University of Basel

Swiss Nanoscience Institute

Swiss Nanoscience Institute
Center of Excellence supported by the University of Basel and the Canton of Aargau

SNI INSight

Showcasing research and activities at the Swiss Nanoscience Institute

June 2022

Change in SNI leadership

Martino Poggio to become new SNI Director

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Excellent master’s theses

Applied research

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Dear colleagues and interested parties,

When we wrote the last edition of SNI INSight, in December 2021, we were hopeful that our world would have returned to normal by summer 2022 and that we would once again be able to devote ourselves fully to our nanoscience research.

Sadly, this wish was only partly fulfilled. At the very start of the year, we had to bid a final farewell to our valued and long-standing colleague and friend Wolfgang Meier. Wolfgang had been responsible for the nanoscience degree at the SNI for many years and was a passionate advocate of students' interests. We will also remember him as an inspiring, innovative scientist and a wonderful person. We miss him dearly.

Neither is it particularly easy to focus on research work given the current political situation. A war, the like of which we would not have thought possible in Europe, is putting fundamental values such as freedom and democracy in jeopardy and causing untold suffering. The situation is hard to bear.

For us in Switzerland, it is also still unclear whether and how we can continue participating in EU projects. With this in mind, researchers and research institutions throughout Europe are lending their support to the Stick to Science initiative, a pan-European campaign that aims to accelerate Switzerland and the United Kingdom's association to Horizon Europe.

The signatories believe that cooperation in science, research and innovation in Europe is more important than ever as we face some of the world's greatest challenges.

The SNI supports this campaign. Although we are primarily active in Northwestern Switzerland, the researchers in our network are dependent on collaborations across the European region. This is a question not only of research funding but also of cooperation within the European research landscape.

Within the SNI, a number of changes will come into effect in August. After sixteen fulfilling years as SNI director, I will hand over my responsibilities to Martino Poggio at the end of July 2022 and once again focus fully on my research activities.

Martino has already shown a strong commitment to the SNI in recent years as an Argovia professor, and I am sure that he will continue the SNI success story. He will be assisted by Patrick Maletinsky as Vice Director and by the SNI Executive Committee, which has been reconstituted and will also assume its duties from August. In this SNI INSight, you can learn more about Martino Poggio and Patrick Maletinsky as well as about the members of the new SNI Executive Committee.

You will find examples of SNI-supported research in this edition of SNI INSight, in which we provide a brief description of the new applied research projects that have been funded by the SNI since the start of the year within the framework of the Nano Argovia program. We also take a look at the topics researched by the two winners of the prize for the best master's thesis in nanosciences at the University of Basel.

In the future, researchers at the SNI will be supported not only by the Nano Imaging Lab but also by the Nano Fabrication Lab, which we are in the process of setting up. By pooling activities relating to nanofabrication within this group, the SNI is ensuring that it is even better equipped to face the demands of the future. The two service and research units – the Nano Imaging Lab and the Nano Fabrication Lab – will be brought together under the umbrella of the Nanotechnology Center.

Lastly, the many enjoyable events held in recent months did succeed in restoring a modicum of normalcy. It is events such as these, where we learn to exchange and discuss ideas with one another as well as getting children and young people excited about the natural sciences, that highlight the importance of dialog in our work – especially in difficult times such as these.

I hope you all enjoy reading this edition of SNI INSight.

Kind – and hopeful – regards,

Christian Schönenberger

Prof. Christian Schönenberger, SNI Director

Change at the top

Christian Schönenberger hands over leadership of the Swiss Nanoscience Institute to Martino Poggio

From August 2022, Argovia Professor Martino Poggio from the Department of Physics of the University of Basel will be the new director of the Swiss Nanoscience Institute (SNI).

For 16 years, Professor Christian Schönenberger has worked to build up the SNI and turn it into what it is today: the center of excellence for nanosciences and nanotechnology in Northwestern Switzerland. Schönenberger took over as director of the National Center of Competence in Research (NCCR) Nanoscale Science from Professor Hans-Joachim Güntherodt in 2006 and simultaneously became the director of the newly founded Swiss Nanoscience Institute.

Thanks to the support of the Canton of Aargau and the University of Basel, he and his colleagues have succeeded in building up a lively network that not only provides young nanoscientists with excellent and demanding education, but also carries out applied and basic scientific research projects at the highest level.

Some time ago, Christian Schönenberger decided that he would devote the last years of his working life exclusively to research. That time has now come, and he is set to hand over leadership of the SNI to Martino Poggio on 1 August.

Together with the different boards, Christian Schönenberger has set the direction for how the SNI develops for sixteen years. Now he is handing over the leadership to Martino Poggio.

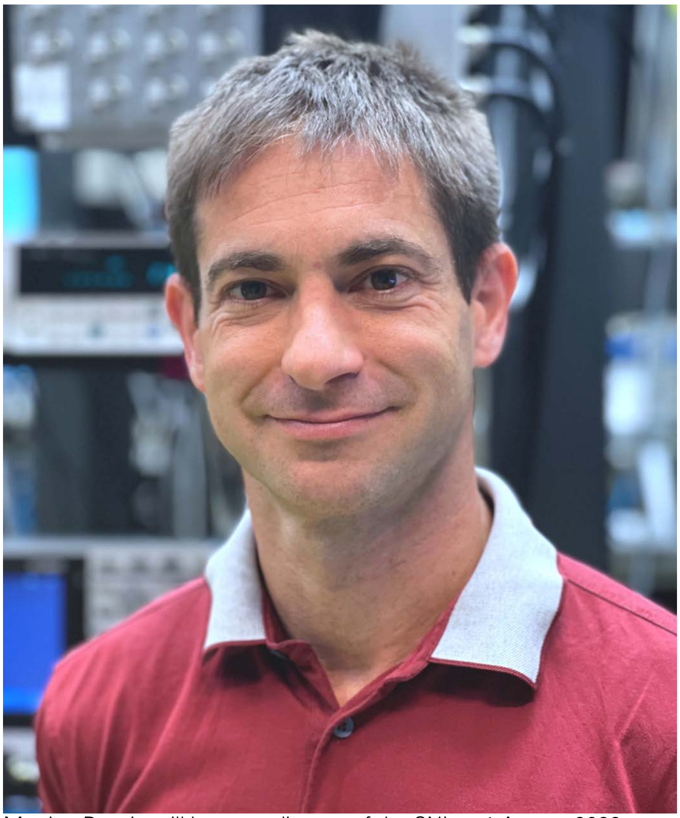
A passion for nano research

Martino Poggio to become new SNI Director

The SNI is a diverse institute, and Argovia Professor Martino Poggio is also characterized by his diverse background – whether it be as a passionate researcher and visionary research manager or in terms of his cultural origins. He came to the University of Basel from the USA in 2009 as an Argovia Assistant Professor and is now set to take over as director of the SNI from Professor Christian Schönenberger in August 2022.

Further information:

Poggio Lab
https://poggiolab.unibas.ch



Martino Poggio will become director of the SNI on 1 August 2022.

Influenced by science

Martino Poggio was born in 1978 in Tübingen, Germany, but grew up in the USA – specifically in Boston, Massachusetts – in an environment that was heavily influenced by science and research. His father was, and still is, a professor at Massachusetts Institute of Technology (MIT), and science was an everyday part of Poggio's life when he was growing up.

In his childhood and teenage years, he developed an interest in IT and computer programming. He was always brimming with questions about all kinds of subjects – and a physics degree seemed to be the best way to find answers to some of these questions.

He began studying physics at Harvard University in Cambridge, MA, and – as is customary for students there – looked for a summer job in one of the laboratories during his bachelor's studies. "I still clearly remember my work with Professor Mara Prentiss, which involved building a laser for atomic physics experiments. It was quite challenging, but it was a great feeling when it worked. That's when I realized it was important for me to do something with my own hands and see the effects for myself – and that's remained the case throughout my career," he says.

A move to the West Coast

At the end of his degree and after countless hours of work in the Prentiss Lab, Poggio was looking for a fresh challenge outside Boston. The unique flair of Santa Barbara, California, seemed to offer a welcome change, and so he applied for a summer position with Professor David Awschalom (who was also a reviewer for the NCCR Nano at the time) at the University of California in Santa Barbara. He must have done a great job, for Awschalom subsequently offered him a place to come back the following year to do his doctoral dissertation.

That is how Poggio came to do his dissertation on the topic of ultrafast optics and semiconductor spintronics. "I found this work fascinating, but I was always dealing with many billions of spins and measuring large effects," Poggio recalls. "That's when I realized that I found the development of more sensitive tools even more interesting."

Interested in sensitive measurements

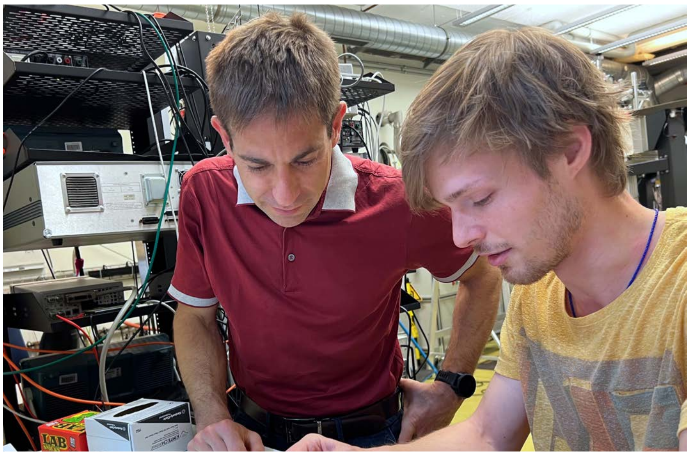
He acquired the necessary knowledge while working as a postdoctoral student in Dr. Dan Rugar's laboratory at the IBM Almaden Research Center in San Jose, California, from 2005 to 2008. "Dan had managed to measure a single spin using magnetic resonance force microscopy," Poggio explains. "My work in his group therefore taught me many of the basic principles for my current research, which aims to develop sensitive measuring techniques."

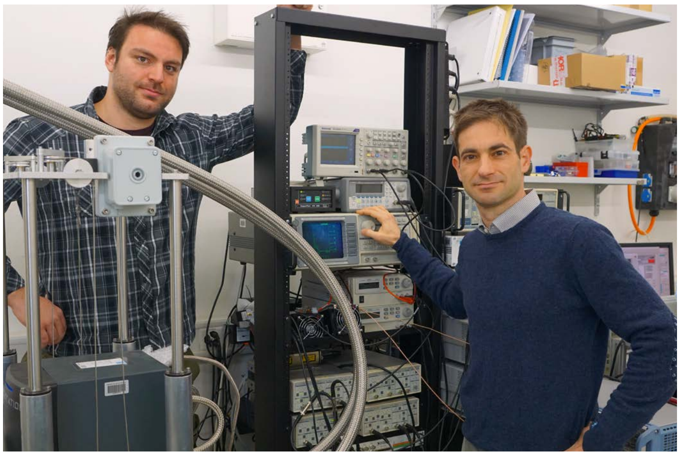
The results of his research work in California were outstanding, and Poggio saw the opportunity to become an assistant professor and set up his own group – which he had dreamed about since he was a young boy. He applied to various positions, including one in Basel, as he'd heard about the Argovia Professorship advertised by the newly founded SNI at the University of Basel by chance.

A big step

"In the end, I had to choose between Minnesota, Pittsburg and Basel," Poggio recalls. Whereas his American colleagues would never have considered moving to Switzerland, Poggio was very open to the idea on account of his Italian roots and existing family connections with Europe. With this in mind, he accepted the offer – which was the best of the three options – to set up a world-class research group.

Poggio has never regretted his move from the USA to Europe. "Although the start-up capital is slightly less than it would have been in the USA, there's ongoing financial support that has helped me to set up my group," he says. From the outset, he was impressed by the quality of the equipment and by the excellent workshops operated by the Department of Physics at the University of Basel. Another key factor for him in Basel was the wealth of experience and knowledge in the area of scanning probe microscopy thanks to pioneers and experts such as Hans-Joachim Güntherodt, Christoph Gerber, Christian Schönenberger and Ernst Meyer. In particular, Poggio also values the quality of education and the level of students' knowledge here in Basel.





The training of young scientists is also close to Martino Poggio's heart.

While setting up his research group, which has now grown to 17 members, he received crucial support in the form of various grants, such as an ERC Starting Grant, and the opportunity to lead an FET Open project.

Mechanics, magnetism and images on the nanoscale

Together with his team, Poggio has focused on research in the areas of nanomechanics, nanomagnetism and nano imaging. A common feature of all three areas is that they involve the development of highly sensitive sensors and devices for investigating fundamental physical phenomena.

In nanomechanics, the researchers from the Poggio Lab measure tiny forces, spins or charges using not only significantly smaller (top-down) devices but also self-assembled (bottom-up) structures. Tiny magnetic fields from individual nanoscale magnets are analyzed using new magnetometers that are also being developed by the Poggio Lab. In this work, the researchers focus on the magnetism of low-dimensional systems in order to gain a better understanding of their magnetic configuration. In the third area of research at the Poggio Lab, the scientists are working on various scanning probe microscopy methods with a view to making this technique even more sensitive and carrying out localized measurements on nano-objects.

Managerial tasks

It is these topics and the associated lab work that fascinate Poggio the most. "It's clear, however, that I'll be taking on more responsibility and managerial tasks in my position," he explains. Poggio previously served as chair of the Department of Physics from 2019 to 2021 and is co-director of the NCCR Quantum Science and Technology (QSIT).

Now, he is to assume the role of SNI Director and therefore the management of the interdisciplinary network from 1 August 2022 onward. "I have a lot to thank the SNI for, and it's time to give something back," he says when asked why he is keen to take on the job of SNI Director. "What's more, the nanoscience research supported by the SNI is a subject that's very close to my heart."

Visibility and growth

For Poggio, the SNI represents an ideal combination of excellence and breadth, providing support for a varied and exciting project portfolio. "The diverse profile of network partners, including universities and major research institutions, paves the way for different approaches and a wide variety of projects," he says.

Poggio also praises the broad education that students receive as part of the nanosciences curriculum: "I would have been interested in a program like this back in my day, as it would have provided me with answers to many of my questions."

With regard to the future of the SNI, Poggio hopes that its unique atmosphere will endure and that both the Canton of Aargau and the University of Basel will continue to provide generous support to the network. He also sees the SNI becoming bigger and enjoying greater visibility in the future. "There are several large nanoscience centers in the world, and I see no reason why Basel shouldn't be one of them. Some excellent work was done here in setting up the NCCR Nano, and this work is now being carried forward by the SNI."

One of the basic prerequisites for growth of the kind imagined by Poggio would be for the SNI to have its own building. This objective has already been pursued by Hans-Joachim Güntherodt and Christian Schönenberger – but the decision doesn't lie in the hands of the SNI Director.

In any case, the establishment of the Nanotechnology Center brings together the well-established Nano Imaging Lab and the recently founded Nano Fabrication Lab under one roof and is a step in the right direction when it comes to expanding the SNI, offering additional services, and making the institute fit for the future.

Further information:

Quantum Sensing Lab
https://quantum-sensing.physik.unibas.ch/en/

Report in SNI update 2012
https://bit.ly/3NSHFBB

Qnami
https://qnami.ch/

An interest in basic and applied research

Patrick Maletinsky becomes new SNI Vice Director

Patrick Maletinsky joined the University of Basel 10 years ago as the Georg H. Endress Foundation Professor of Experimental Physics. When he takes over as vice director of the SNI in August, he will be tasked with supporting and deputizing for the new director, Martino Poggio, as well as being responsible for the SNI's applied Nano Argovia program on the SNI Board of Directors.

Patrick Maletinsky will become Vice Director of the SNI from August 1, 2022.

A long relationship with the SNI

Although Patrick Maletinsky is only in his early 40s, he is already seen as one of the "old hands" of the SNI network. His dissertation, which he wrote in Professor Atac Imamoglu's group at ETH Zurich, was funded by the forerunner institution to the SNI, the National Centre of Competence in Research (NCCR) Nanoscale Science. For this work, Maletinsky used optical techniques to study nuclear spins in quantum dots and their interactions with electrons.

Although he is originally from the Canton of Aargau, he then turned his back on nano research in Switzerland for three years and instead travelled to Harvard University in Cambridge, USA, where he undertook a postdoc in Professor Amir Yacoby's group. There, he began researching tiny sensors that use quantum mechanical effects and are based on defect centers in diamonds.

The researchers working on this project utilize the spin of individual electrons orbiting within the defect centers. This spin is sensitive to magnetic and electric fields in its environment, and its response can be detected using various measurement techniques in order to derive information about the fields. When the sensors are then combined with scanning probe microscopes, they allow researchers to scan the surface of a sample in precise detail.

Ten years in Basel

When Patrick Maletinsky arrived at the Department of Physics in Basel as Georg H. Endress Assistant Professor in 2012, his aim was to set up an innovative research group that continued this line of research, developing quantum sensors that could be used to study extremely small magnetic fields in nanoscale resolution.

He has now succeeded in his goal and supervises an excellent team of 16 researchers, who develop technology that has become established in various areas that depend on the detailed analysis of magnetic fields.

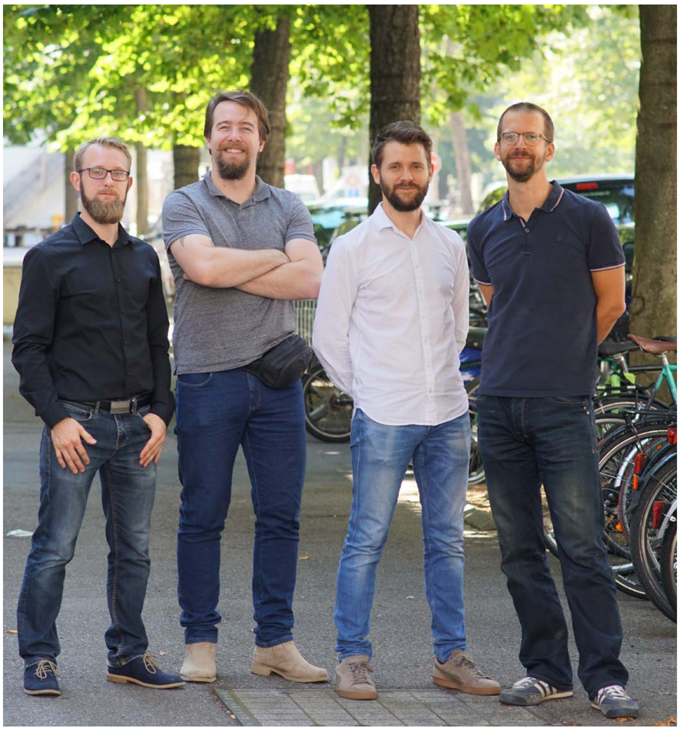
"It took us about five years to develop the technology to the point where we could use it to study a range of nanomaterials," explains Patrick. "For example, our technology is the only way of visualizing the extremely weak magnetism of antiferromagnetic materials and two-dimensional magnetic systems on the nanoscale."

In 2019, he received an ERC Consolidator Grant from the European Research Council (ERC) for research into two-dimensional magnets. This project involves studying atomically thin magnetic systems with a view to achieving a better fundamental understanding of these materials and using them for applications in spintronics. With his new QuantERA international collaboration project SensExtreme, Patrick Maletinsky is currently seeking to establish the applications of his quantum sensors under extreme conditions such as ultrahigh pressures and ultracold temperatures, where they could provide unique insights into exotic new materials.

Founding Qnami: a key milestone

The technology developed at Maletinsky's Quantum Sensing Lab is not only of great importance to him and his research group. Around the world, other researchers and companies are also keen to study and visualize magnets on the nanoscale using quantum sensors. With this in mind, Patrick teamed up with the former Basel postdoc Mathieu Munsch to found the start-up "Qnami" over five years ago.

Qnami has developed a quantum platform for magnetic material analysis in nanometer resolution and marketed this technology in the form of ProteusQ, the first complete quantum microscope system to utilize diamond defect centers. For example, the device allows users in



The Qnami founding team in 2019. Alexander Stark, Felipe Favaro, Mathieu Munsch and Patrick Maletinsky.

the semiconductor industry to localize and analyze flaws in integrated circuits in nanoscale detail.

Although Patrick was also involved in operational activities in the company's early days, the Qnami team now includes specialists in various fields, and Patrick's involvement centers around consultancy. "On the one hand, I'm available to help with customer inquiries about applications. On the other hand, I also advise the Qnami team when it comes to expanding the technical portfolio and making new contacts," he says.

He explains that this combination of a majority of time spent on academic research along with a manageable involvement in Qnami is an optimum balance. For him, both aspects of his work are a source of motivation: getting to the bottom of things and carrying out independent research, on the one hand, and applying results and keeping customers happy, on the other.

Corroboration of research

Patrick's future role in the Nano Argovia program fits in perfectly with this balance and also offers an exciting new challenge. "Applied research can potentially serve as a corroboration of basic research," he says. "So far, I've seen this important aspect of the SNI's work more from the outside and via the Nano-Tech Apéros. Now, I'm looking forward to getting more involved, meeting new companies and expanding my network."

Valuable resource

Access to an interdisciplinary network is one of the things that Patrick particularly values about the SNI. "I've been an SNI member since the beginning, as I've always been able to supervise at least one PhD School project. The events associated with SNI membership have made it easier and more straightforward for me to network with colleagues not only from the University of Basel but also from the University of Applied Sciences Northwestern Switzerland and the Paul Scherrer Institute."

Patrick also praises the services of the Nano Imaging Lab, which he has made greater use of in recent years in particular, as well as the excellently trained nano students: "The students are a valuable resource for my group, and the people who've done projects, master's theses and doctoral dissertations with me have always been hugely talented."

Once he is better acquainted with the subject matter, Maletinsky wants to develop specific ideas to further strengthen the position of the SNI. From his existing standpoint as a member and principal investigator, he sees the SNI as being well positioned, efficient, transparent and well managed. Over the coming months, he will familiarize himself with his new responsibilities and get to grips with the SNI from a different perspective after many years of membership.

SNI Executive Committee
New members and distributed tasks

The composition of the SNI Executive Committee will also change as of 1 August. Some of the tasks previously performed by Christian Schönenberger as director will then be taken over by members of the SNI management.
We would like to thank all former members of the SNI Executive Committee for their commitment and hope that they will remain supportive of the SNI.

Member of the SNI Executive Committee	Representative of
Prof. Dr. Jörg Huwyler	Pharmaceutical Sciences / Nanoscience Curriculum
Prof. Dr. Roderick Lim	Biozentrum
Prof. Dr. Patrick Maletinsky	Vice Director / Nano Argovia Program
Prof. Dr. Kirsten Moselund	Paul Scherrer Institute PSI
Prof. Dr. Martino Poggio	Director / SNI PhD School
Prof. Dr. Torsten Schwede	Vice President's Office for Research
Prof. Dr. Oya Tagit	University of Applied Sciences Northwestern Switzerland (FHNW)
Prof. Dr. Oliver Wenger	Chemistry
Claudia Wirth	General Manager
Prof. Dr. Ilaria Zardo	Physics / Nanotechnology Center

Members of the SNI Executive Committee take on various tasks.

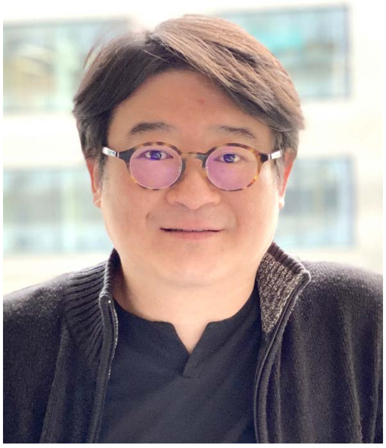
In the future, Jörg Huwyler will be responsible for the nanosciences progrm and will represent the Department of Pharmaceutical Sciences.

Jörg Huwyler will be responsible for the nanoscience program at the SNI and will represent the Department of Pharmaceutical Sciences.

He studied biology and earned his PhD at the Biozentrum of the University of Basel before working as postdoc at the University Hospital Basel and then joining the Brain Research Institute at UCLA School of Medicine in Los Angeles. He subsequently worked for seven years at F. Hoffmann-La Roche in Basel, during which time he qualified as a university lecturer in pharmacy. In 2006, he moved to the University of Applied Sciences Northwestern Switzerland (FHNW). Since 2010, he is full professor of Pharmaceutical Technology at the Department of Pharmaceutical Sciences at the University of Basel. His research focuses on the development of innovative drug delivery strategies using particulate drug carriers. To that effect, he has already been involved in several SNI projects.

Further information:

Research group Huwyler
https://bit.ly/3MXyIGb



Roderick Lim will continue to act as the contact person for all matters relating to the Biozentrum.

Roderick Lim has been an active SNI member for many years as an Argovia Professor and will continue to act as the contact person for all matters relating to the Biozentrum.

Roderick Lim studied applied physics at the University of North Carolina at Chapel Hill and received his PhD from the National University of Singapore (NUS)/Institute of Materials Research and Engineering (IMRE). Following a one year stint as a research associate at the Micro and Nano Systems Cluster in IMRE, he joined the NCCR Nano/Biozentrum in Basel as a postdoctoral fellow in 2004. In 2009, he was appointed Argovia Professor for Nanobiology. With his team, he studies fundamental principles and functional relationships between molecular mechanics, selectivity and transport in biological systems. Rod Lim is a co-founder of ARTIDIS, a company that applies nanomechanics to cancer diagnostics.

Further information:

Research group Lim
https://bit.ly/3OfAJhl

ARTIDIS
https://artidis.com

Patrick Maletinsky will become Vice Director and will also be responsible for the applied Nano Argovia program.

Patrick Maletinsky will become Vice Director of the SNI on 1 August and will also be responsible for the applied Nano Argovia program.

Patrick Maletinsky studied physics at ETH Zurich and, after several stays abroad (JILA Boulder, Colorado; ENS Paris), also completed his doctorate there. Following his time as a postdoc at Harvard University (MA, USA), he was appointed Georg H. Endress Professor at the University of Basel in 2012. At the Department of Physics, Patrick has established a group that works on quantum sensing and that has been involved in numerous SNI projects. In 2016, he and a group of research colleagues founded the startup Qnami together.

Research group Maletinsky
https://quantum-sensing.physik.unibas.ch/en/

Qnami
https://qnami.ch

Kirsten Moselund will be responsible for matters relating to the Paul Scherrer Institute. (Image: A. Herzog, EPFL)

Kirsten Moselund is a new member of the SNI network. She will be responsible for matters relating to the Paul Scherrer Institute on the SNI Executive Committee.

Kirsten Moselund studied engineering at the Technical University of Denmark (DTU) and holds a PhD from the Swiss Federal Institute of Technology Lausanne (EPFL). She was at IBM in Rüschlikon until 2022 – first as a postdoc then as permanent researcher and lastly as head of the Materials Integration and Nanoscale Devices group. Since February 2022, she has been head of the newly established Laboratory for Nano and Quantum Technologies (LNQ) at PSI and also professor of electrical and microengineering at EPFL. Her research interests include nanophotonics, solid-state devices, novel materials and the development of devices at the interface between quantum computing and the classical world.

Kirsten Moselund
https://www.psi.ch/en/lnq/people/kirsten-moselund

Further information:

Research group Poggio
https://poggiolab.unibas.ch/

Martino Poggio will become the new director of the SNI on 1 August. In this role, he will represent the SNI externally and will also be responsible for the PhD School.

Martino Poggio studied physics at Harvard University in Massachusetts, USA, and received his PhD from the University of California, Santa Barbara. He then conducted research at the IBM Almaden Research Center in San Jose, California, and joined the SNI and the Department of Physics at the University of Basel as Argovia Professor in 2009. Since then, he has led a group working on nanomechanical sensing, nanomagnetism and sensitive scanning probe microscopy.

Martino Poggio will become the new director and will also be responsible for the PhD School.

Research group Schwede
https://bit.ly/3QiWpLL

Torsten Schwede has represented the President's Board of the University of Basel on the SNI Executive Committee as Vice Rector Research since 2018.

Torsten Schwede studied chemistry at the University of Bayreuth, Germany, and at the Albert Ludwig University of Freiburg, Freiburg im Breisgau, Germany. After completing his PhD, he worked at the pharmaceutical company GlaxoSmithKline until he was appointed Professor of Structural and Bioinformatics at the Biozentrum of the University of Basel in 2001. His research group investigates methods for modeling and simulating three-dimensional protein structures in order to elucidate protein functions at the atomic level. Since May 2018, Torsten Schwede has been Vice Rector for Research at the University of Basel.

Torsten Schwede has represented the President's Board of the University of Basel on the SNI Executive Committee since 2018. (Image: University of Basel)

Research group Tagit
https://bit.ly/39vZ04A

Oya Tagit is joining the SNI and will represent the interests of the University of Applied Sciences Northwestern Switzerland on the SNI Executive Committee.

Oya Tagit studied biology and biotechnology at the Middle East Technical University in Ankara, Turkey, and earned her PhD at the MESA+ Institute for Nanotechnology at the University of Twente in Enschede, Netherlands. She then worked in various positions in academia and industry in the Netherlands, France and Ireland (University of Twente, Radboud University Medical Center, MSD/Merck, Pierre and Marie Curie University, Université Paris Sud, Magnostics). Since 1 April 2022, she has been Professor of Biointerfaces at the Institute of Chemistry and Bioanalytics of the FHNW School of Life Sciences. Her research group focuses on the development of nanoparticles and interfaces to modify and monitor biological systems.

Oya Tagit will represent the interests of the University of Applied Sciences Northwestern Switzerland. (Image: FHNW)

Oliver Wenger will represent the Department of Chemistry. (Image: University of Basel)

Oliver Wenger is a long-standing SNI member and now represents the Department of Chemistry on the SNI Executive Committee.

Oliver Wenger studied chemistry at the University of Bern, where he also completed his doctorate. Following postdoctoral positions at the California Institute of Technology (Caltech) in Pasadena, USA, and at the University of Strasbourg, France, he became an assistant professor at the University of Geneva. He was then appointed associate professor at the University of Göttingen, Germany, before returning to Switzerland in 2012 and joining the University of Basel. With his research group at the Department of Chemistry, he studies artificial photosynthesis.

Further information:

Research group Wenger
https://wenger.chemie.unibas.ch/en/

As Managing Director of the SNI, Claudia Wirth is a member of the SNI management.

Claudia Wirth has been managing director of the SNI since 2014 and is responsible for finance, human resources and administration.

Claudia Wirth studied German language and literature, history and political science (MA) at the University of Stuttgart. She then worked at the Fraunhofer Institute for Industrial Engineering in Stuttgart, Germany, and as a marketing consultant for computer science at the scientific publisher Springer. Following management positions in marketing and sales at various science and non-fiction publishers in Germany, she joined the University of Zurich as science manager at the Artificial Intelligence Laboratory (AI Lab) in mid-2002. Before coming to the SNI in Basel, she worked at the Institute of Retail Management (IRM) at the University of St. Gallen.

Ilaria Zardo will be the representative for the newly established Nanotechnology Center and will represent the Department of Physics.

Ilaria Zardo will be the representative on the SNI Executive Committee for the newly established Nanotechnology Center, which is composed of the Nano Imaging Lab and the Nano Fabrication Lab and will represent the Department of Physics.

Ilaria Zardo studied physics at the University of Rome, Italy, and earned her PhD in Rome and at the Technical University of Munich (TUM), Germany. She was then a postdoctoral researcher at TUM and Eindhoven University of Technology, Netherlands. In 2015, she joined the Department of Physics of the University of Basel as a professor. With her research group, she studies fundamental processes in tailored nanostructures, and she has a particular interest in lattice dynamics and phonon transport on the nanoscale.

Research group Zardo
https://nanophononics.physik.unibas.ch/de/

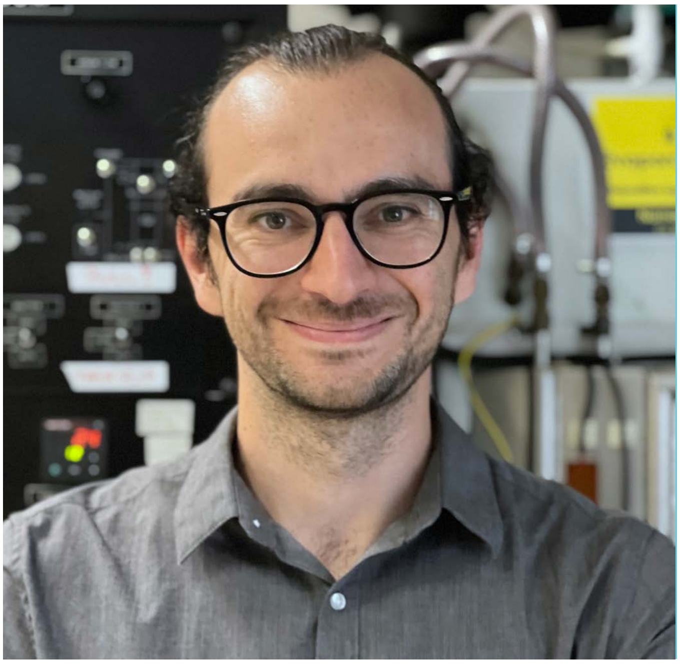
Nano Fabrication Lab
An investment in the future

Given the enormous advances in nanosciences and nanotechnology over recent years, it is increasingly important to ensure the professional and efficient production of nanostructures. This summer, the Swiss Nanoscience Institute will therefore begin operating a Nano Fabrication Lab (NF Lab) that brings together various existing activities in order to make nanofabrication in Basel fit for the future.

The Nano Fabrication Lab will be led by Dr. Gerard Gadea, who is currently working as a postdoctoral researcher in the Phononics Group of Professor Ilaria Zardo and has many years of experience in nanofabrication. Gerard will be supported by technical assistant Arnold Lücke.

At the Nano Fabrication Lab, the technical equipment needed for nanofabrication will be brought together from various working groups at the Department of Physics of the University of Basel. The existing clean room will also become part of the Nano Fabrication Lab, as will the clean room that the University of Basel plans to rent in the new building of the Department of Biosystems Science and Engineering (D-BSSE) of ETH Zurich in Basel.

Together with the SNI's well-established Nano Imaging Lab – which provides outstanding imaging and analysis services – the new Nano Fabrication Lab will form the Nanotechnology Center of the SNI.



Gerard Gadea will led the SNI's Nano Fabrication Lab starting 1 July, 2022.

"Pooling this expertise and equipment under one roof at the Nano Fabrication Lab will make it easier for prospective customers to professionally and reliably fabricate desired nanostructures under professional supervision."

SNI Director Professor Christian Schönenberger

We mourn the loss of Professor Wolfgang Meier, SNI Vice Director of the nanoscience curriculum at the University of Basel

On 25 January 2022, Professor Wolfgang Meier passed away much too early in the presence of his family after a long illness.

With his passing, we have lost an excellent, innovative scientist who was constantly developing new ideas and, above all, a wonderful person who impressed us with his serenity and composure.

Wolfgang became a role model for many students and young researchers. As Vice Director of the nanoscience curriculum, he championed the interests of nanoscience students and made a significant contribution to ensuring that this fledgling degree program at the University of Basel has continued to develop for the benefit of students and is now very well established.

Within the interdisciplinary SNI network, Wolfgang represented not only the course but also the interests of the Department of Chemistry on the SNI Executive Committee.

He was committed to the SNI since it was founded, and worked hard to support scientific exchange across different institutions and disciplines. Always open to and supportive of new approaches and questions, he was quite simply a wonderful colleague, supervisor and friend. He is sorely missed, and we have fond memories of his friendly, soft-spoken, reliable and endearing manner. Our thoughts are with his family.

Best master's theses in nanosciences
Prizes awarded to Vera Weibel and Mathias Claus

This year's prize for the best master's thesis in nanosciences at the University of Basel has once again been awarded to two young researchers, after Vera Weibel and Mathias Claus both impressed the jury with their excellent work.

Superconducting metamaterial for analog quantum simulation
Vera Weibel studies an artificial material with special properties

Vera Weibel wrote her prizewinning master's thesis at EPFL under Professor Pasquale Scarlino, having studied a superconducting metamaterial – an artificial material with properties that do not occur in nature. A material of this kind could potentially be used to prevent losses in quantum systems.

Researchers around the world are searching for artificial materials with optical, electronic or magnetic properties that do not occur in nature. These "metamaterials" consist of periodically arranged elements with a micro or nano structure. The size of these structures must be smaller than the wavelength of the phenomenon that is to be observed. Researchers typically begin by designing the materials on the computer and calculating their properties before producing and studying them in real life.

A material with a tiny, periodic structure

In her master's thesis, Vera Weibel developed one such metamaterial with superconducting properties by periodically arranging the starting material, niobium nitride, into individual structural elements with a size of approximately 50 micrometers. These elements act as resonators – systems that vibrate in response to excitation in a specific frequency range. As a result of the chosen size of the structures, this chain of resonators vibrates in the microwave region and can therefore store microwave photons. The degree of coupling between the resonators and their respective neighbors can be fine-tuned by varying the distance between them – the closer they are to one another, the better their coupling, and vice versa. In the metamaterial studied by Vera, the resonators had alternating spacings. This meant that the photon states in the material could be described using a specific model (the Su-Schrieffer-Heeger model) that was originally developed for polyacetylene.

"In the future, it may be possible to use the material for analog quantum simulation – a branch of quantum computing," Vera says when asked about the potential applications of a metamaterial of this kind. "The idea is to "reconstruct" the quantum system with components that obey the laws of quantum physics and that can simulate a specific quantum problem. The metamaterial I studied could be coupled to a qubit in order to study loss mechanisms in quantum systems," she adds.

Design, simulation and analysis

Vera began by designing the structure on the computer and calculating its theoretical properties using simulations. The structure was then produced by colleagues from her working group at EPFL. In subsequent practical experiments at temperatures close to absolute zero, Vera was able to verify the reliability of the simulations. "We were pleasantly surprised at how well the simulations agreed with the actual results," she says, summarizing this initial phase of her work.

In Vera's case, the master's thesis at EPFL came about thanks to a contact of her project supervisor, Jann Hinnerk Ungerer from the Schönenberger team at the Department of Physics. "The topic was very interesting and also gave me a chance to get to know another research institution outside of the University of Basel," says Vera.

Vera Weibel will receive one of the two prizes for the best master's thesis in nanoscience at the University of Basel in 2022. In this thesis, she investigated a superconducting metamaterial.

Further information:

Research group- Pasquale Scarlino, EPFL
https://www.epfl.ch/labs/hqc/

Short video with Vera and Mathias
https://youtu.be/DyoPupfgaMs

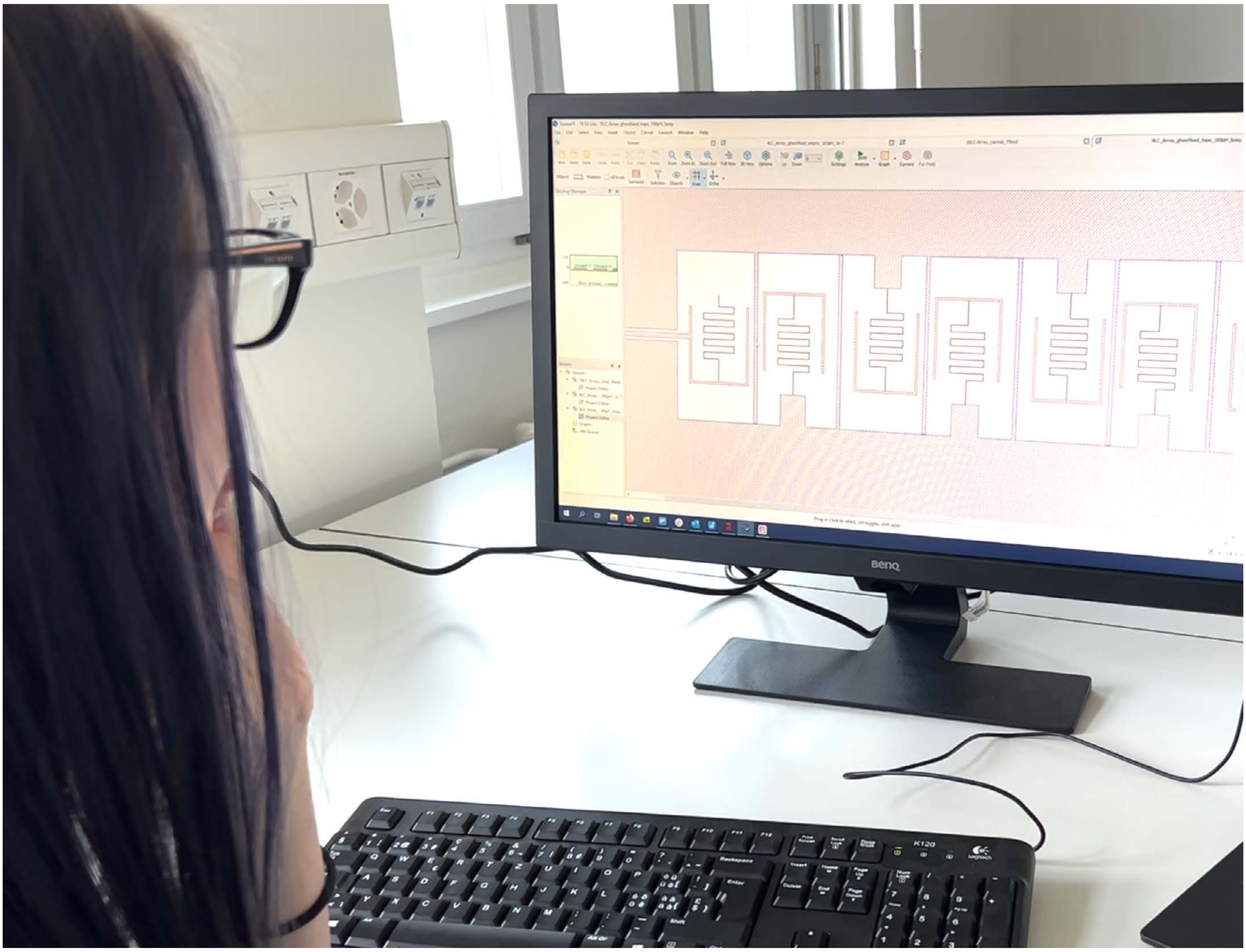
She had a great time in Lausanne, brushed up on her French and learned a great deal. At the same time, she experienced the advantages and disadvantages of working at a significantly larger institution. "For example, the clean room at EPFL was better than the one in Basel. On the other hand, the sheer size of the institution meant that I had significantly less contact with other research groups," she says. The situation in Basel is quite different – especially among the nanoscience students! This small group of students are very well connected with one another and regularly exchange ideas.

Not what she expected

When she started studying nanoscience, Vera didn't imagine that she would one day complete her master's thesis in experimental physics. After all, she first attended the bachelor's information day at the University of Basel in 2015 because she was interested in studying biology.

"That was when I heard about the nanosciences degree for the first time, and I was sold on the idea immediately," she recalls. "I thought it was great that the nanosciences degree began by giving us an insight into all of the natural sciences and that only later did we decide what we wanted to study in greater depth."

After starting the degree, it took Vera a while to develop her passion for experimental physics. "In the block courses during the bachelor's program, I primarily chose courses relating to biology and IT. Then, during the master's program, I realized I was particularly interested in experimental physics and gradually began to focus on that area."
That being said, she doesn't regret having gained considerable experience in other subject areas, and she would begin her scientific career with a nanosciences degree in Basel again in a heartbeat. "The interdisciplinary nature of the program really taught me to



Vera first designed the superconducting metamaterial on the computer and used simulations to theoretically calculate its properties.

think in a joined-up manner and to familiarize myself with new topics quickly," she says.

The next milestone: a doctoral dissertation

Indeed, Vera is already familiarizing herself with another new topic. In March 2022, she began her doctoral dissertation in Professor Andrea Hofmann's newly founded group at the Department of Physics of the University of Basel. She is studying specific quantum mechanical states in germanium-silicon heterostructures that she hopes to couple with a superconductor. In this work, Vera benefits not only from her knowledge of semiconductors that she gained from her master's thesis, but above all from the organizational skills that she picked up during her studies and wide-ranging project work.

Vera is looking forward to the months and years ahead as she works on her dissertation, which has got off to a very positive start. "I'm in a great young team and have really enjoyed the work so far," she says.

"What particularly impressed me about this work was the amazing agreement between the theoretical prediction and the experiment."

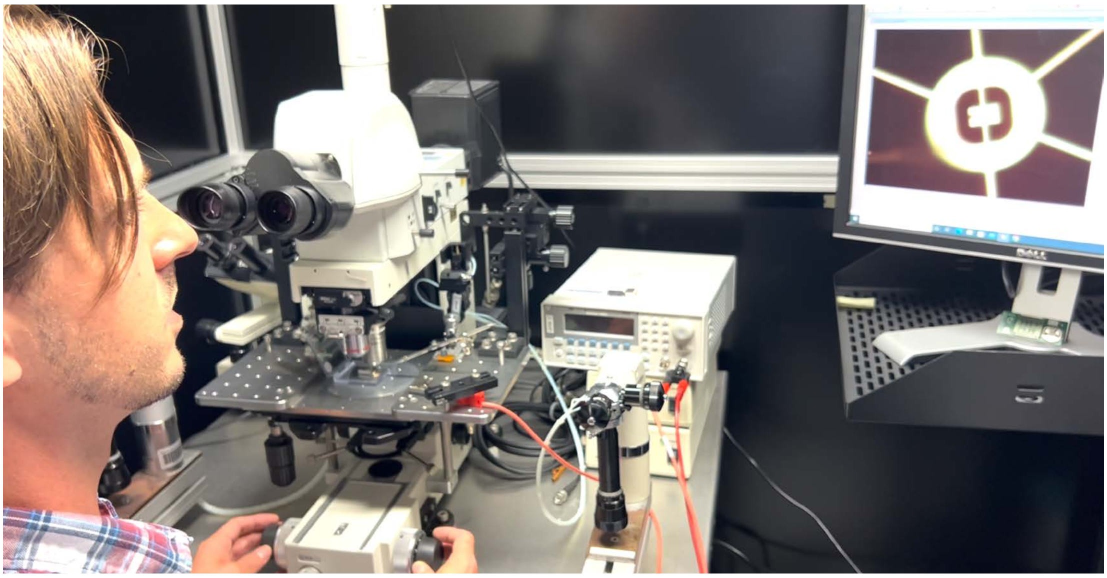
Professor Christian Schönenberger, Department of Physics, University of Basel

Precise data on tiny magnets

Mathias Claus has developed a sensor that can be used to analyze the magnetism of tiny magnets

For his prizewinning master's project in Professor Martino Poggio's group at the Department of Physics of the University of Basel, Mathias Claus developed a torsion rocker that can be used to study the magnetization of tiny magnets in precise detail. His project was so successful that he began a doctoral dissertation immediately after his master's with a view to optimizing the sensor so that it can also be used to investigate new, extremely thin, two-dimensional magnetic materials.

Mathias Claus also wins the prize for the best master's thesis in nanoscience at the University of Basel. He has developed a sensor that can be used to analyze the magnetism of tiny magnets.


To display the torsion rocker Mathias needs to use a microscope.

Further information:

Research group Poggio
https://poggiolab.unibas.ch

Short video with Mathias and Vera
https://youtu.be/DyoPupfgaMs

Fixed at two ends

The magnetization of small magnets is often analyzed by using tiny cantilever probes to scan the sample. For his master's thesis, Mathias Claus has now explored a promising new way of studying the magnetization of extremely small magnets using a torque sensor that is also known as a "torsion rocker." This mini seesaw is attached to springs on the right and left, causing it to swing back and forth like a pendulum at a specific frequency.

"Now, if we place a small magnet on this torsion rocker and apply an external magnetic field, the oscillation frequency of the sensor changes. How the frequency changes depends primarily on the magnetization of the tiny magnet," explains Mathias Claus. "The measured change in frequency allows us to draw conclusions about the magnetic properties of the magnet."

In this work, the researchers are assisted by previous computer simulations, which can be used to calculate the vibrational frequency changes as a function of magnetization. "The more closely the simulations agree with the measurement results, the more accurate the image we obtain of the magnetization and the more meaningful our analyses become," explains Mathias.

Also suitable for superconductors

The sensor system that Mathias developed and tested for his master's thesis can also be used to describe superconductors more accurately. To do this, the researchers position the circular superconductor in question on the torsion rocker, induce an electrical current within it, and change the temperature in the system. When they reach the critical temperature – that is, the temperature at which the superconductor conducts electric current without resistance – there is a dramatic change in the flow of current and therefore also in the magnetic field. In turn, this change can be measured based on the change in the oscillation frequency of the torsion rocker.

"The most impressive part about Mathias' work is that we started with an idea for the ideal magnetic torque sensor at the nanoscale. Over the course of his project, Mathias developed a state-of-the-art fabrication process and, after testing the sensor, showed that it actually outperforms some of the previously used sensors."

Professor Martino Poggio, Department of Physics, University of Basel

Ongoing research

Mathias finds this topic so fascinating that he is continuing his research into the special new type of sensor immediately after his master's degree – albeit now as a PhD student at the SNI PhD School. His work is supervised by Professor Ilaria Zardo and Professor Martino Poggio from the Department of Physics of the University of Basel.

The researchers are confident that a torque sensor of this kind could achieve significantly greater sensitivity than conventional cantilever sensors. There is still a lot of work to do, however. "Right now, I'm working on improving the quality factor of my device," says Mathias. "With this in mind, it's important to shield the lattice vibrations (phonons) of the torsion rocker so that fewer phonons from outside can couple with the sensor. At the same time, it's also important to minimize the loss of phonons, which we need for the measurements."

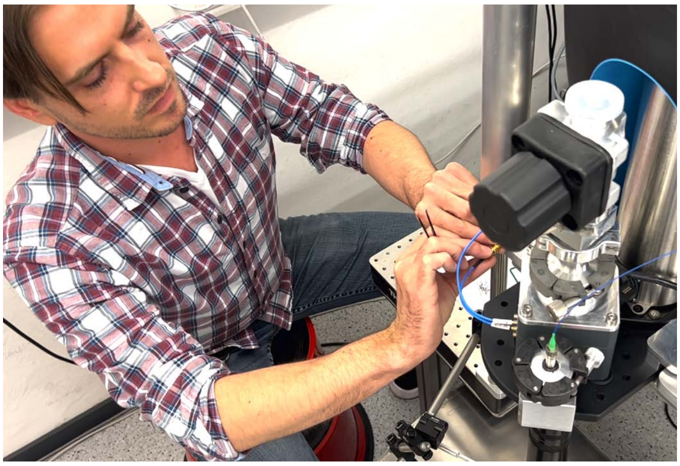
Mathias will subsequently establish a standardized production process and attempt to use the new sensor to characterize the magnetic properties of extremely thin, two-dimensional heteromaterials.

Above all, Mathias's research will contribute to basic scientific analyses of micro and nano magnets. The new two-dimensional heterostructures that he wants to study have numerous potential applications in electronics, sensors and computer technology.

A latecomer to the world of physics

With this topic, Mathias has stumbled across a task that he really enjoys. "It's fascinating how new lithographic methods allow us to produce such tiny structures – it's almost like art," he says.

It was only while doing his bachelor's degree in nanosciences that Mathias developed a fascination with



For his doctoral thesis, Mathias is optimizing the sensor he developed in his master's thesis.

nanofabrication and physics. When he began the nanoscience degree in 2015, he was interested above all in the interdisciplinary and biological aspects of the program. Gradually, however, Mathias started to sense that physics was also the driving force behind many achievements in biology and medicine – and so he tried doing a block course in physics, as he explains: "I did a block course with Professor Zumbühl at the Cryo Lab and realized that I could do it when I put my mind to it."

It's now clear that things turned out for the best. For Mathias, the decision to leave Eastern Switzerland for Basel many years ago and to embark upon a nanoscience degree was absolutely the right choice. As well as the fascinating interdisciplinary curriculum, he particularly enjoyed the close contact with other students and lecturers. "I felt comfortable here in Basel right from the outset, and I'm now delighted to be able to continue my research within a fantastic team and as a member of the SNI PhD School."

Annual Report 2021

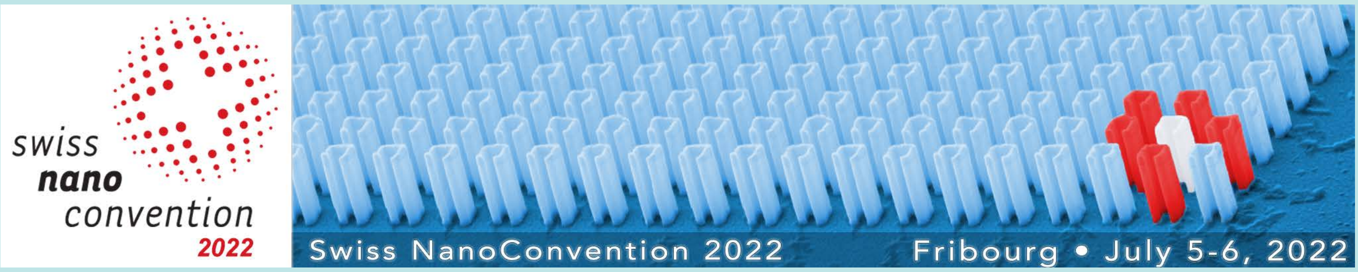
It has proven effective to publish the SNI Annual Report in two parts, with the general part providing a concise summary of all SNI activities relating to the network, the nanoscience program, the PhD School, and basic and applied research, as well as services and communication activities over the previous year.

We've now made this general part even shorter and clearer so that all interested parties can gain a quick overview of the SNI's work. In addition, the scientific supplement provides descriptions of progress made in all SNI-funded research projects in the Nano Argovia program and the SNI PhD School.

Annual Report 2021 (English)
Jahresbericht 2021 (German)
Scientific supplement 2021 (English)

In another new feature this year, we've also produced a summary of 2021 in pictures:

Video looking back on 2021 with statements by various SNI members (with German or English subtitles, 7:50 minutes)
Short version (English, 1:50 Minuten)



Swiss NanoConvention 2022

The next Swiss NanoConvention will be held in Fribourg from 5 to 6 July.

https://swissnanoconvention.ch/2022/

The convention is being organized as a face-to-face event and registration is now open. As a member of the SNI, you are entitled to free entry. If you haven't yet received information about the code, please write to:
outreach-sni@unibas.ch

Nano Argovia projects

Over the next few pages, we provide a summary of the four new applied Nano Argovia projects that we launched in 2022.

The projects ACHROMATIX, Hydrogel-Patch, LIGARECO, Nanocompass, NanoLase, NANO-thru-BBB and PEPS were launched in 2021 and are to receive funding for a further year. The project HPDET-EM has been extended on a cost-neutral basis until the end of 2022.

A robust combination in the fight against cancer

In the Nano Argovia project B7H3 Nanobody PC, researchers are developing an innovative nanobody-polymer conjugate – a combination of a cell-specific nanobody and a polymer substrate that can be loaded with different active substances. This is intended for use in the fight against cancer, where the aim is for the nanobody-polymer conjugate to be able to cross the blood-brain barrier and bind to a specific target molecule on the surface of cancer cells. Depending on the active substance that is subsequently released, it may allow the successful combating or imaging of cancer cells in the brain.

Nanobodies that bind to specific molecules

Despite significant advances in research, cancer remains one of the most common and deadly diseases in the Western world. Nowadays, conventional treatments such as chemotherapy and radiotherapy are often complemented by antibody-containing medications that bind to very specific molecules on the surface of cancer cells. Nanobodies – also known as single-domain antibodies – are developed in order to specifically bind to proteins that are particularly commonplace in this location. If these nanobodies are combined with polymer substrates, which can be loaded with various therapeutic or diagnostic active substances, they also pave the way for new treatment approaches. These nanobody-polymer conjugates are more robust than antibodies and only about a tenth of the size, and the researchers aim to vary their composition to allow them to cross the blood-brain barrier.

In the Nano Argovia project B7H3 Nanobody PC, a team of scientists led by Dr. Christian Geraths (CIS Pharma AG) is combining a newly developed humanized nanobody with a technology developed by CIS Pharma that allows polymer substrates to be loaded with a therapeutic payload or a diagnostic reagent.

The target molecule selected by the team of researchers from CIS Pharma, the FHNW School of Life Sciences, the Paul Scherrer Institute PSI and the University Children's Hospital Zurich (without funding from the SNI) is a protein that is produced in greater quantities on the surface of cancer cells in some 60 percent of cancers. For this reason, the newly developed nanobodies specifically bind to this type of tumor cells in order to release their cargo into them in a controlled manner without attacking healthy cells.

Suitable for therapy and diagnostics

The scientists are also exploring the possibility of using the nanobody-polymer conjugate to specifically target cancer cells with growth-inhibiting substances (e.g. radioactive isotopes). In addition, they are investigating whether the method is suitable for monitoring courses of treatment or for use in early detection.

Dr. Daniela Winkler and Michael Hackebeil from CIS Pharma produce the polymer carrier used in the Nano Argovia project. (Image: CIS Pharma)

Further Information:

Nano Argovia program
www.nanoargovia.swiss

CIS Pharma AG
https://www.cis-pharma.com

FHNW School of Life Sciences
https://www.fhnw.ch/de/die-fhnw/hochschulen/lifesciences

Paul Scherrer Institute
https://www.psi.ch/en

University Children's Hospital Zurich
https://www.kispi.uzh.ch

This approach might also be successful at treating brain tumors (glioblastoma), which has so far only been possible to a limited extent. Here, it is necessary for active substances to cross the blood-brain barrier – and the plan is to achieve this using the nanobody-polymer conjugate.

> "We're optimistic that our modular technology, with its high degree of flexibility, will also be suitable for diagnosing and treating cancers that require substances to cross the blood-brain barrier."

Dr. Christian Geraths, CSO at CIS Pharma AG

Effect of cosmic radiation on power semiconductors

In the Nano Argovia project CRONOS, an interdisciplinary team of scientists is studying the effect of cosmic radiation on specific layers in power semiconductors. The researchers want to gain a better understanding of which physical processes can lead to failures in order to apply these insights to the development of power semiconductors offering greater robustness.

Suitable for high currents and voltages

Fossil fuels are out. Instead, an increasing number of applications are being electrified and supplied with energy from renewable sources. This process calls for semiconductor components that are designed to handle high currents and voltages.

Crucially, the functionality of these modern power semiconductors depends on the reliability and integrity of the "gate oxide layer" – a layer between the gate electrode and the semiconductor substrate. Typically just 50–100 nanometers thick, this layer is required to prevent leakage currents. When used in outdoor applications, such as in electric vehicles, solar installations or wind turbines, the gate oxide layers are exposed to large temperature variations, moisture and even cosmic radiation for a period of many years. Despite these harsh environmental conditions, their properties must not change – and the layers must continue to operate reliably over a long period of time without malfunctioning.

Load test with exposure to radiation

In the Nano Argovia project CRONOS, researchers from the FHNW School of Engineering (Windisch), the ANAXAM technology transfer center and the industrial partner SwissSEM Technologies AG (Lenzburg) are investigating how reliably these nanoscale gate oxide layers operate under controlled exposure to cosmic radiation. To do this, the researchers simulate cosmic radiation by irradiating power semiconductors with protons and neutrons while simultaneously applying a voltage. The team, which is led by Professor Renato Minamisawa and Professor Nicola Schulz (both from the FHNW), then subjects the gate oxide layers to electrical and thermal load testing.

Seen here loaded with semiconductor chips for the planned irradiation experiments, the sample holder was developed as part of the Nano Argovia project CRONOS. (Image: FHNW Windisch)

"For us, the Nano Argovia project CRONOS is an ideal opportunity to work with experts in the field of power semiconductors and material analysis and to benefit from their expertise."

Dr. Arnost Kopta, CTO SwissSEM Technologies AG

Developed and supplied by the industrial partner SwissSEM Technologies, the power semiconductors are insulated-gate bipolar transistors (IGBTs) that can be used in many high-power applications where electric energy needs to be converted into a specific form, for instance in electric vehicles.

By studying the power semiconductors in detail, the researchers hope to gain a better understanding of the physical processes that cause components to fail when cosmic radiation penetrates the gate oxide layers. They then hope to apply this understanding to the development of more-robust power semiconductors.

Further information:

Nano Argovia program
www.nanoargovia.swiss

SwissSEM GmbH
https://www.swiss-sem.com

FHNW School of Engineering
https://www.fhnw.ch/de/die-fhnw/hochschulen/ht

ANAXAM
https://www.anaxam.ch/en

Function test before flash-freezing

In the Nano Argovia project FuncEM, researchers are developing an extension of the cryoWriter system, which can be used to flash-freeze tiny quantities of samples – with no loss of material – before they are examined using cryo-electron microscopy. The aim is for the planned extension module to allow "living" samples to be imaged under an optical microscope immediately prior to the freezing process. This will allow researchers to obtain important information about the functionality of the analyzed structures.

Further information:

Nano Argovia program
www.nanoargovia.swiss

cryoWrite AG
https://opencorporates.com/companies/ch/1447480

Research group Thomas Braun
https://bit.ly/3kLY2TW

Paul Scherrer Institute
https://www.psi.ch/en

Preparation of tiny sample quantities

It's hard to imagine modern biomedical and basic research without cryo-electron microscopy (cryo-EM), a technique that allows detailed three-dimensional imaging of tiny structures in biological samples.

The young start-up cryoWrite AG has developed a sample preparation system that can be used to instantly cool tiny quantities of sample materials down to temperatures below -150°C with no loss of material. In the process, the water contained within the sample does not form crystals but rather adopts a glass-like state in a process known as vitrification. As this process leaves the molecules in the cells intact, cryo-EM can then be used to examine them very closely and visualize their three-dimensional structure.

Correlation between structure and function

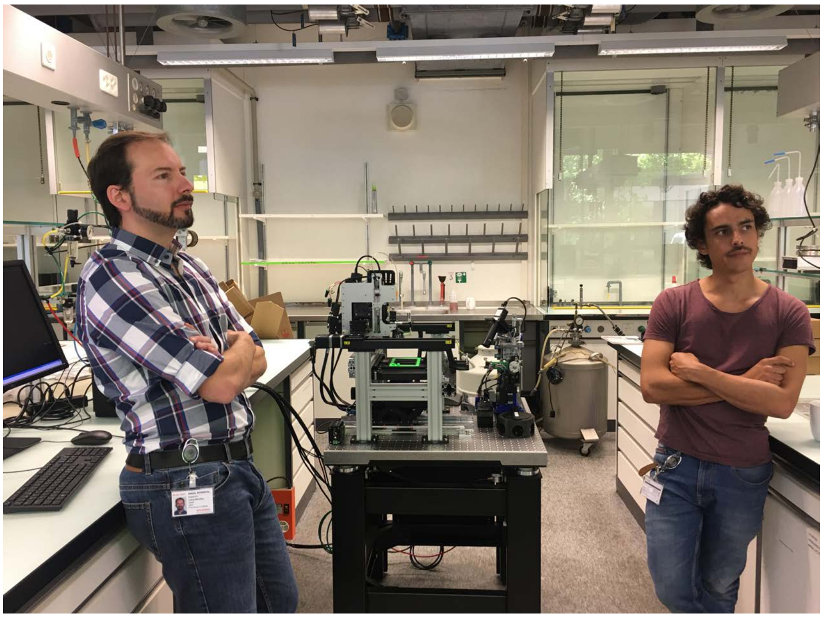
In many situations, it would be useful for researchers to be able to examine the functionality of target structures in living samples immediately prior to vitrification with a view to analyzing correlations between structure and function.

As part of the Nano Argovia project FuncEM, researchers from the University of Basel, the Paul Scherrer Institute PSI and the company cryoWrite are therefore developing and testing an extension module for the cryoWriter system that allows the thin sample layer to be imaged using fluorescence and dark-field microscopy immediately prior to vitrification.

Under the leadership of Dr. Thomas Braun from the Biozentrum, this interdisciplinary team is initially focused on examining thin organelles known as cilia. These threadlike projections play an important role in the movement of eukaryotic cells and in numerous diseases.

The researchers are carrying out their analyses using a newly developed prototype of the cryoWriter system, which allows the sample to be examined directly on the sample holder using optical and fluorescence microscopy.

In this process, the sample environment ensures cell survival and does not restrict the motility of the cilia. The team is also planning to set up a monitoring system to record the movements of these organelles. As these examinations will take place on the same sample holder immediately prior to sample vitrification, they will allow researchers to establish a direct link between functionality and the identified structure.



Nicolas Candia and Alejandro Lorca Mouliaà of cryoWrite are working with the Nano Argovia project team to further develop cryoWrite technology. (Image: cryoWrite)

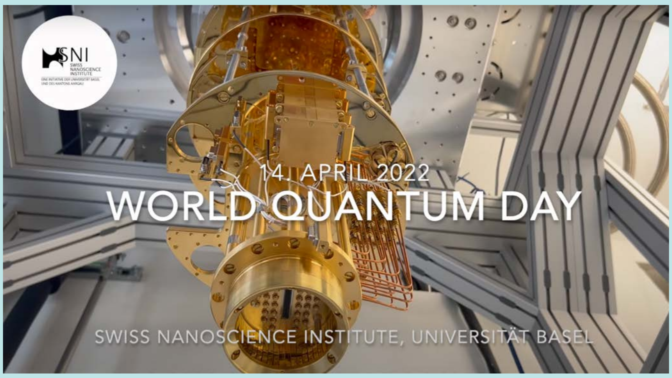
“The Nano Argovia program is a fantastic opportunity for us to refine our new prototype in collaboration with specialists from the Biozentrum and the Paul Scherrer Institute, thereby improving our opportunities in the marketplace.”

Professor Andreas Engel, CEO at cryoWrite AG

Other videos

We’ve produced numerous informative videos in recent months. To mark World Quantum Day on 14 April, for example, we asked people on the street and researchers from the SNI network what quanta actually are and what’s so special about them. Video (German with English subtitles): https://youtu.be/ksL7Lvp2Yaw

Other videos demonstrate short, entertaining experiments for the whole family. For example, one video provides instructions for building a Cartesian diver: https://youtu.be/GzhoWZnwwBc



Check out the full range of videos from the SNI on our YouTube channel: https://bit.ly/3u9XLjv

Foldable and rollable in the future

In the Nano Argovia project META-DISPLAYS, scientists are developing a component for rollable and foldable displays that will specifically alter and control the propagation of light. This "metasurface phase retarder" must be color-neutral and allow good transmission of light – although it should also reduce back reflections and thereby maximize contrast. Above all, it must be extremely thin so that the screen remains highly flexible.

Further information:

Nano Argovia program
www.nanoargovia.swiss

Rolic Technologies Ltd.
https://on.basf.com/3xtllYA

CSEM
https://www.csem.ch/Home

Paul Scherrer Institute
https://www.psi.ch/en

Various requirements

In the future, there will be an increasing number of foldable and rollable screens, tablets and smartphones. To ensure high flexibility, the components incorporated into these devices need to be thinner than their conventional counterparts. It is also necessary to reduce the back reflection of ambient light in order to maximize display contrast.

To this end, researchers from CSEM Muttenz, the Paul Scherrer Institute PSI and Rolic Technologies Ltd. are participating in the Nano Argovia project META-DISPLAYS with a view to developing a "metasurface phase retarder" that – in combination with a polarizer – will meet these conditions while remaining highly transparent.

Promising structured surfaces

A metasurface phase retarder has tiny, nanoscale structures on its surface that enable highly effective control of the phases of an electromagnetic field emitted by a light

In the future, greater use will be made of flexible screens. (Image: Rolic Technologies)

"A metasurface device will enable Rolic to strengthen its competitive advantage as a material supplier to the display industry. In addition, metasurface technology has great potential in other segments of consumer electronics – for example, as flat screen elements in smartphones."

Dr. Richard Frantz, Head of Development, Rolic Technologies Ltd.

source. Using state-of-the-art lithographic methods, it's possible to structure the surfaces of these phase retarders in different ways to achieve the necessary high level of phase retardation of light passing through a layer with a thickness of only a few hundred nanometers.

Led by Dr. Benjamin Gallinet (CSEM), the team will test different surface nanostructures with a view to identifying a combination that can reduce the thickness of the phase retarder while achieving high transmission and color neutrality. For this, the researchers are using nanotechnology-based lithography methods (ultraviolet nanoimprint lithography) that can also be applied on an industrial scale.

More modern and simpler
The new logo of the SNI

From June onward, the Swiss Nanoscience Institute will use its new and improved logo.

Simpler, more modern and with better brand recognition, the SNI logo has been revamped with the help of Basel-based branding agency STUDIO NEO. Professional versions are now available in German and English for various uses.

The new logo alludes to the waves seen on the coat of arms of the Canton of Aargau, as seen in the old version, and the jigsaw piece in the old logo is now incorporated into the SNI lettering. Above all, the descriptor has also been changed to reflect the fact that the SNI has long since outgrown its original status as an initiative to become an established center of excellence for nanosciences in Northwestern Switzerland.

Please use the new logo exclusively from 1 June. You find the logo on our web page (https://nanoscience.ch/de/media-2/download-logo/). We will be delighted to provide you with files if you need other formats (c.moeller@unibas.ch).

SNI
Swiss Nanoscience Institute
Center of Excellence supported
by the University of Basel
and the Canton of Aargau

SNI
Swiss Nanoscience Institute
Exzellenzzentrum
der Universität Basel und
des Kantons Aargau

SNI
Swiss Nanoscience Institute
Exzellenzzentrum
der Universität Basel und
des Kantons Aargau

Events

As we slowly return to normality and are able to participate in face-to-face events again, it’s great to get together with colleagues instead of just seeing them sitting in front of a screen. Above all, it’s in the interactions with children that we can now see what we were missing over recent months.

Inauguration of the new TEM/STEM

A highlight for the team of the Nano Imaging Lab and its users

Further information:

Article in SNI INSight (December 2021)
https://bit.ly/3r53pAn

Contact person for the TEM/STEM
marcus.wyss@unibas.ch

Contact person for the NI Lab
markus.duerrenberger@unibas.ch

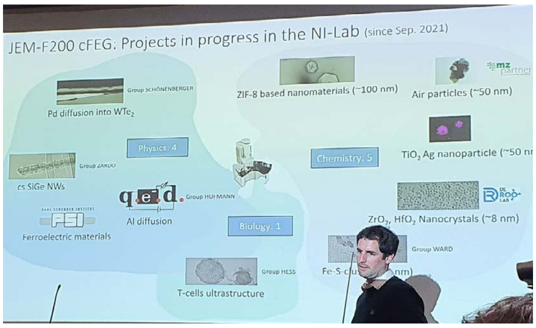
In May, the Nano Imaging Lab (NI Lab) presented its new transmission electron microscope (JEM-F200) to the public. The inauguration was a chance for some 30 guests from various departments of the University of Basel, the University of Applied Sciences and Arts Northwestern Switzerland and the company Sauter to witness the quality and the wide range of applications of the new instrument for themselves.

Following an introduction to the subject matter by SNI Director Professor Christian Schönenberger and the head of the NI Lab, Dr. Markus Dürrenberger, the specifics of the new TEM/STEM were explored in a presentation by Dr. Marcus Wyss, who is responsible for the new instrument at the NI Lab. As well as explaining the advantages offered by the new machine, Wyss also examined the physical, chemical and biological questions that the JEM-F200 is suitable for solving and the projects it has already tackled.

The event concluded with a guided tour of the NI Lab’s laboratories before the participants came together for a drinks reception and a chance to engage in further discussions regarding imaging and analysis.

“I find the high resolution images delivered by the new TEM/STEM fascinating, and I’m looking forward to seeing it enter widespread use.”

Professor Christian Schönenberger, Department of Physics, University of Basel



The new TEM/STEM of the NI Lab is already being used in numerous scientific projects, as Marcus Wyss explains in his presentation. (Image: S. Erpel, NI Lab, University of Basel)

Participants received a detailed explanation of the new TEM/STEM so that they could better understand the applications to which the instrument is particularly suited. (Image: S. Erpel, NI Lab, University of Basel)

Opportunity for SNI members

Electron Diffraction Experience Center inaugurated in Basel

In 1928, a groundbreaking experiment by Devisson and Germer showed that electrons are diffracted like waves, thereby confirming the theory of quantum mechanics. Almost 100 years later, the young start-up ELDICO Scientific has inaugurated the Electron Diffraction Experience Center in Basel, where this phenomenon can be used to determine 3D structures.

Eric Hovestreydt, co-founder and Chief Commercial Officer of ELDICO, welcomes visitors to the opening ceremony of the "Electron Diffraction Experience Center" at the Innovation Park Allschwil. (Image: ELDICO Scientific)

On 30 March, an opening ceremony was held to inaugurate the Electron Diffraction Experience Center at Switzerland Innovation Park Basel Area. The event provided participants including international experts from science and industry with an opportunity to discuss how electrons can be used to improve the characterization of crystals.

Crystallographic analyses have traditionally been carried out using X-rays in a technique whereby an X-ray beam strikes a crystal and forms a diffraction pattern on a detector. This pattern can then be used to deduce the structure of the sample. Electron diffraction works according to the same principle, albeit using electrons instead of X-rays.

One key advantage is that it does away with the tedious – and sometimes impossible – process of preparing large crystals. The fact that electrons interact with matter more strongly than X-rays means they can provide unadulterated data even from nanoscopic crystals, thereby delivering a decisive advantage in numerous applications.

Nano Argovia project lays the foundations

For example, the determination of the three-dimensional structure of organic molecules such as proteins or pharmaceutical compounds is another area in which electron-beam diffraction will play an important role in the future. Working with a team within the framework of the Nano Argovia project A3EDPI, Dr. Tim Grüne had shown that this approach was effective and that structural elucidation using electron-beam diffraction was even possible with organic substances.

Further information:

ELDICO scientific
https://www.eldico-scientific.com

Reports in SNI INSight
https://bit.ly/3wD29Hh
https://bit.ly/3ucL9lg

Interested parties should please contact
projects@eldico.ch

The on-site scientific team will get back to you immediately.

Based on these findings, ELDICO Scientific has now developed and launched an electron diffractometer. The first instrument (the ELDICO ED-1) is now at the disposal of the Electron Diffraction Experience Center in Basel.

As the SNI is the academic partner within the four-way consortium, SNI members now have access to this innovative and promising technology.

> "With the electron diffractometer, we can facilitate the entry of academic crystallographers into nanocrystallography. We look forward to receiving many interesting samples from SNI researchers and hope to work closely together with numerous scientific publications."

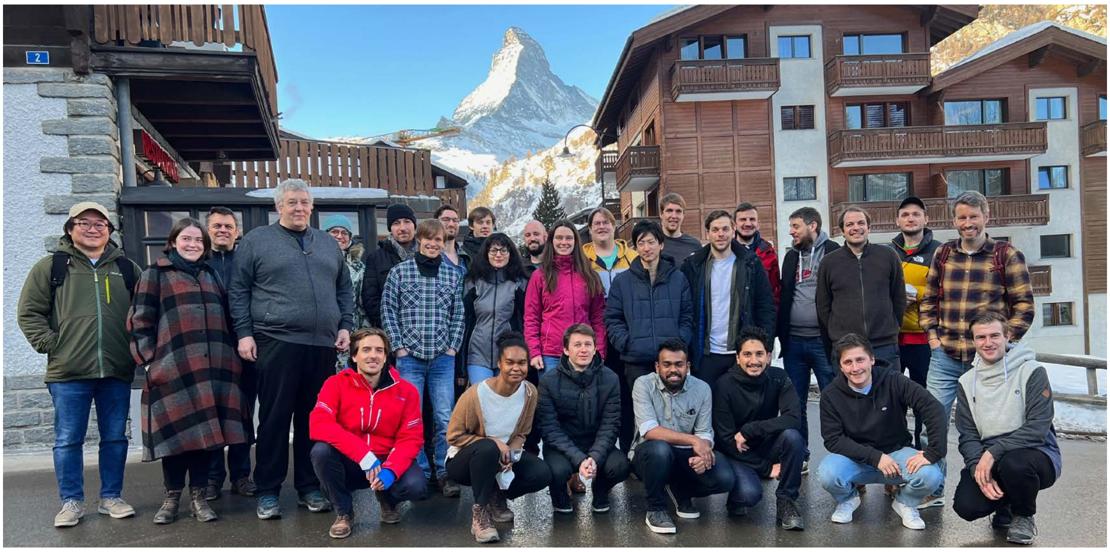
Dr. Eric Hovestreydt, Founder and Chief Commercial Officer of ELDICO.

Highlights from Nanoscience in the Snow 2022

Video
https://youtu.be/KfnFZbJneOc

Nanoscience in the Snow
Always a refreshing and inspiring experience

Going by the name of "Nanoscience in the Snow," the SNI Winter School is always a highlight for SNI PhD students. It is an opportunity for them to discuss their wide-ranging dissertation projects in an informal setting and to spend a few hours together in the snow in different regions of the Swiss Alps.



After a forced hiatus due to the coronavirus pandemic, "Nanoscience in the Snow" was held in Zermatt in January this year. Despite great weather and a breathtaking backdrop, none of the participants struggled to focus on the numerous scientific talks.

"I was really impressed by the quality of all the talks," says Dr. Andreas Baumgartner, coordinator of the SNI PhD School. "It really pays dividends that we not only provide our doctoral students with scientific training but also offer them courses on public speaking."

Capri Spring School

Electron transport in a beautiful setting

Since 2015, the Swiss Nanoscience Institute has supported the Capri Spring School for doctoral students as well as several postdocs working on nanoscale electronic transport. After a two-year hiatus due to the COVID pandemic, the return of this one-week conference in May 2022 allowed 35 young researchers to benefit from the knowledge of leading international scientists. Between discussions about their research, participants also found time to discover the beautiful surroundings of the event – and to make some new contacts.

A small island and tiny objects of research

It was 18 years ago that doctoral students from across Europe first met in Capri, Italy, to exchange ideas and learn more about electronic transport processes. At this project meeting, a team of researchers led by Professor Hermann Grabert from the University of Freiburg, Germany, all of whom were collaborators in the EU project DIENOW, were so captivated by the particular charm of Capri that they established the Capri Spring School.

In 2006, Professor Christian Schönenberger was invited to speak at the conference – and was also impressed with its unique atmosphere. "I was delighted with the Spring School, which provided a relaxed, informal atmosphere where doctoral students could get together with top-class scientists. At the SNI, we therefore decided to support this wonderful, small-scale conference with a view to building up the SNI's links on the international stage," recalls Schönenberger.

Many more applicants than places

Today, the Capri Spring School is very well established and attracts around four times as many applications from interested doctoral students than the number of places available. "Every year, the organizing team chooses a topic," explains Dr. Dario Bercioux (Donostia International Physics Center (DIPC) in San Sebastián, Spain), who is one of the main organizers, "and then we select the participants based on their area of work and their CV." Only one person is allowed to attend from each working group. As word of the high quality of the Capri Spring School has got around, the conference now serves as a meeting place for doctoral students and a few postdocs from all over the world each spring.

In Capri, the participants enjoy excellent talks by leading international researchers and can even present their own research in the form of short talks and posters. Breaks and group dinners in a relaxed atmosphere offer them the chance to engage in a direct and straightforward exchange of ideas – in a way that would not be possible at a major international conference.

Every year, the organizers of the Capri Spring School put together an exciting program on a specific subject area. (From left to right: Alessandro De Martino (London, UK), Arturo Tagliacozzo (Naples, Italy), Hermann Grabert (Freiburg, Germany), Dario Bercioux (Donostia-San Sebastián, Spain), Christian Schönenberger (Basel, Switzerland), Reinhold Egger (Düsseldorf, Germany)

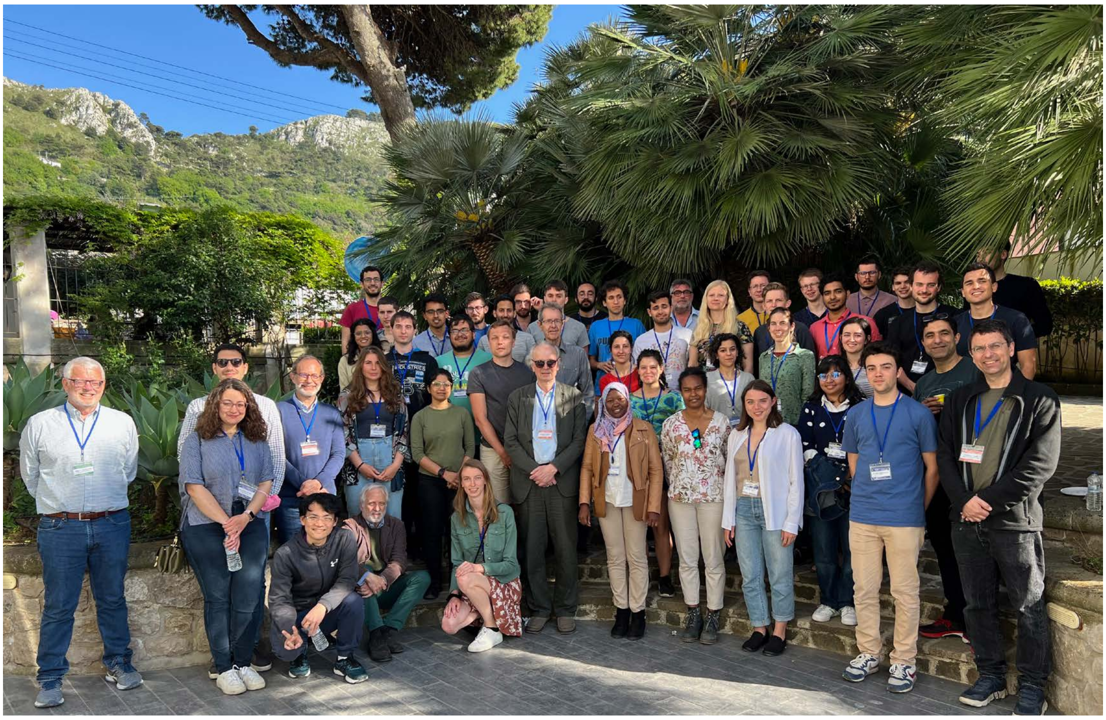
Two-dimensional materials

In 2022, most of the talks revolved around moiré patterns generated by two-dimensional materials. The organizers took care to offer an exciting mix of experimental and theoretical approaches, inviting researchers from Germany, Israel, Italy, Canada and the USA to speak at this year's event. All of the speakers delivered multiple talks so that the participating young researchers could benefit as much as possible from their wide-ranging knowledge.

Further information:

Web page Capri Spring School
http://www.capri-school.eu/

Video Capri Spring School 2022
https://youtu.be/zS2Op2zty58



In this beautiful setting, participants had the chance to discuss each other's research, make new contacts and gain new insights into electronic transport on the nanoscale.

An ideal networking opportunity

For participating doctoral students, the Capri Spring School was the perfect opportunity to get to know other PhD students working on similar topics. This year, the event was attended by two doctoral students from the University of Basel: Alexina Ollier, an SNI doctoral student in Professor Ernst Meyer's group, and Rounak Jha, a doctoral student working with Professor Christian Schönenberger. Both of them were delighted with the event.

"The Capri Spring School offered a unique chance to learn more about twisted bilayer graphene. It also provided an excellent opportunity to build a network of students working in a similar field and to have some discussion with the organizers and the speakers."

Alexina Ollier, SNI PhD student in the group of Professor Ernst Meyer, Department of Physics, University of Basel

“Voller Energie”
An exhibition all about water

On 6 March, Dr. Marc Seidel, the manager of Museum Burghalde in Lenzburg, opened the special exhibition “Voller Energie” (Full of energy), which was developed to mark the 100th anniversary of the Lenzburg municipal utilities. The Swiss Nanoscience Institute actively contributed to the new exhibition by setting up a water laboratory for researchers of all ages.

In this small but impressive exhibition, visitors now have the opportunity to experience diverse aspects of water and energy until 30 December 2022. The exhibition is accompanied by the comprehensive publication *Voller Energie*, which examines the subject area from various different perspectives.

For those who want not only to look and read but also to experience the unique properties of water for themselves, the exhibition also includes a small water laboratory that was developed by the SNI team. Here, various entertaining videos provide information on the physical and chemical properties of water, and numerous experiments invite visitors to experience and try things out for themselves.

Over the course of the year, the SNI’s outreach team will be involved in various events as well as offering a series of workshops.

Museum director Marc Seidel opened the special exhibition “Voller Energie” at the Burghalde Museum in Lenzburg in March. Numerous water-related experiments await researchers of all ages in the water laboratory.

Further information:

Web page Museum Burghalde
https://www.museumburghalde.ch/ausstellung/voller-energie-2.html

Video opening ceremony
https://youtu.be/l8JU7esmO2c

Videos about unique properties of water

Water in general
https://youtu.be/-cn3Cs3Rp_g

Aggregate states
https://youtu.be/r0ljhfKXkrg

Density anomaly
https://youtu.be/_FyBIR7yDP8

Surface tension
https://youtu.be/n3TeX7ZibSo

Thermal capacity, purity
https://youtu.be/G0GDx4KSjWE

tunBasel
Great for children and young people

May 2022 saw the return of tunBasel after a two-year hiatus, offering children and young people the chance to experience natural sciences and technology for themselves by taking part in numerous activities.

Further information:

Web page tunBasel
https://tunbasel.ch/experimente/338/

Impressions from the SNI booth
https://youtu.be/2zrXBCO_ylg

Video SNI experiments
https://www.youtube.com/watch?v=bTNlHnnv98I&t=5s

Together with the Department of Physics, the SNI also participated in this year's tunBasel by organizing entertaining activities relating to soap. With handwashing and hygiene on everyone's minds in recent months, what better way to express your creativity than by designing your own soap and experimenting with blowing some very unusual bubbles?

Many children and young people took advantage of this offer at the University of Basel's stand. They poured more than 33.5 kg of soap and refined it with a selection of fragrances and colors.

The children at the SNI/Physics booth poured more than 2800 bars of soap. The team from the SNI and the Department of Physics also consumed 80 liters of soap suds for beautiful and fancy soap bubbles.

If you're interested in an AFM workshop, please write to:
outreach-sni@unibas.ch

AFM workshop
An offer from the SNI

It's hard to imagine the world of modern research without atomic force microscopes (AFMs). These instruments help researchers around the world to shed light on physical, chemical and biological processes by visualizing the world of atoms and molecules and supporting all kinds of analytical processes.

For school classes, the SNI has offered workshops on atomic force technology for some time – and a class from the Kirschgarten high school recently took up this offer.

"We received a fascinating introduction to atomic force microscopy from the SNI outreach team and had the chance to dive into the micro and nano cosmos for ourselves using the portable AFMs provided by the SNI," says Sarah Müller, a teacher at the Kirschgarten high school who has a degree in nanosciences from the University of Basel. Together with her colleague Dan-Felix Scherrer (who also has a master's degree in nanosciences from Basel), Sarah developed a course for her students to help them gain a better un-

The students made a wooden model of an atomic force microscope to understand the principle of operation. (Image: M. Wegmann, SNI) derstanding of this totally alien world of tiny structures and nano phenomena.

The SNI's two outreach managers, Dr. Kerstin Beyer-Hans and Dr. Michèle Wegmann, adapt the workshop to the wishes of their target group. In most cases, they begin by building a wooden model of the AFM together with the students in order to illustrate how the instrument works.

Portable AFMs are then used to show the students how measurements are actually performed, allowing them to see the indentations (pits) on a CD, the irregularities on a butterfly's wing, or the fine details of folded DNA for the first time.

Using a portable AFM, the students were then able to experience real AFM measurements. (Image: M. Wegmann, SNI)

"We got a great introduction to atomic force microscopy from the SNI outreach team and were also able to dive into the micro- and nanocosmos ourselves with the portable AFMs provided by the SNI."

Sarah Müller, teacher at the Kirschgarten high school who has a degree in nanosciences from the University of Basel

Summer activity
UV beads sound alarm

Wouldn't it be great if kids asked for sunscreen voluntarily and it didn't take a lot of persuasion every time before putting it on? Maybe our cool UV alert bracelets will help!

We give away and raffle craft sets for UV alert bracelets (while supplies last).
Link

The bracelets feature UV-sensitive beads that change color when exposed to the sun. The bracelets are a reminder that UV rays cause sunburn and skin damage, and that applying sunscreen is an important way to protect against them. In addition, the UV beads can be used to conduct exciting experiments that show where and how strong the UV rays are.

Further information:

Videos

Experiments
https://youtu.be/o9sYuPps5fc

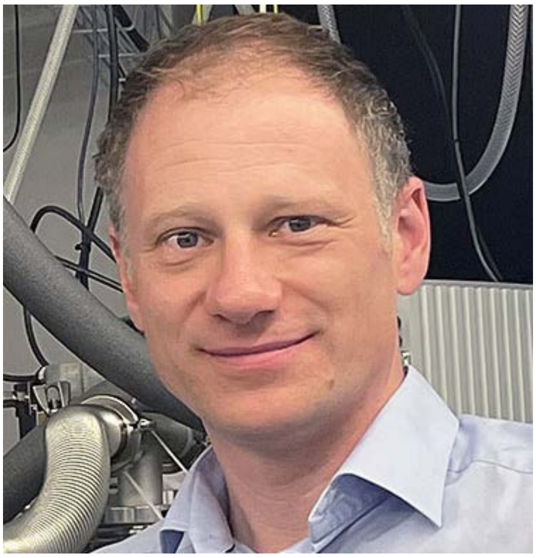
Pearl bracelets
https://youtu.be/G8RwbmfDGjo

Key ring
https://youtu.be/ZsBdDnpi-LI

Skipper knot bracelet
https://youtu.be/o1H2vxvmR8w

Weaver knot bracelet
https://youtu.be/ghuleD9sh3A

News from the SNI network



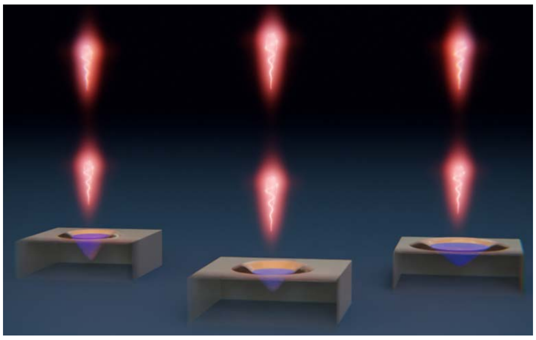
Prof. Stefan Willisch, Department of Chemistry, University of Basel (Image: Department of Chemistry, University of Basel)

Congratulations to Stefan Willitsch

The Swiss National Science Foundation (SNSF) has awarded Professor Stefan Willitsch from the Department of Chemistry with a highly endowed SNSF Advanced Grant.

In his project, chemist Prof. Stefan Willitsch will investigate how approaches from quantum logic can be used to study collisions of molecules and decipher the dynamics of chemical reactions.

Based on news from the University of Basel
https://bit.ly/3n4sqd4



Although the quantum dots produced by the Basel researchers are different, they emit identical light particles. (Image: Department of Physics, University of Basel)

Twin photons from unequal sources

Identical light particles (photons) are important for many technologies that are based on quantum physics. A team of researchers from Basel and Bochum has now produced identical photons with different quantum dots – an important step toward applications such as tap-proof communications and the quantum internet.

Uni News University of Basel
https://bit.ly/3OidkMN

Video
https://youtu.be/VluqCm5PFAY

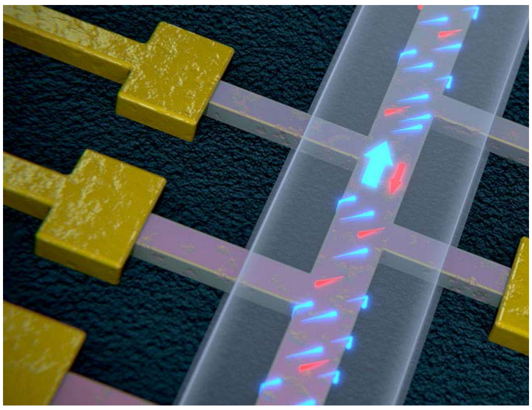
Original source
https://www.nature.com/articles/s41565-022-01131-2

Quantum one-way street in topological insulator nanowires

Very thin wires made of a topological insulator could enable highly stable qubits, the building blocks of future quantum computers. Scientists see a new result in topological insulator devices as an important step toward realizing the technology's potential.

Uni News University of Basel
https://bit.ly/3QrSLiU

Original source
https://www.nature.com/articles/s41565-022-01124-1



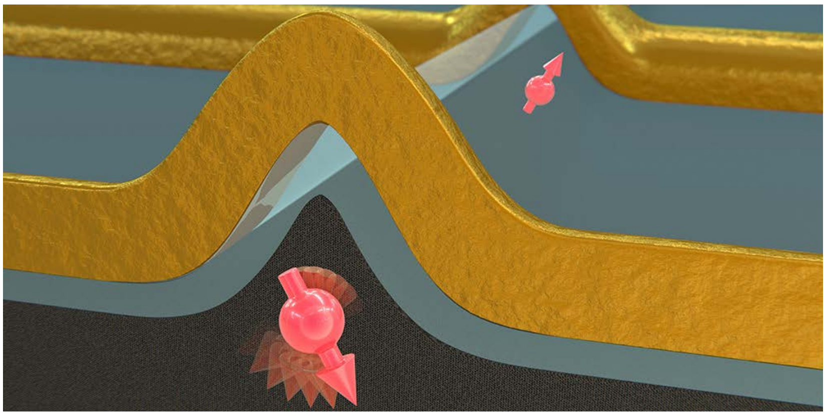
Applying a magnetic field causes current to flow more easily in one direction along the nanowire than in the opposite one. (Image: Department of Physics, University of Basel)

"Hot" spin quantum bits in silicon transistors

Quantum bits (qubits) are the smallest units of information in a quantum computer. Currently, one of the biggest challenges in developing this kind of powerful computer is scalability. A research group at the University of Basel, working with the IBM Research Laboratory in Rüschlikon, has made a breakthrough in this area.

Uni News, University of Basel
https://bit.ly/39B6IdR

Original source
https://www.nature.com/articles/s41928-022-00722-0



The newly developed qubits are based on so-called holes (red) whose spin (arrow) in one or the other direction stores the information. They are arranged in an architecture based on silicon transistors. (Illustration: NCCR Spin)

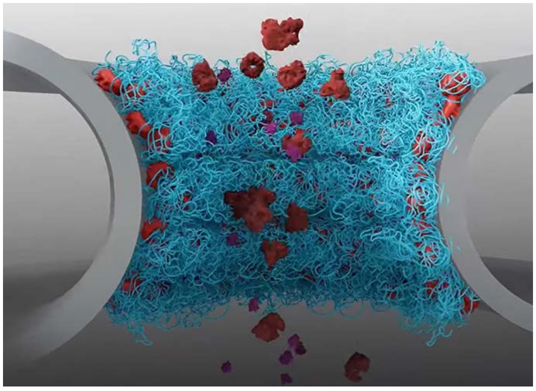


Illustration of the nuclear pore. (Image: Biozentrum, University of Basel)

Safeguarding the cell nucleus

The nucleus is guarded by a highly secure door, the so-called nuclear pore, thatcontrols the transport of substances from the cytoplasm to the cell nucleus and back. Aresearch group at the University of Basel has now shown that different shuttle proteinsoccupy the nuclear pore to prevent unsolicited leakage of molecules. These proteinsform an escape-proof, failsafe mechanism by compensating for one another to fortifythe pore.

Media release, University of Basel
https://bit.ly/3kRqFic

Original source
https://bit.ly/3Fo51f9

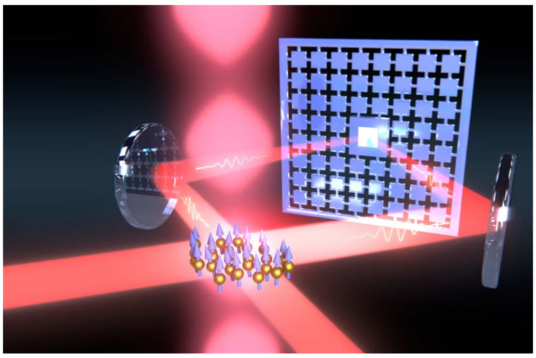
Cooling matter from a distance

Researchers from the University of Basel have succeeded in forming a control loop consisting of two quantum systems separated by a distance of one meter. Within this loop, one quantum system – a vibrating membrane – is cooled by the other – a cloud of atoms, and the two systems are coupled to one another by laser light. Interfaces such as this allow different kinds of quantum systems to interact with one another even over relatively large distances and will play a key role in quantum technologies of the future.

Media release, University of Basel
https://bit.ly/3sgF387

Original source:
https://bit.ly/3FBn0Pv

Video
https://youtu.be/gWER3ToDqNo



Light is used to couple a vibrating membrane to a cloud of atoms in order to form a control loop. The two different quantum systems — consisting of the membrane and the spins — therefore regulate one another's temperature with no need for external measurement. (Image: Department of Physics, University of Basel)

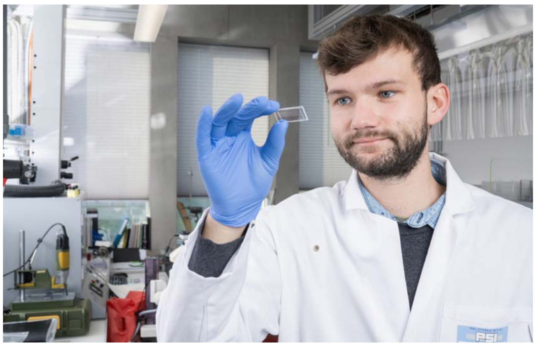
New rapid test could detect coronavirus and flu simultaneously

Researchers from the University of Basel and the Paul Scherrer Institute PSI have developed a rapid test for Covid-19 with a novel functional principle. Although it requires further testing and improvements, the initial results are promising: As well as determining whether a Covid-19 infection is present, the test also promises to provide information on the status of the disease. It could also detect other diseases and different coronavirus variants.

Media release, PSI and University of Basel
https://bit.ly/3vYCGZX

Original source:
https://pubs.acs.org/doi/10.1021/acsanm.1c03309

Video
https://youtu.be/7VKskNZCoMc



Thomas Mortelmans developed a rapid test for infections with SARS-CoV-2 at PSI. (Photo: Paul Scherrer Institute/ Mahir Dzambegovic)

SNI INSight — Showcasing research and activities of the Swiss Nanoscience Institute

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Image: C. Möller and named sources

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