



## SNI update December 2014



### Words from the Editor

Dear Colleagues

The last few weeks were busy with numerous events that nicely reflect how the SNI is involved in diverse activities also outside research.

In mid-November, we invited the PhD students of the SNI PhD School for a workshop on Intellectual Property where experts provided interesting insights into the subject. We welcomed a much younger but not less enthusiastic audience during this year's "Zukunftstag" or "Future Day" of the University of Basel. During this event that was jointly organized by

the Department of Physics and the SNI, about twenty girls and boys got a glimpse of the exciting world of research.

In late November, the first SNI Lecture took place. The Argovia-Professor Rodrick Lim had invited Professor Jan Liphardt from Stanford University. Jan Liphardt started his intensive day in Basel with an inspiring lunch talk for students. Later, he presented his fascinating research on the biophysics of breast cancer to a broader audience. Just two days later, the symposium in memory of our founding father Professor Hans-Joachim Güntherodt was held. Many of his colleagues and former students attended the event and talked about their research and how Hans had influenced and shaped their lives. It was really impressive to hear from so many sides what an excellent motivator and bridge-builder Hans-Joachim Güntherodt had been.

After all these activities in November, we are now getting prepared for the end of the year. We are starting

to write the annual report and are collecting the information needed. As this year, Aargau has requested us to have all numbers ready by the end of January, I ask all SNI members and Project Leaders to provide us with the required information in a timely manner.

I would like to sincerely thank everyone inside and outside the SNI for your cooperation and commitment in 2014. It is a pleasure to see how dedicated all of our colleagues have been and what they have achieved this year. On behalf of the whole SNI-Team, I wish you and your families a relaxing and peaceful Christmas time and a good start in a healthy and prosperous new year.

Best regards

Director Swiss Nanoscience Institute, University of Basel

## Cover Story

### Tailor-made structures

*Progress in nanoscale science also brings new challenges for chemists. Compounds that are used to study the laws of the nanoworld have to fulfill certain criteria and colleagues from other disciplines need molecules with tailored characteristics for their studies. When it comes to questions like this, Professor Marcel Mayor from the Department of Chemistry at the University of Basel is one of the contact persons for scientists at the SNI. He is fascinated by chemical structures that have not yet been synthesized and is enthusiastic about experiments on the border with physics. Therefore, his research is ideal to be included in the interdisciplinary research activities of the SNI. Just recently, a second proposal from Marcel Mayor for the SNI PhD school has been funded.*

#### **Matter behaves like light**

A phenomenon that Mayor is particularly interested in is the wave behavior of molecules. According to the laws of quantum mechanics, not only does light behave as a wave, but also matter does. In 1924, Louis-Victor de Broglie developed this theory on the wave properties of particles in his PhD thesis. With a double-slit experiment, scientists at the University of Tübingen provided the experimental evidence. In the experiment, which is considered as one of the most beautiful physical experiments, researchers shoot electrons through a double slit. On a screen behind the slits, an interference pattern with many stripes appears and not, as one might expect,

an image of the double slit. Such a pattern of stripes is also obtained when light waves are sent through the double slit. Through interactions between the waves, the wave amplitude is reduced or amplified and thus leads to the typical interference pattern. Quite remarkably, these double-slit experiments demonstrated that matter also behaves like light.

#### **Does this also apply to biomolecules?**

In the macroworld around us, we cannot observe such a phenomenon. However, already in 1961, this wave behavior has been demonstrated for electrons. In recent years, different scientists have shown that atoms and molecules behave as waves as well. In a paper published in *Nature Nanotechnology*, Marcel Mayor and colleagues from the University of Vienna, have proven that even large molecules form this interference pattern, which serves as evidence of wave behavior. Together with his colleague Dr. Valentin Köhler from the Department of Chemistry at the University of Basel, Mayor now wants to take it a step further. In a recently approved project for the SNI PhD school, the scientists plan to investigate the wave behavior of biomolecules. First, they need to design suitable compounds and fulfill the rather complicated experimental requirements. The recently hired PhD student Jonas Schätti will start these experiments using small peptides. Based on many years of experience in the two groups, these peptides are synthesized so that they do not interact with each other, move well in the gas phase and leave a signal when they hit the screen behind the double slit. If these experiments are successful, the acquired know-how can then be applied to larger biomolecules such as proteins.

Marcel Mayor commented on the positive decision for the project: «I am really excited that the SNI supports such a high-risk project and I am curious to see how we explore the limits of quantum theory in this thesis.»



The interference pattern of large molecules was shown on the cover of «Nature Nanotechnology».

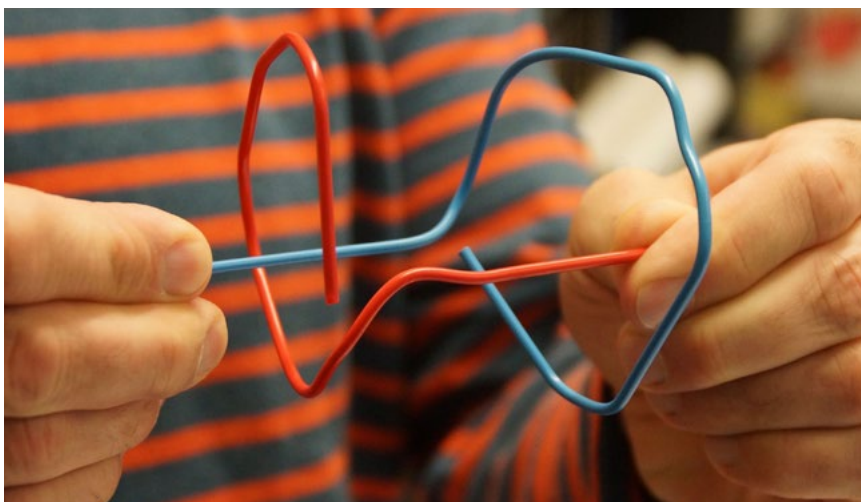


**Molecular muscles are possible**

Marcel Mayor is involved in another project of the SNI PhD school. Together with Dr. Michel Calame from the Department of Physics, he supervises the PhD student Yves Aeschi in his attempt to develop a molecular muscle. The idea is based on earlier studies in which the Mayor group synthesized electrically conductive chemical compounds that Michel Calame then applied in tiny electronic switches. The chemists synthesized circular hydrophilic compounds (called Cyclophanes) with a rod-shaped hydrophobic extension. In polar solvents, these compounds form mechanically linked dimers. This happens as the rods protrude into the hydrophobic interior of the circular part. Now scientists functionalize these rods even further so that redox reactions change the forces between the rod and the ring. The reaction leads to a shortening or lengthening of the dimers similar to a muscle. During this thesis, the electrochemically controlled changes of the system will be investigated and optimized.

**Patience is a virtue**

The team of Marcel Mayor works on numerous other projects: molecules like a spiral staircase or carbon rings that did not exist before in the entire universe and much more. All projects have in common that the chemists synthesize new substances with special properties step by step. They need a lot of perseverance, a lot of know-how and luck, and an enjoyment of interdisciplinary exchange with other nano-scientists.



Marcel Mayor explains how two compounds form mechanically linked dimers.

**We introduce...****Marcel Mayor, Professor of Chemistry at the University of Basel**

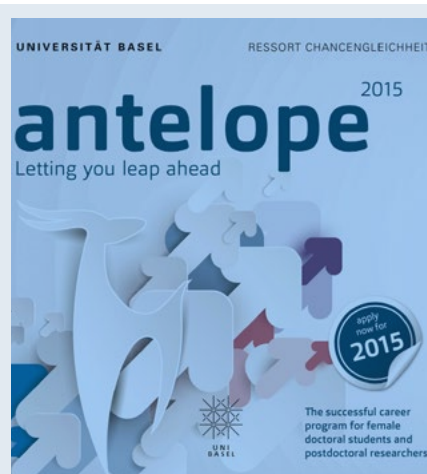
*Marcel Mayor is a chemist through and through. He is fascinated by chemical compounds, especially by those that do not exist yet or have unusual structures and need years to be synthesized. His goal is to achieve a great complexity and to discover new things using a variety of chemical compounds. His work is also strongly influenced by co-operations with physicists, as they need tailor-made molecules with certain chemical and physical properties. In addition to*

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*scientific research, Marcel Mayor is also involved in research management activities to support the research community and to guarantee the proper education of young scientists.*

Marcel Mayor was born in 1965 in Zurich and grew up in Thun. After he received his high school diploma, he was uncertain if he should focus on physics, computer science, philosophy, mathematics or chemistry. Finally, he decided to study chemistry in Bern, because he felt that in this field he could still discover a lot. However, many of his questions were not answered during his time at university. He had the impression that he did not learn enough about general concepts but instead got to know a collection of exceptions. Nevertheless, when he had successfully completed his studies in 1991, he knew that chemistry was simply the best. He could create matter that did not exist before and could let his creativity run wild. Additionally, for Mayor, chemistry had and still has just the right level of complexity and detail.

#### **Career start in France**

After finishing his diploma, Mayor started his PhD thesis under Professor Scheffold in Bern. The work on vitamin B<sub>12</sub> derivatives went well, but his supervisor died shortly before the defense. With the support of the University of Bern in this exceptional situation, Mayor was still able to finish his PhD in 1995 without any problems. Supported by a grant from the Swiss National Science Foundation, he began a postdoctoral position with Professor Jean-Marie Lehn at the Louis Pasteur University in Strasbourg working on organic syntheses



Marcel Mayor is a chemist through and through.

in combination with electrochemistry. When the fellowship had expired, he continued to work as a research assistant in the same laboratory and concentrated his research on molecular wires. According to Mayor, he enjoyed great benefits from working with the Nobel Laureate: "Jean-Marie has always been very close to research. At least every other week, you could talk to him about your project." Based on the successful work in the Lehn group, Mayor was offered a position at the College de France in Paris and Strasbourg in 1997.

#### **Establishment of the Institute of Nanotechnology**

In 1998, the time had come for Mayor to look for alternatives and new opportunities. He was tempted to accept a job in industry, but was even more enthusiastic to shape the establishment of the newly founded Institute of Nanotechnology at the Karlsruhe Institute of Technology (KIT). "It was a great time," Mayor recalls. "It was a bit like Big Brother for scientists. Physicists, chemists and material scientists were gathered in containers. We had strong financial support, but all disciplines were represented in subcritical quantities – so that we simply had to work together." These collaborations were very fruitful and led to worldwide acknowledged publications and prizes.

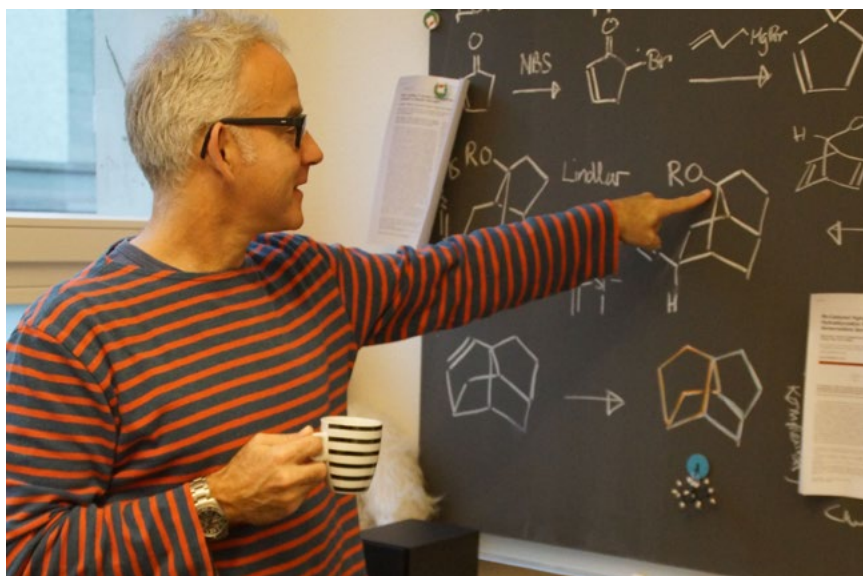
After successful habilitation at the University Louis Pasteur in Strasbourg in 2005, Mayor had several options to choose from. Professor Hans-Joachim

Güntherodt had become aware of the young chemist and wanted him at the University of Basel. For Mayor, Basel was attractive due to the excellent quality of research, the friendly atmosphere among colleagues and the proximity to Karlsruhe and so he decided to move to Switzerland.

### Good start at the University of Basel

Since 2005, Mayor has done his research mainly in Basel. He still has kept a small research activity with a few employees at the KIT in Karlsruhe. He explains the background of the double position: “My research happens in part at the interface of experimental physics, which is excellent in Basel. However, due to the size of the institutions, the KIT provides a scientifically much larger and more diverse environment than the one in Basel.” In 2011, his work in Basel got another boost when he was promoted as full professor and the University of Basel generously equipped the Mayor group with new laboratories and resources.

Today, he enjoys being able to pursue his ideas, to have the freedom to live out his creativity and to synthesize molecules that have not existed before and that promise to have interesting chemical and physical properties. It does not discourage him and his staff that the syntheses of these compounds sometimes take several years. For Mayor, a potential application is not the main focus. “It is the mission of universities to conduct basic research and to ensure that we provide an excellent comprehensive education at



Marcel Mayor enjoys being able to pursue his ideas.

the forefront of knowledge to young people,” he notes.

Mayor is dedicated to this task and has invested time in research management as well. From 2011 – 2012, he was Dean of Research at the University of Basel and since 2011, he has been a member of the Research Council of the Swiss National Science Foundation.

### Professorship in China

Mayor not only supports the education of young scientists in Switzerland and Germany, but also holds a professorship in China at the Sun-Yat-Sen University in Guangzhou (formerly Canton). Approximately twice a year, he spends a week at the Chinese University, which is with its 85,000 students more than six times bigger than the University of Basel. Currently, two Chinese students spend two years of their PhD thesis in Mayor’s laboratory in Basel. In the friendly Mayor team, the two young Chinese scientists will learn a lot about chemistry and will have the chance to get to know the country and people.

### With enthusiasm and perseverance to success

As Mayor is engaged in a lot of activities, he does not spend as much time doing sports as he would like to. Nevertheless, he regularly manages to participate in the Inferno-Triathlon in his home canton in the Bernese Oberland. During the triathlon as well as in the laboratory during the synthesis of complex molecules, the distant goal can be achieved with motivation, perseverance and the will to succeed.



## SNI prize for the best Master thesis

The Swiss Nanoscience Institute will award a prize for the best Master thesis in nanoscale science in 2014.

Students of the nano curriculum who have successfully finalized their Master thesis in 2014 can apply. The award includes 2000 Swiss Francs and a report about the thesis in the SNI newsletter *SNI update*.

Please submit a pdf file of the thesis together with an evaluation from the PI to [Jacqueline.isenburg@unibas.ch](mailto:Jacqueline.isenburg@unibas.ch) until 31<sup>st</sup> December 2014.

## Annual report 2014

We have started to write the annual report 2014 and ask all PI, Co-PIs and SNI members to submit the requested information by 29<sup>th</sup> December to

[Claudia.wirth@unibas.ch](mailto:Claudia.wirth@unibas.ch).



Many thanks for your support.

## Events

### Workshop on intellectual property

In mid-November, the SNI-team organized a workshop on intellectual property for the PhD students of the SNI PhD School. During the meeting, the participants were introduced to this new topic and made aware of its importance.

Twenty SNI PhD students gathered in MuttENZ at the Hotel Mittenza for an afternoon and got an insight into the world of intellectual property through talks by Wolfgang Henggeler from Unitecra, Tomas Brenner from the Hightechzentrum Aargau and Robert Sum from Nanosurf. Additionally, they participated in a workshop led by Wolfgang Henggeler where they practiced identifying the patentability of example inventions. This way, the students learned a lot about the proceedings of technology transfer experts that lead to the decision of whether to patent an invention or not.



«The IP-Workshop was an accessible and clear way to learn a lot about patenting, trademarks and copyrights,» commented Nadia Linda Opara, PhD Student in the SNI PhD School.

### Exciting Future Day

This year on November 13, more than twenty boys and girls visited the Physics Department to explore the physics- and nano-world through fascinating experiments. It was the first time that the University of Basel had asked the various departments to actively participate in the “Zukunftstag” and to provide a program for the young children of university colleagues.

The SNI and the Physics Department jointly offered a mix of activities.

These were made public over the website of the Ressort Chancengleichheit and fully booked within a few days. The program started with a vivid talk by Christian Schönenberger on light and colors. Through various experiments, the kids could learn for example that light consists of waves, how colors are mixed and why the light at sunset turns red. The kids



Concentration is the key to balance the ball.

continued with a course about floating that was constructed by Peter Reimann and his team. There, the kids made a ball float only through their muscular strength, or balanced Ping-Pong balls with a hair dryer. They had to invest just the right amount of strength to move a specially purpose-built air cushion boat over the finish line. Next on the schedule was a workshop held by Michael Steinacher and his team. The 10 to 13 year old kids could prove a steady hand by soldering their own game of skill. Additionally, the girls and boys could have an insight into the micro- and nano-world at various microscopes. Monica Schönenberger and Christel Möller instructed the kids to examine samples from flora and fauna. The kids left the Physics Department in a good mood and with lots to talk about at home.

### SNI Lecture and Lunch Talk

On November 25, the SNI held its first SNI lecture and invited both colleagues and the general public to join this event. Professor Roderick Lim had invited Professor Jan Liphardt to hold this very first lecture. The



More than twenty girls and boys visited the «Zukunftstag» at the Department of Physics.

scientist from Stanford University in California took the audience on a trip through the world of biophysics and especially focused on the biophysics of breast cancer. However, before he talked to the public, the charismatic researcher took two hours to talk to nanoscience students. In his entertaining and motivating lunch talk, he offered the students a new perspective on his research. He not only spoke about his successful work, but also gave a broad picture of what is still left for young scientists to discover. After a lively discussion, he ended his lunch talk with the advice „go out - invent - explore – initiate“ and surely left a long-lasting impression.



Professor Jan Liphardt ended his lunch talk with the advice «go out - invent - explore -initiate!»

In the future, the SNI Lectures will be held regularly. A host at the SNI will invite a renowned scientist to speak about his field of expertise.

## Symposium in memory of Professor Hans-Joachim Güntherodt

A one-day symposium was held on November 27 in Basel to honor and remember Professor Dr. Hans-Joachim Güntherodt. Afterwards, his family, colleagues, students, and coworkers were invited to a festive dinner.



The scientists, some of whom had traveled far to attend, not only talked about their recent research, which originates from the years with Hans-Joachim Güntherodt, but also about their own personal memories of Professor Güntherodt, who unexpectedly passed away in July 2014. He was not only an excellent scientist, but also a great mentor and motivator. In his distinctive way, he knew how to challenge, support, involve and motivate his colleagues and students. It was mentioned many times how well he knew to build bridges: bridges between basic research and industry, bridges between disciplines such as physics and biology, bridges between institutions, but also bridges between people such as young students and science experts.

Professor Güntherodt has died, but throughout the whole day it became visible how his spirit will live on. His fascination for science, his optimism and his openness towards new ideas will live on through his students and colleagues.

## Press releases and uni-news from SNI members

### University of Basel, 09.12.2014. Nanotechnology Against Malaria Parasites

Malaria parasites invade human red blood cells, they then disrupt them and infect others. Researchers at the University of Basel and the Swiss Tropical and Public Health Institute have now developed so-called nanomimics of host cell membranes that trick the parasites. This could lead to novel treatment and vaccination strategies in the fight against malaria and other infectious diseases. Their research results have been published in the scientific journal *ACS Nano*.

### University of Basel, 25.11.2014. Cooling With the Coldest Matter in the World

Physicists at the University of Basel have developed a new cooling technique for mechanical quantum systems. Using an ultra-cold atomic gas, the vibrations of a membrane were cooled down to less than 1 degree above absolute zero. This technique may enable novel studies of quantum physics and precision measurement devices, as the researchers report in the journal *Nature Nanotechnology*.

### University of Basel, 21.11.2014. Professor Patrick Maletinsky receives SNSF Starting Grant

Four scientists from the University of Basel have successfully applied for a Starting Grant from the Swiss National Science Foundation (SNSF). This spring, the SNSF implemented these starting grants as a replacement



for grants from the European Research Council (ERC). Prof. Marek Basel and Prof. Kelly Tan from the Biozentrum and the physicist Prof. Patrick Maletinsky and the chemist Dr. Christof Sparr will each receive funding of about 1.5 million francs over five years for their research projects.

### University of Basel, 19.11.2014. "Foreign Policy" selects Ed Constable to the top 100 Leading Global Thinkers 2014

The US magazine Foreign Policy has selected Prof. Ed Constable, chemist and Vice Rector for Research of the University of Basel, as one of the 100 leading Global Thinkers of 2014.

### University of Basel, 13.11.2014. A Twisted World – Chemists Build a Molecular Banister

Chemists at the University of Basel have succeeded in twisting a molecule by combining molecular strands of differing lengths. The longer strand winds around a central axis like a staircase banister, creating a helical structure that exhibits special physical properties. The results were published in the renowned scientific journal *Angewandte Chemie International Edition*.

The complete media releases and uninews can be found at:  
[https://www.nccr-nano.org/nccr/media/recent\\_press\\_releases](https://www.nccr-nano.org/nccr/media/recent_press_releases)

## Third SNI video is now online

The third video of the SNI about the Nanostudy Program and the PhD School is now finalized. On our Website or on Youtube, you get to know what four young nano-scientists have to say about their education at the SNI.

[www.nanoscience.ch/nccr/media/video](http://www.nanoscience.ch/nccr/media/video)



The third SNI video also shows how nice Basel can be in summer.

## Please give feedback

Please give your feedback and share your news and ideas for SNI update with [c.moeller@unibas.ch](mailto:c.moeller@unibas.ch).