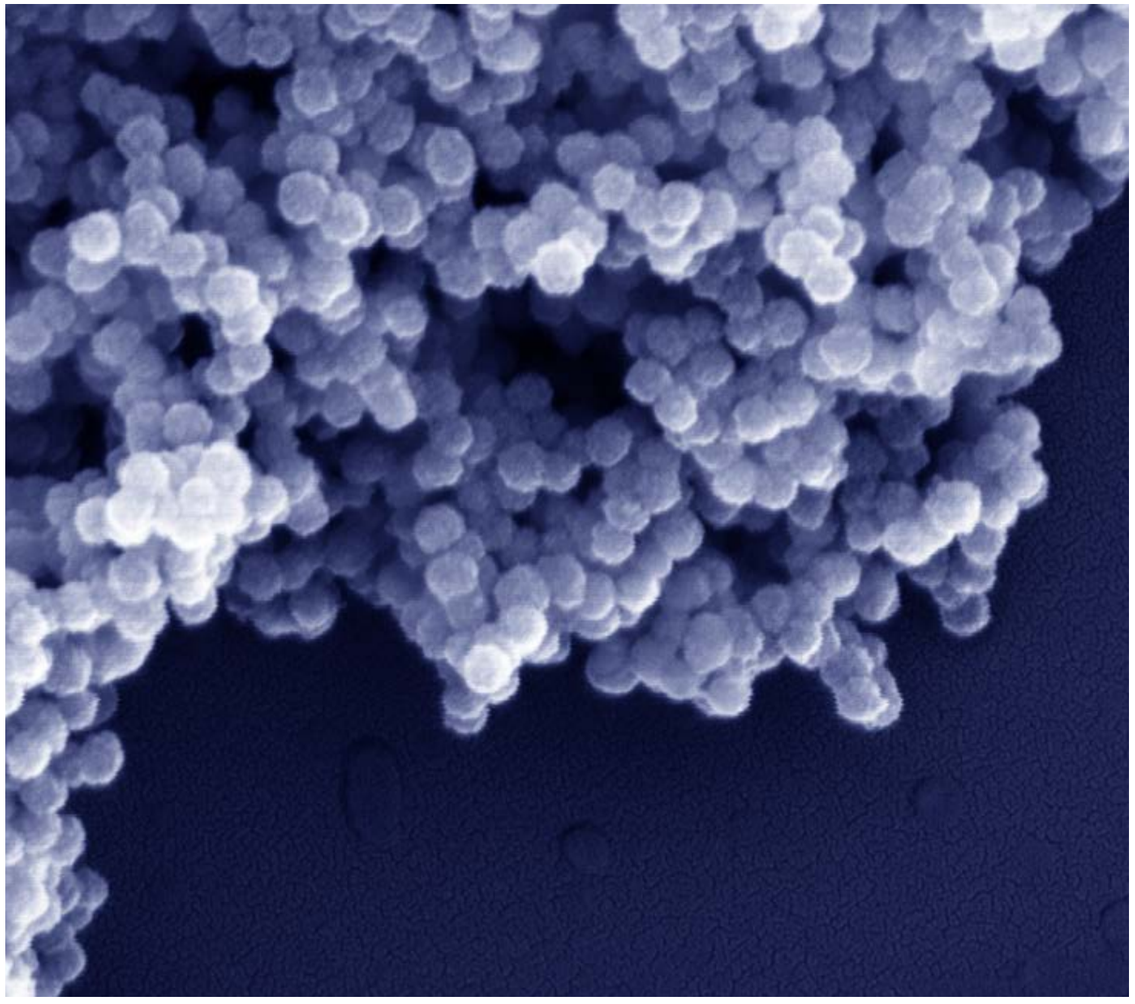


The minuscule new magnetic field sensor will be suitable for mass production. (Image: Spintec/FHNW)

New hybrid pixel detector for cryo-electron microscopy
In the Nano Argovia project HPDET-EM, electron microscopy experts are working together to install and test a new detector that meets the requirements of cryo-electron microscopy (cryo-EM) better than models used for synchrotron and X-ray analyses. The hybrid pixel detector developed by DECTRIS has a high readout speed and sensitivity. Researchers have developed the necessary protocols for its operation and analysis in conjunction with cryo-EM in order to further develop the technology for applications in the life sciences.

Cooperation with: DECTRIS // Biozentrum, University of Basel // Paul Scherrer Institute

Project description: https://bit.ly/3HjVMwO



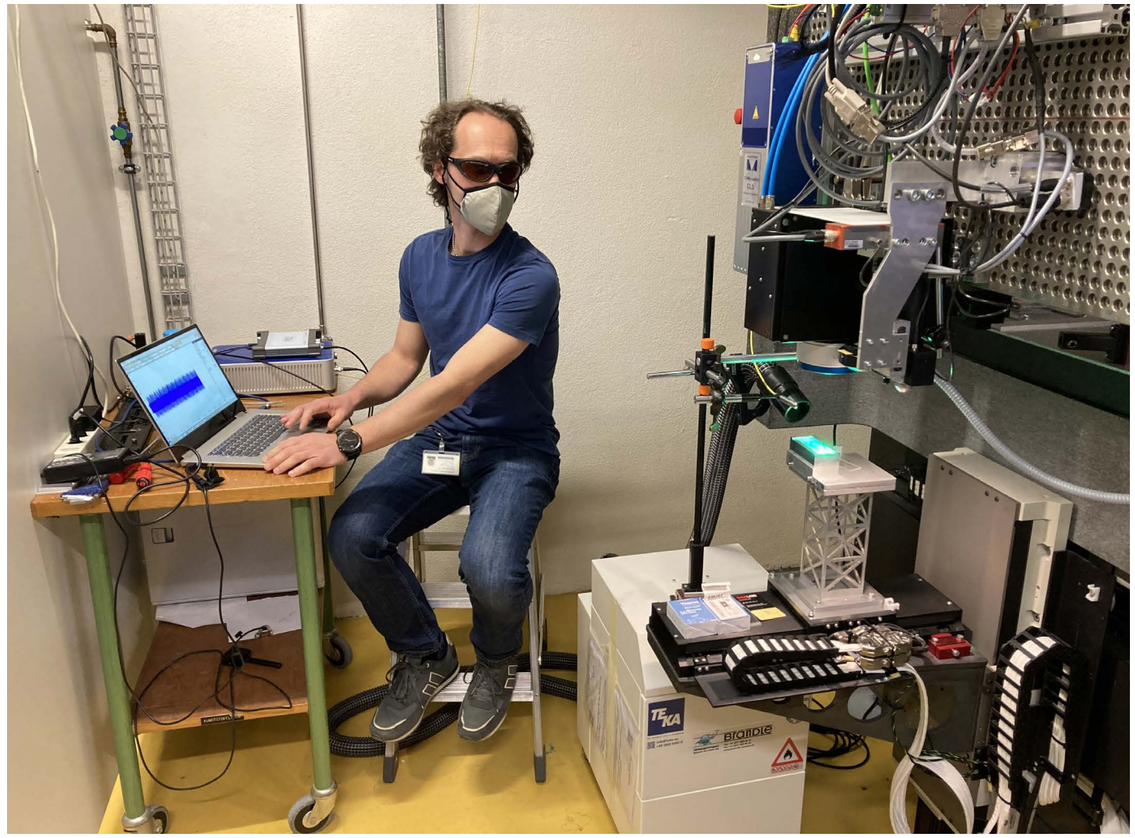
In the Nano Argovia project NANO-thru-BBB, researchers are developing a new technological platform for the development of nanoparticles that can cross the blood-brain barrier. (Image: Perseo Pharma)

Overcoming the blood-brain barrier
In the Nano Argovia project NANO-thru-BBB, researchers are developing a platform to design nanoparticles that can efficiently cross the selective barrier between the brain and the bloodstream. Using cellular blood-brain barrier models (*in vitro*) and zebrafish (*in vivo*), they have investigated the effect of chemical and structural differences between the surfaces of the nanoparticles. Computer analyses provide data on the ideal nanoparticle structure that allows passage of the blood-brain barrier.

Specifically, nanoparticle-packaged enzymes will be transported into the brain in order to treat inherited lysosomal storage diseases. In the long term, the project will provide a reliable database for conducting clinical trials with optimized nanoformulated enzymes aimed at tackling these metabolic diseases.

Cooperation with: Perseo pharma // FHNW School of Life Sciences // Department of Pharmaceutical Sciences, University of Basel

Project description: https://bit.ly/33XBKK5



Claudio Furrer, from the FHNW Institute of Product and Production Engineering, is a member of the LanakPro project team. (Image: A. Stumpp, Institute of Product and Production Engineering, FHNW Windisch)

Acoustic signal to control laser structuring processes

In the Nano Argovia project LanakPro, researchers are developing an effective control method for a laser nanostructuring process in order to improve development times and processing costs. Using acoustic signals, the planned instrument provides fast and reliable information about the progress and quality of the nanostructuring process, thereby allowing it to be controlled.

The researchers first created an "acoustic fingerprint" of the optimum structuring process and then matched this with the actual signal pattern when measuring the sample. Thanks to the algorithms developed and an underlying reference model, it should then be possible to register deviations, intervene in the process and make the necessary adjustments.

Cooperation with: Orvinum // FHNW School of Engineering // FHNW School of Life Sciences

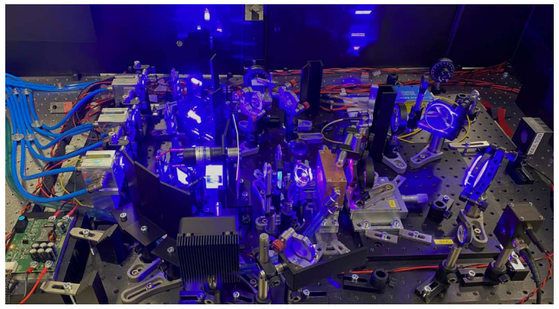
Project description: https://bit.ly/33XBpqN

New ultrashort-pulse laser source for nanomaterial processing

In the Nano Argovia project NanoLase, researchers are developing a novel laser source that generates ultrashort pulses. The new device is expected to be more cost-effective, reliable and compact than existing laser systems. It will also generate pulses that are several times shorter than those of current industrial lasers, enabling a transition from laser micromachining to laser nanomachining. In addition to industrial material processing, a laser source of this kind would be highly beneficial in the life sciences and numerous other scientific applications. To this end, the researchers have developed a laser amplifier made of titanium-doped sapphire with a new single-crystal fiber geometry (SCF).

Cooperation with: TLD Photonics // FHNW School of Engineering // Paul Scherrer Institute

Project description: https://bit.ly/34m600S



Experimental setup of the femtosecond laser. Blue light is emitted from the new pump diodes. (Image: B. Resan, Institute of Product and Production Engineering, FHNW Windisch FHNW)

"The NanoLase project is very exciting and promising for TLD Photonics as it helps to develop a new technology, as well as to demonstrate its use in materials processing. It can bring a new product line to TLD Photonics, which could represent a breakthrough from laser micro- to laser nano-machining."
Stephan von Wolff, CEO of TLD Photonics

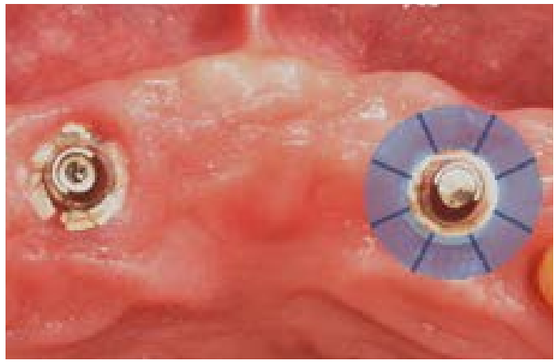
Hydrogel template for preventing inflammation

In the Nano Argovia project LIGARECO, researchers investigated the prophylactic use of a hydrogel template to prevent inflammation around dental implants. The template consists of a microstructured, absorbable hydrogel and is intended to stimulate the targeted formation of collagen fibers around dental implants. Like with a natural tooth, these fibers are intended to anchor the implant collar into the surrounding soft tissue more effectively in order to form a barrier that prevents the entry of bacteria and therefore protects the implant against bacterial infections.

The researchers initially focused on the fabrication of the hydrogel template before turning their attention to the functional microstructuring and nanostructuring of the hydrogels in order to control the settlement of ligament-forming cells and the formation of the desired fibers.

Cooperation with: NovoNexile // FHNW School of Life Sciences // University Center for Dental Medicine Basel (UZB)

Project description: https://bit.ly/3lOUES2



Jaw with two implants. Left: unguided soft-tissue growth around an implant; right: a diagram of the hydrogel template with growth channels. During implantation, this template is inserted between the bone and the exposed soft tissue before the wound is sealed. (Image: K. Mukaddam (UZB) and FHNW)

"The Nano Argovia program is a valuable opportunity to work with two leading regional institutions, in the form of the FHNW and the University of Basel, in order to develop the next generation of functional biomaterials."
Dr. Stefano Tugulu, founder and director of NovoNexile

Averting wear and tear

In the Nano Argovia project Promucola, researchers developed a ceramic coating for titanium implants to make them more resistant to wear. When titanium samples are coated using the plasma spray method, a biocompatible powder mixture is heated and then sprayed onto the implant. In addition to the desired layers, the resulting rapid cooling produces various phases on the surface that influence hardness and abrasion resistance. The researchers analyzed the conditions under which these layers form and how they can subsequently be stabilized. Based on these results, they were able to optimize production and develop a procedure for the post-treatment of the implants.

Cooperation with: Orchid Orthopedics Switzerland // FHNW School of Life Sciences // ANAXAM

Project description: https://bit.ly/3rfhmwG

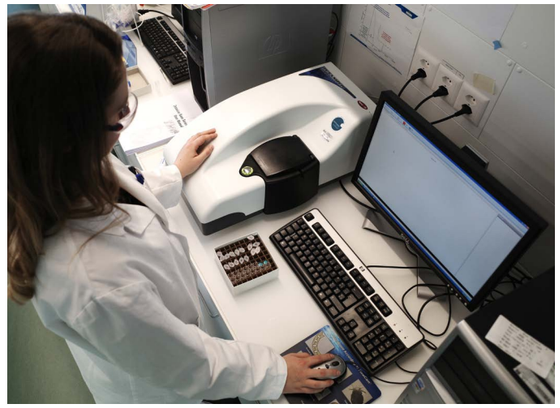
The plasma spray method was used to equip the samples with a ceramic coating that then underwent precise analysis and post-treatment.

Delivery under pressure

In the Nano Argovia project ForMeL, a research team developed liposomes that can be loaded with pharmaceutical agents which are subsequently released in response to changes in pressure. Mechanoresponsive liposomes of this kind could, for example, be used to directly target blood clots in vessels affected by arteriosclerotic narrowing, dissolving them without the need to flood the patient's entire body with anticoagulants. The researchers investigated and optimized the production and formulation of liposomes on a laboratory scale, as well as developing a freeze-drying process and analytical methods. All of these steps can now be transferred to the pilot scale.

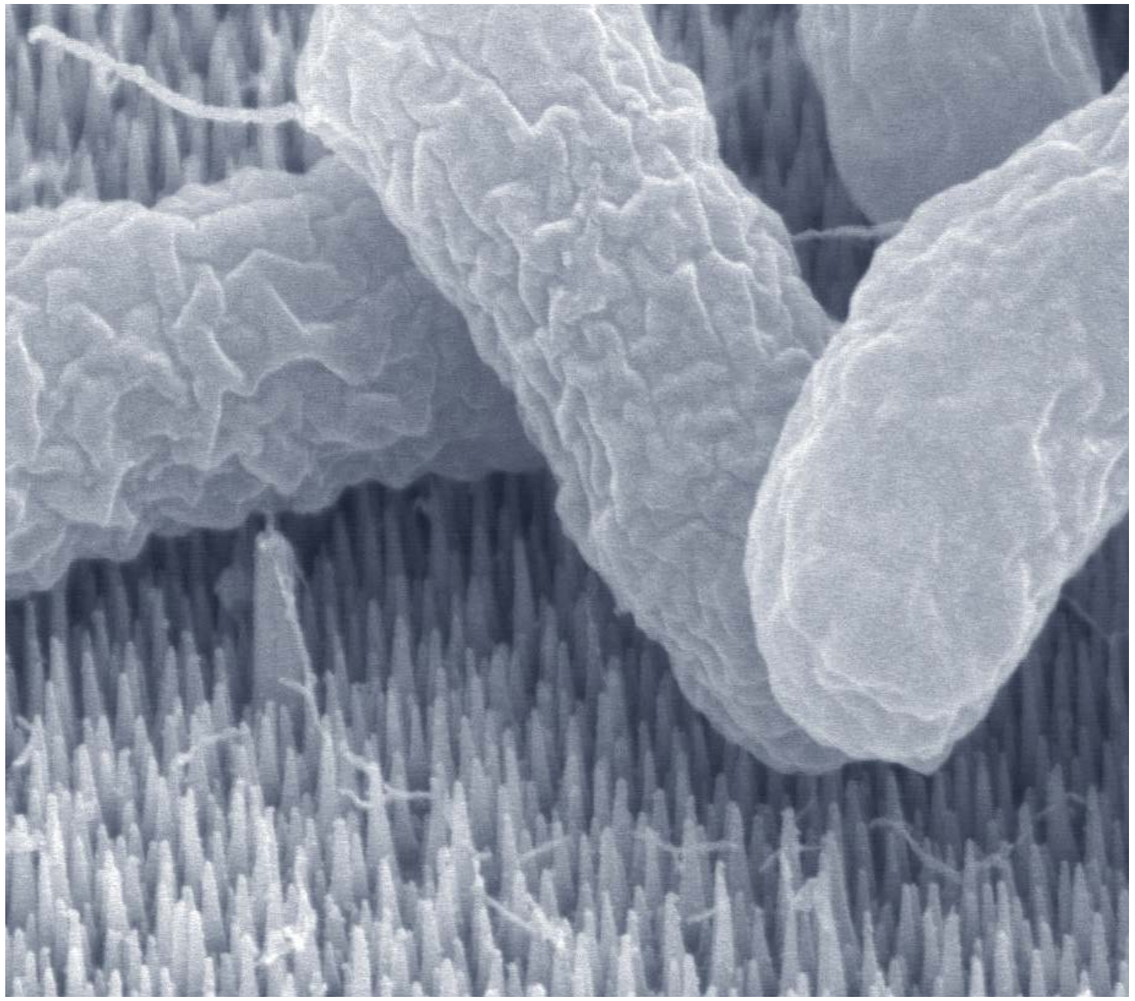
Cooperation with: Acthera Therapeutics // FHNW School of Life Sciences // ANAXAM

Project description: https://bit.ly/3lWQdEZ



Initially, the investigation focused on the production and formulation of liposomes on the laboratory scale. The results were then transferred to the pilot scale so that material could be produced for the first preclinical trials. (Image: FHNW)

"For a recently formed startup like ours, the Nano Argovia program is an ideal opportunity to create the technical prerequisites for preclinical and clinical testing of mechanoresponsive liposomes."
Dr. Andreas Zumbühl, Chief Technology Officer, Acthera Therapeutics (Basel)



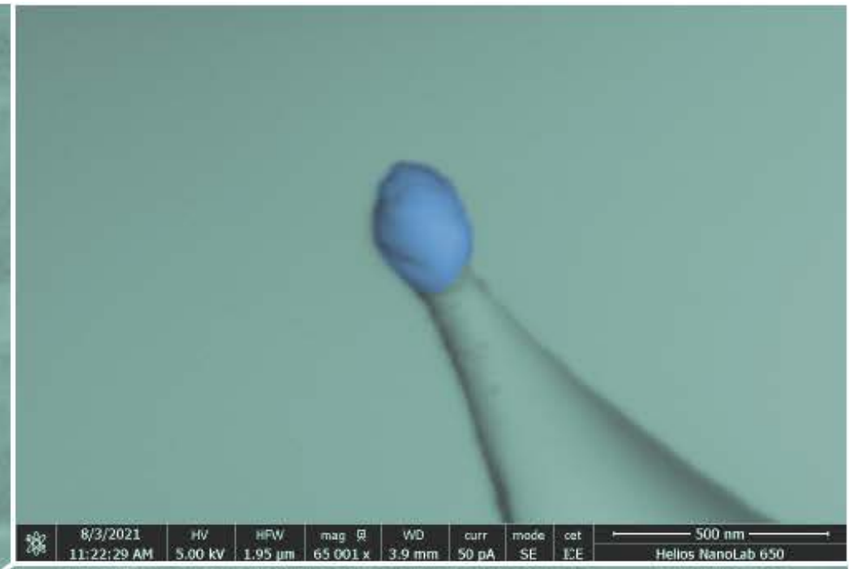
Surface structures of different sizes and heights are intended to prevent the growth of bacteria and the formation of biofilms. (Image: Dental Medicine/Nano Imaging Lab, University of Basel)

Nanostructures against bacteria

In the Nano Argovia project TiSpikes, a team of scientists investigated how a nanostructure can be used to prevent bacterial growth and the formation of biofilms on dental titanium implants. The researchers used atomic force microscopy to determine which surface structures are most effective at inhibiting the growth of different types of bacteria. Moreover, they explored the hypothesis that ideal nanostructuring of the implant surfaces not only prevents the growth of bacteria, but also ensures good adhesion of the surrounding tissue cells. In turn, this can reduce bacterial colonization in the space between implant and tissue, thereby preventing inflammation.

Cooperation with: Institut Straumann // University of Basel, Department of Dental Medicine // University of Basel, Department of Physics // FHNW School of Life Sciences (FHNW)

Project description: https://bit.ly/3ocvcOF



Tiny cobalt tip

Using the gas injection system on a focused electron beam microscope, staff at the Nano Imaging Lab are able to chemically modify the tips of tiny cantilever probes.
Seite 47

The SNI's Nano Imaging Lab offers customers from industry and academia a comprehensive service in the field of surface imaging and processing.

Nano Imaging Lab: Outstanding imaging services

The SNI also includes the Nano Imaging Lab (NI Lab), where six members of staff work to provide imaging services for research and industry.

Thanks to the excellent equipment available at the NI Lab, including various electron and scanning probe microscopes, the team is able to select the most suitable imaging technique and therefore to provide outstanding imaging services to customers from academia and industry. These services include not only various sample preparation methods and chemical analyses, but also the production of attractive colorized images. In addition to research activities, the NI Lab team also plays an active role in training and outreach.

At the start of 2021, work on the NI Lab's equipment was subject to restrictions — and it was only over the course of the year that the situation returned to normal. The NI Lab processed a total of over 170 orders from more than 110 different customers in 2021. These orders come from both industrial companies and a variety of research institutions.

Nano Imaging Lab: https://bit.ly/3h37wbu
Video Nano Imaging Lab: https://youtu.be/HarVffOUdlY

New scanning transmission electron microscope for better resolution

The staff of the SNI's Nano Imaging Lab (NI Lab) have begun operating a new scanning transmission electron microscope (STEM). Manufactured by the company Jeol, the instrument provides impressively high resolution and magnification.

Dr. Marcus Wyss, who joined the NI Lab team as a new member of staff in summer 2021, is now on hand to produce high-resolution images of nanostructures inside thin samples as well as material analyses.

Report: https://bit.ly/3zpvciz

Marcus Wyss is the main point of contact for customers from a wide range of areas with questions and applications relating to the new scanning transmission electron microscope.

"The new Jeol F200, with its TEM, SEM, STEM and EDX capabilities, is not only powerful but also versatile and provides us with the feedback we need for our project relating to the growth of nanocrystals."
Dr. Gerard Gadea, postdoc at the Department of Physics, University of Basel

Collaboration with Technorama

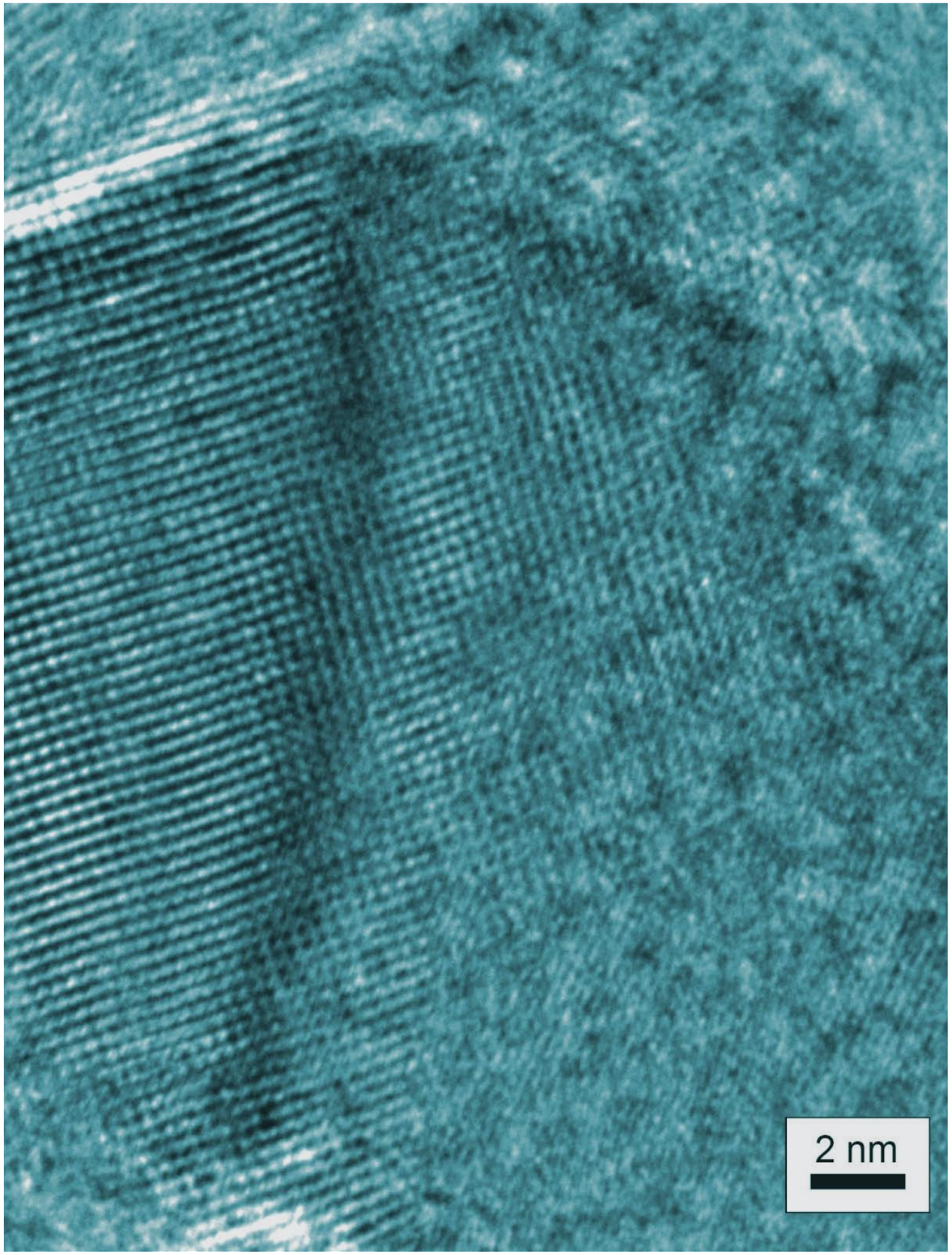
The Nano Imaging Lab provides support to the Swiss Science Center Technorama in Winterthur, which has had a scanning electron microscope (SEM) since 2021 thanks to a fundraising campaign. The SNI became one of the principal sponsors alongside the company Gloor Instruments, which launched the donation drive.

To brief Technorama's laboratory managers on the initial steps of operating the SEM and sample preparation, the NI Lab team organized a workshop — and will continue to be on hand to advise and assist the Technorama team in the future. There are also plans for the SNI outreach team to hold joint workshops with the center.

Report: https://bit.ly/3l5zdfu

At a workshop at the SNI's Nano Imaging Lab, the team from the Swiss Science Center Technorama was briefed on sample preparation and operating the scanning electron microscope.

"The team at the NI Lab gave us an excellent primer on conducting practical work with the SEM and provided us with an overview of how to prepare different types of samples."
Kim Kaltenbach from the Technorama biology lab



The first images of titanium dioxide nanoparticles obtained with the new scanning transmission electron microscope (STEM) show the crystal structure of particles with different orientations. (Image: Nano Imaging Lab, University of Basel)

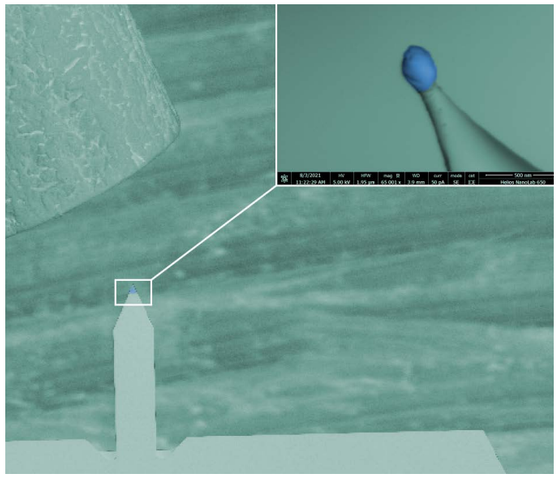
Chemical modification of surfaces

The Nano Imaging Lab is involved in numerous research projects, and this work increasingly involves the chemical modification of surfaces. As the NI Lab has a scanning electron microscope equipped with both a focused ion beam (FIB) and a gas injection system (GIS), its staff are able to make tiny, targeted changes to various surfaces. Indeed, they can not only remove material but also apply specific compounds in a highly targeted manner. The materials available to the NI Lab team include platinum, tungsten, carbon and cobalt, which has magnetic properties.

For example, the NI Lab is contributing to the FET Open project "FIBsuperProbes," which is led by Argovia Professor Martino Poggio from the Department of Physics at the University of Basel. As part of this international project, researchers from Basel, Zurich, Tübingen and Zaragoza are developing exceptionally sensitive and precise probes for scanning probe microscopy.

Their vision is to pave the way for a new era in scanning probe microscopy in which nanoscale sensors – and in particular superconducting components – are patterned directly on the tip of cantilever probes. Using focused ion beam technology, the researchers produce these tiny sensors with a very high degree of functionality and sensitivity in a process that relies on the unique capability of FIB to mill, grow or structurally modify materials. The resulting probes will help researchers get to the bottom of phenomena in physics, chemistry and the material sciences that cannot be studied using current technology.

Staff from the NI Lab are contributing to the project by, for example, integrating tiny quantum interference devices into the cantilever probes. A new method for producing these quantum interference devices uses ion deposition to realize Josephson contacts made of tungsten. Tungsten is of particular interest as a material because it has superconducting properties at low temperatures. This "transition temperature," below which tungsten conducts electricity without resistance, is within the range in which the researchers are carrying out their investigations.

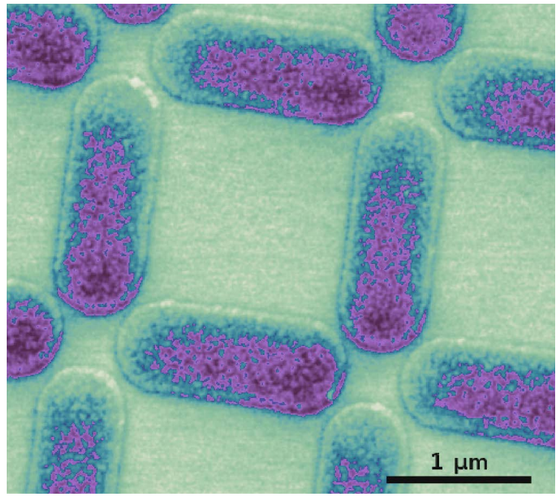


Using focused electron beam-induced deposition, staff from the NI Lab are able to apply a cobalt tip to a tiny cantilever probe. (Image: Nano Imaging Lab, University of Basel)

In another approach, the staff of the NI Lab used focused electron beam-induced deposition to functionalize a commercially produced cantilever probe with a tiny cobalt tip. This tip enables an atomic or magnetic force microscope to analyze the magnetic fields of a wide range of materials.

In order to familiarize themselves with the various microscopes and methods in greater detail, the NI Lab tested the various tips for a wide range of samples. For example, the team used the cobalt tip to investigate not only a magnetic tape but also "artificial spin ice." Based on an analysis using magnetic force microscopy, the NI Lab team were able to record the magnetic interactions between tip and sample – from which they could reconstruct the magnetic structure of the sample surface.

Information on FIBsuperProbes: https://www.fibsuperprobes.com



The magnetic fields of artificial spin ice were imaged using a magnetic force microscope with a tiny cobalt tip on its cantilever probe. (Image: Nano Imaging Lab, University of Basel)

"With their state-of-the-art FIB microscope and their specialist knowledge, the team from the NI Lab are an integral part of the FIBsuperProbes project. If it weren't for their expertise and resources, the project simply wouldn't be possible."
Argovia Professor Martino Poggio
Department of Physics, University of Basel

Network: Active and diverse

The basis for all SNI activities is the SNI network, which includes the Departments of Chemistry, Physics, Pharmaceutical Sciences and Biomedicine and the Biozentrum at the University of Basel, as well as research groups at the Schools of Life Sciences and Engineering at the University of Applied Sciences Northwestern Switzerland (FHNW) in Muttenz and Windisch, the Paul Scherrer Institute PSI, the Department of Biosystems Science and Engineering at the Federal Institute of Technology (ETH) Zurich in Basel (D-BSSE), the CSEM (Centre Suisse d'Electronique et de Microtechnique) in Muttenz and the newly founded ANAXAM technology transfer center. The wider network also includes the Hightech Zentrum Aargau in Brugg and Basel Area Business & Innovation, which work to promote knowledge and technology transfer.

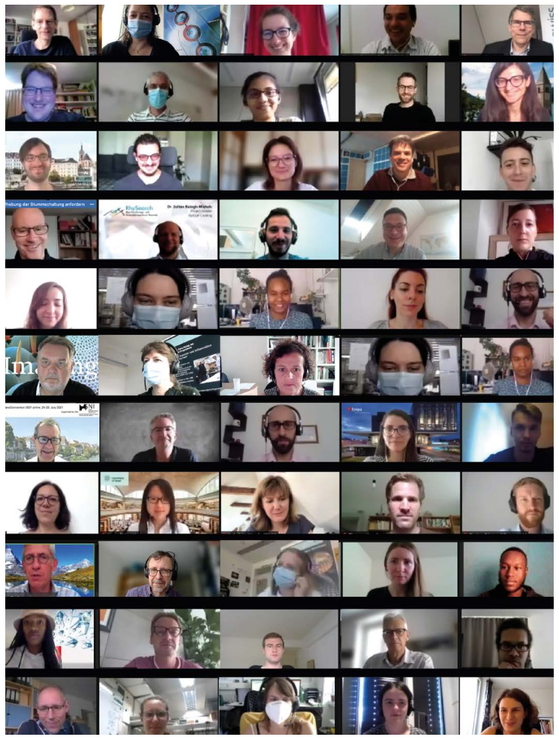
Swiss NanoConvention 2021
An online success

In one of the highlights of 2021, the SNI organized the Swiss NanoConvention (SNC), which was canceled last year due to the pandemic.

The difference between SNC 2021 and previous years' events, however, was that the almost 500 participants met online rather than in person. Thanks to the numerous sponsors and excellent organizational work, the SNI team laid the foundations for a successful conference – and it was then the 36 leading experts in their various fields, along with the chairs, exhibitors and all of the participants, who made SNC 2021 Online such a success.

Report: https://bit.ly/3gYwicN

"My thanks go to the whole team for the hard work to put together such a great conference. Professional work paired with passion is the perfect combination!"
Dr. Pierangelo Gröning, Empa



The year 2021 was the first time that the Swiss NanoConvention could only be held online, but the event was nevertheless a huge success.

The CEO of ELDICO Scientific, Eric Hovestreydt, working on the new ELDICO ED-1 electron diffractometer, which will soon be available for use by SNI members. (Image: ELDICO Scientific)

Electron diffraction for structural analysis
A unique network for SNI members

ELDICO Scientific, a startup that developed within the SNI network, has launched an electron diffraction instrument that can be used to analyze the 3D atomic structure of nanoscale materials.

One of the first devices will be made available to the Electron Diffraction NWCH Innovation Platform (Innovationsplattform Electron Diffraction NWCH). ELDICO Scientific runs this platform together with the Switzerland Innovation Park Basel Area, and it can be used by a consortium that currently has four members. The SNI is the consortium's academic partner, allowing its network to access this promising technology. In 2021, ELDICO made all of the necessary preparations in order for the instrument to analyze its first samples in 2022.

Report: https://bit.ly/3BC6vk0

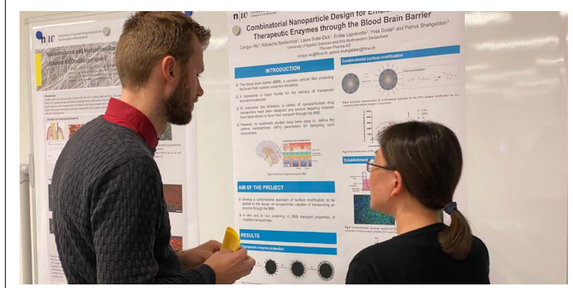
Annual Event and Nano-Tech Apéro
Opportunities for an exchange of ideas

Events such as the Annual Event and the Nano-Tech Apéro provide a vital forum for the exchange of ideas within the SNI network. At the Annual Event, members of the network meet for a scientific conference and a chance to discuss their approaches and results with one another, as well as making new contacts and developing new ideas for collaboration. The Nano-Tech Apéro is aimed at project partners in the Nano Argovia program and at companies in Northwestern Switzerland with an interest in the applied research program.

Following a forced one-year hiatus due to the coronavirus pandemic, both events returned in 2021. In September, almost 90 SNI members met for the Annual Event in Lenzerheide. Everyone was delighted with the event, as it provides an opportunity for interdisciplinary discussions and to develop ideas jointly in an informal setting.

The Nano-Tech Apéro was held at the premises of Omya in Egerkingen in October 2021. As well as information on the SNI and selected Nano Argovia projects, the program also included a presentation of the host company, Omya, and concluded with an aperitif. This provided an opportunity for people to get to know one another, exchange ideas and develop new approaches to projects.

Report and video: Annual Event: https://bit.ly/3s5e1AF
Nano-Tech Apéro: https://bit.ly/3nZQyyr



At the Nano-Tech Apéro, project leaders provided information on the various applied research projects in the form of talks and a poster session.

Communication and outreach: Sharing the fascination

The SNI has been committed to science communication and public relations since it was founded. To this end, the SNI communications and outreach team takes part in a variety of events such as the TecDays, trade fairs and science festivals with a view to sharing its fascination and enthusiasm for the natural sciences with a wide audience.

As well as printed materials containing information on the various areas of the SNI, the SNI team is increasingly providing information in the form of videos. The content of these videos ranges from research findings, impressions of events and interviews with students to scientific explainers and instructions for experiments that children can easily carry out at home.

These videos and the information on the SNI and its activities are publicized through various social media channels, which now have over 2,800 combined followers.

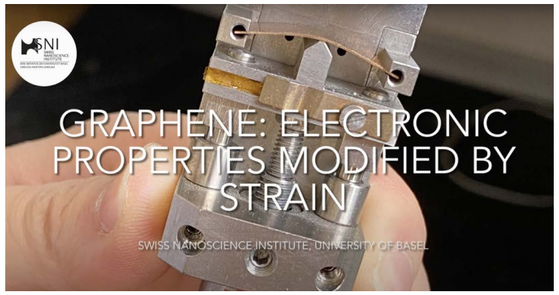
Returning to events and focusing on social media

In terms of events, the year 2021 was still dominated by the COVID-19 pandemic. Personal contact was, to a large extent, restricted – but it was possible to resume some face-to-face activities in summer and at the end of the year. The SNI outreach team was therefore able to take part in various events aimed at bringing the fascinating world of the natural sciences closer to children, young people, parents and grandparents alike.

Some events were connected to the SNI's involvement as a partner to Museum Burghalde in Lenzburg. For the museum's special exhibition "Saubere Sache" on the subject of soap, the SNI contributed experiments, information materials and videos as well as participating in a "soap weekend" in August and offering workshops themed around soap. As part of this collaboration, the SNI team has also planned its contributions to the forthcoming special exhibition on water, entitled "Wasser – Voller Energie." For this exhibition, the SNI team has once again developed experiments, as well as preparing illustrative materials on the topic of water.

It was very gratifying to see the return of the TecDays and Science Days at Europa-Park Rust (Germany) at the end of the year, enabling direct, face-to-face contact with children and young people. For events of this kind, the SNI team develops experiments, handicraft projects and games that all relate to a specific topic. The TecDays were themed around nanomedicine, whereas the activities at the Science Days were related to viruses, bacteria and microfungi. For those who were unable to attend in person, digital content was also available.

The SNI team is increasingly focusing on activities on social media and therefore on the production of videos that are distributed via these networks. To this end, the staff have expanded the broad range of experiment videos for children, as well as producing short films on research topics, the nanosciences degree and various SNI events. In 2021, the videos produced by the SNI had almost 190,000 views on YouTube, resulting in a total playing time of over 4,250 hours.



The 36 videos produced by the SNI team in 2021 featured topics such as experiments, events, research findings, bachelor's and master's program and the SNI in general.

Further information:

Experiments page: https://bit.ly/3v5hukW
YouTube channel: https://bit.ly/3u9XLjv
LinkedIn: https://bit.ly/3rbYP4s
Twitter: https://twitter.com/SNIunibas
"Voller Energie" exhibition: https://bit.ly/3Ggz47p
Short research videos: https://bit.ly/3KVMcCk

In 2021, the Science Days were themed around viruses, bacteria and microfungi. As visitors to the SNI stand learned, these also include some "friends" of humankind. (Images: K. Beyer-Hans, SNI)

Financial report

The Swiss Nanoscience Institute (SNI) was founded at the University of Basel in 2006. It was initiated by the Canton of Aargau with the goal of advancing research in the nanosciences, supporting knowledge and technology transfer in collaboration with industrial companies from Northwestern Switzerland, and serving as a center for the training of young scientists. These core aspects – teaching, basic and applied research, and knowledge and technology transfer – are reflected in the SNI's finances.

Focus on basic research

Given that basic research serves as the cornerstone of innovation, the SNI supports the work of the two Argovia Professors at the University of Basel, Roderick Lim and Martino Poggio, as well as that of three titular professors at the PSI. In total, the funding for these professors amounts to some CHF 1.6 million. Through their scientific research and the resulting publications, the two Argovia Professors make a substantial contribution to the global reputation of the SNI. They are involved in numerous international collaborations and, in 2021, secured almost CHF 1.8 million in third-party funding from Switzerland and beyond.

Projects relating to basic science are also undertaken by doctoral students from the SNI PhD School, which was founded in 2012 and had a total of 40 doctoral students enrolled in 2021. Given the larger number of supported doctoral students, the outgoings of the SNI PhD School in 2021 rose to more than CHF 2 million.

The practical work is carried out by the doctoral students at various institutions in the SNI network – and the students then earn their doctorates from the Faculty of Science at the University of Basel. Eight doctoral students successfully defended their dissertations in 2021.

Vitally important transfer to industry

Since its founding, the SNI has placed considerable importance on knowledge and technology transfer to industry, which takes place within the framework of the successful Nano Argovia program. As part of this program, which is tailored to the needs of industry, industrial companies from Northwestern Switzerland can explore novel lines of applied research with at least two academic partners from the SNI network.

During the second challenging year as a result of the coronavirus pandemic, the Nano Argovia program also saw participation by companies that had not yet been represented in the SNI network. In total, there were twelve Nano Argovia projects underway in 2021, of which nine were newly launched and three had been extended for a second year. Seven of the twelve industrial partners came from the Canton of Aargau, while five were from the two Basel half cantons.

Given the higher number of new projects, as well as delayed starts to projects in 2020, the outgoings for knowledge and technology transfer (KTT & PR) rose to some CHF 2.3 million in 2021. The project partners contributed approximately CHF 1.8 million to the applied Nano Argovia projects via public research funding instruments (e.g. Innosuisse, Swiss National Science Foundation and EU funding) and funding from the research institutions themselves. The industrial partners contributed around CHF 1.3 million in the form of in-kind services.

Outstanding service

Various lines of research receive significant support in the form of the imaging services and research carried out by the staff of the Nano Imaging Lab (NI Lab), which has now grown to six people. The NI Lab assists customers from industry and academia and is also involved in projects at the ANAXAM technology transfer center. Despite the ongoing restrictions due to the coronavirus pandemic in 2021, the NI Lab team was able to offer its customers valuable analyses and microscope imaging of nanoscale samples as well as advising them on research projects. In the future, the NI Lab will join forces with a nanofabrication group to form the SNI Nanotechnology Center. In 2021, advance payments of some CHF 0.65 million were made toward equipment for the nanofabrication lab, although these funds do not yet appear in the accounts shown below.

Study and outreach

A total of 69 students were enrolled in the nanoscience program in 2021 – 43 in the bachelor's and 26 in the master's program. The "Nano Study" item of the SNI budget comes to around CHF 0.5 million. With a number of events making a comeback in 2021, the SNI team participated in order to raise awareness of this demanding degree program, which is the only one of its kind in Switzerland.

It was also possible to resume a limited number of outreach activities in 2021. In June, however, the pandemic meant that it was only possible to hold the Swiss NanoConvention online. In the second half of the year, it was then once again possible to attend science fairs and science festivals in person. As well as these formats, where the focus is on face-to-face contact, the SNI also turned its attention to digital contributions on social media. For example, short videos on research projects, the degree program, events and experiments generated a positive response in 2021, and the social media channels enjoyed a significant increase in the number of followers.

Investments for the future

With a view to driving further advances in nanoscience research in the region, the SNI invested in various projects in 2021 – including the Electron Diffraction NWCH Innovation Platform. In return for its contribution of some CHF 0.36 million, which appears in the accounts as part of the Management item, the SNI receives services for its network. Further investments relate to the ANAXAM technology transfer center, of which the SNI is a founding member, and a collaboration with the Paul Scherrer Institute. Here, the SNI is involved in the realization and commissioning of an experimental station (SOPHIE), which allows experiments at the Swiss Synchrotron Light Source.

In the last line of the balance sheet, approximately CHF 7 million are shown as "SNI assets per 31/12/2021 in CHF". This balance does not take into account commitments of CHF 3.45 million already made in previous years. These include equipment for the planned Nanotechnology Center as well as for the Nano Imaging Lab and the Biozentrum, which will sustainably support the expansion of nanotechnology in Northwestern Switzerland. Due to these deductions, the effective balance of the SNI stands at approximately CHF 3.55 million. It should also be noted that the funds for the SNI PhD School must always be budgeted for a period of 48 months – and that the funds are therefore tied up and unavailable to the SNI for four years. These costs still to be incurred are also not included in the balance sheet.

We would like to extend our sincere thanks to the Finance department at the University of Basel for its efficient financial reporting. Heartfelt thanks are also due to the Cantons of Aargau, Basel-Stadt and Baselland for supporting the SNI. Their commitment is what makes it possible for the SNI to train excellent young researchers, conduct scientific work at the highest level, and transfer our findings to companies in the region.

The following table shows expenses for 2021 by category in accordance with the financial report of the University of Basel dated 26 February 2022.

Expenditure 2021 in CHF

		Univ. Basel	Canton AG	Total
Management	Personnel and operational costs	372'760	624'039	996'799
	Overhead	—	650'000	650'000
Infrastructure	Infrastructure building	—	—	—
	Infrastructure equipment	147'205	486'839	634'044
KTT & PR	Personnel and operational costs	57'471	394'240	451'711
	Nano Argovia projects	—	1'877'696	1'877'696
Outreach	Operational costs	42'965	46'727	89'692
Support	Argovia professorships	573'857	973'497	1'547'354
	PSI professors	—	59'503	59'503
Nano Study	Bachelor and master programs	253'904	220'251	474'155
Nanotechnology	Nano Imaging/			
Center	Nano Fabrication	430'803	124'530	555'333
SNI PhD School	Research projects	916'062	1'119'631	2'035'693
Total expenditure 2021 in CHF		**2'795'027**	**6'576'954**	**9'371'981**

The following table shows the SNI balance sheet as of 31 December 2021:

SNI balance sheet 2021 in CHF

	Univ. Basel	Canton AG	Total
Grants	2'635'334	5'000'000	7'635'334
Investment income	12'539	176'309	188'848
Income	**2'647'873**	**5'176'309**	**7'824'182**
Expenditure	**2'795'027**	**6'576'954**	**9'371'981**
Balance year 2021	**(147'154)**	**(1'400'645)**	**(1'547'799)**
SNI assets per 01/01/2021	**2'140'128**	**6'456'193**	**8'596'321**
Annual balance	(147'154)	(1'400'645)	(1'547'799)
SNI assets per 31/12/2021 in CHF	**1'992'975**	**5'055'548**	**7'048'523**

Organization

Argovia Board
Landammann A. Hürzeler, Head Department of Education, Culture and Sport, Canton of Aargau
Prof. Dr. C. Bergamaschi, President FHNW
Prof. Dr. C. Rüegg, Director PSI
Prof. Dr. A. Schenker-Wicki, President University of Basel
Prof. Dr. C. Schönenberger, Director SNI
Prof. Dr. G.-L. Bona, Director Empa
Dr. W. Riess, IBM Department Head & Coordinator Binnig & Rohrer Nanotechnology Center

SNI Board
Prof. Dr. C. Schönenberger, Director SNI
Prof. Dr. P. M. Kristiansen, Vice Director (Network)
Prof. Dr. D. Loss, Vice Director (Theoretical Physics)
Prof. Dr. W. Meier, Vice Director (Chemistry & Nano-curriculum)
Prof. Dr. E. Meyer, Vice Director (Experimental Physics)
Prof. Dr. M. Poggio, Vice Director (ANAXAM & Experimental Physics)
Prof. Dr. A. Schier, Vice Director (Biozentrum)
Prof. Dr. T. Schwede, Vice Director (President's Office)

Steering Committee Nano Imaging Lab
Prof. J. P. Abrahams (Biozentrum)
Dr. M. Dürrenberger (NI Lab, SNI)
Prof. Dr. C. E. Housecroft (Chemistry)
Prof. Dr. R. Y. H. Lim (Biozentrum)
Prof. Dr. E. Meyer (Physics)
Prof. Dr. M. Poggio (Physics)
Prof. Dr. C. Schönenberger (SNI and Physics)
Prof. Dr. H.-F. Zeilhofer (Associate Vice President Innovation, University of Basel)

SNI Management
C. Wirth, General Manager (HR & Finance)
Dr. A. Baumgartner (PhD School)
Dr. A. Car (Coordination Nanocurriculum)
S. Chambers (Coordination Nanocurriculum)
Dr. K. Beyer-Hans (Communications & outreach)
S. Hüni (Communications & outreach)
Dr. C. Möller (Communications, media contact & social media)
Dr. M. Wegmann (Communications, outreach & social media)

Nano Imaging Lab
Dr. M. Dürrenberger (head)
E. Bieler (SEM)
S. Erpel (SEM, TEM)
D. Mathys (FIB-SEM, image coloring)
Dr. M. Schönenberger (AFM, LSM)
Dr. M. Wyss (since June 2021) (TEM, FIB-SEM)

Lists of members and projects 2021

Principal investigators and associated members
https://bit.ly/35d2hDa

PhD students
https://bit.ly/33C97lr

SNI PhD School projects
https://bit.ly/3v5cCMp

Nano Argovia projects 2021
https://bit.ly/33EY0rY

Further information

If you would like to know more about the Swiss Nanoscience Institute, please visit our website (www.nanoscience.ch) or follow us on LinkedIn, Twitter or YouTube. There we regularly post news from the network.

Scientific supplement
Scientific reports from all the Nano Argovia and SNI PhD School projects from 2021 can be found on our website www.nanoscience.ch or by scanning the QR code.
https://bit.ly/34Zj3970

Cover image:
The image shows heart cells (red) and their nuclei (turquoise). (Image: F. Züger, FHNW and University of Basel)

About this publication:
Design concept: STUDIO NEO
Text and layout: C. Möller and C. Schönenberger with support of PIs and PhD students
Translations: UNIWORKS (Erlangen, Germany)
Images: If not referenced: C. Möller
Print: Publikation Digital, Biel, Switzerland

Educating Talents
since 1460.

University of Basel
Petersplatz 1
P.O. Box 2148
4001 Basel
Switzerland

www.unibas.ch

Swiss Nanoscience Institute
University of Basel
Klingelbergstrasse 82
4056 Basel
Switzerland

www.nanoscience.ch

Scientific supplement