

1. Scientific News:

Renato Renner's group, Zurich:

The thermodynamic meaning of negative entropy: Reversible computation can in principle be performed without energy losses, while irreversible operations require dissipation of work into heat. The latter is often referred to as Landauer's principle, and can be formulated as a bound on how much work it costs to erase a bit or qubit of data. However, this standard formulation does not take into account the possibility that we have access to a quantum memory that may be entangled with the system we wish to erase, i.e., the memory contains quantum information about the system. In this more general case we show that the work cost of erasure is determined by an information theoretic

quantity that depends on the information in the quantum memory. Since this quantity can become negative in the quantum case, an observer who is entangled with a system may gain work while erasing it, and consequently cool down the environment.

Ref.: L. del Rio, J. Åberg, R. Renner, O. Dahlsten, Vlatko Vedral, *Nature* **474**, p.61–63, [link](#)

ETH Life: [link](#)

Tagesanzeiger: [link](#)

Nature Podcast: Interview L. del Rio, [at min 14.30](#)

Nicolas Gisin's group, Geneva:

Nicolas Gisin was recently invited to give a Plenary talk at the ECOC conference. There were over 1000 experts from all areas of optical communication R&D industry as well as academics in the audience at this plenary session. The vision underlying quantum communication and our work within QSIT, which exploits the gifts of nature for secure communication were presented. Topics ranged from the group's work on fundamental concepts

such as the impossibility to copy an unknown quantum state and the intrinsic randomness of quantum events to more applied areas where some commercial successes have already been realised and was well received by this diverse audience.

Web: <http://www.ecoc2011.org/Conference-Program/Plenary-Speakers.aspx>

Philipp Treutlein's group, Basel:

Hybrid optomechanical system realized: Laser light can exert a force on material objects. In the field of optomechanics, such light forces are exploited for cooling and control of the vibrations of mechanical oscillators. In a number of recent theory papers it was proposed that laser light could be used to couple the motion of ultracold atoms in a trap to the vibrations of a single mode of a mechanical oscillator. In the resulting hybrid optomechanical system the atoms could be used to read out the motion of the oscillator, to engineer its dissipation, and ultimately to perform quantum information tasks such as coherently exchanging the quantum state of the two systems.

Now, the Treutlein group reports the experimental realization of a hybrid optomechanical system. In their experiment, an optical lattice couples ultracold atoms to a micromechanical membrane oscillator. If the trap frequency of the atoms in the lattice is matched to the eigenfrequency of the membrane, the coupling leads to resonant energy transfer

between the two systems. Both the effect of the membrane vibrations onto the atoms as well as the backaction of the atomic motion onto the membrane were observed. Moreover, the dissipation rate of the membrane was engineered by coupling it to laser-cooled atoms. These results were recently published as "editors suggestion" in *Physical Review Letters* (2011).

In a related experiment, the Treutlein group studied optomechanical properties of SiN membranes. By frequency-tuning the membranes over a large range, Andreas Jöckel, Matt Rakher, Maria Korppi and colleagues were able to clarify the influence of support resonances on the mechanical quality factor of the membranes. The results explain why individual membrane's quality factors were found to vary over a large range, an important and outstanding question in the field of optomechanics. The results were published recently in *Appl. Phys. Lett.* **99**, 143109 (2011).

Richard Waburton's group, Basel:

The group has been in a setting up phase for much of 2011 but despite the fact that the labs looked like a building site, scientifically all was not lost in 2011.

i. We have managed to tune the quantum dot optical transition energy in situ over several GHz continuously, both to the red and to the blue, by tuning the nuclear spin polarization. The surprising feature of this experiment is that the nuclear spins can be polarized both up and down with right-handed circularly-polarized laser light! A collaboration with the Loss group helped us unravel the physics of this. [C. Kloeffel et al., Phys. Rev. Lett. 106, 046802 (2011)]

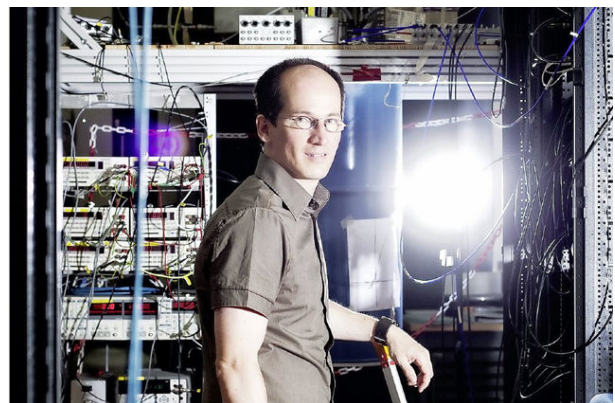
ii. The transition energy of a quantum dot tends to fluctuate as it is sensitive to the fluctuating semiconductor environment. Achieving an exact optical pi-pulse with a pulsed narrowband laser is challenging in these circumstances. Inspired by techniques in spin resonance, an alternative is to chirp the pulse, an adiabatic passage, as in this case, population inversion becomes insensitive to the exact transition energy. This idea was implemented

in the optical domain with colleagues in France (Toulouse and France) using highly chirped ps laser pulses, and robust exciton generation was achieved. [C. M. Simon et al., Phys. Rev. Lett. 106, 166801 (2011)]

iii. We have developed a tunable microcavity. The cavity is of the Fabry-Perot-type, just like a standard laser cavity out of the optics textbook, but highly miniaturized. At its heart is a highly smooth, curved mirror with radius 50 microns. Tuning is achieved by moving the mirror relative to the sample, in the vertical direction for wavelength, and in the lateral directions to position the field anti-node. An optical beam can be coupled in and out at low temperature with free space optics. Trial experiments with a single quantum dot in the cavity have demonstrated the tuning capability and have revealed a Purcell effect, a weak coupling. This paper had a very rough ride in the high-impact journals but eventually after a lengthy delay emerged unscathed in Journal of Applied Physics. [R. Barbour et al., J. Appl. Phys. 110, 053107 (2011)]

2. Awards:

Andreas Wallraff, Professor for solid state physics at ETH Zurich, wins this year's Max Rössler Prize in recognition of his outstanding research at the interface of quantum physics and information technology. The award comes with 200,000 Swiss francs as prize money and was made possible by a donation of 10 million Swiss francs from Max Rössler and the "Max Rössler Funds of the Empiris Foundation" to the [ETH Zurich Foundation](#). The prize has been awarded annually since 2009 to young and visionary professors at ETH Zürich who recently obtained a tenured position, in order to support their future research activities. Andreas Wallraff will use the prize to strengthen his team and to support talented students.



ETH press release: [link](#) ; ETH Life: [link](#);
Tagesanzeiger: [link](#); Blick am Abend, p. 11: [link](#)

3. Past Events

Topical Meeting on Topological Properties of Electronic Materials

May 6, 2011, Geneva

The topical meeting on the topological properties of electronic materials organized in Geneva on May 6 gathered Swiss scientists active in the field together with international experts. The key aims were to discuss the most recent development in this active area of research and to provide a pedagogical introduction to key concepts for other researchers interested in topological materials. Approximately 100 participants were present, who indicated their clear interest in the subject and expressed satisfaction for the format of the meeting.

Organizer: Alberto Morpurgo

NCCR QSIT Junior Meeting

June 21 - 24, 2011, Passugg, GR



The idea of the Junior Meeting is to give junior members (PhD students and postdocs) of NCCR QSIT the opportunity to present topics of their field in an introductory way and to allow for exchange among the different groups within the NCCR. The meeting further aims to enhance the networking between the young scientists. 26 participants from the different partner institutions presenting talks and posters participated at this year's meeting in Passugg.

Organizers: Andreas Reinhard and Marco Tomamichel

Website: [Link](#)

Workshop on 'Atomic chips'

June 22 - 24, 2011, Dep. of Physics, University of Basel

In June 2011, the Treutlein group at Uni Basel organized a workshop on atom chips and related topics. A particular focus of the talks was on quantum metrology with chip-based atomic clocks and atom interferometers, where substantial progress was made in the past 2 years. Researchers are now able to maintain internal-state coherence for more than 10 seconds and to operate atom interferometers beyond the standard quantum limit

by making use of entangled atomic ensembles. In addition, related topics such as hybrid ion-atom traps and the manipulation of single photons from quantum dots were discussed. The workshop was attended by 35 researchers (20 from various QSIT groups, 15 external). Funding was provided by QSIT and by the Basel QC2 Center for Quantum Computing and Quantum Coherence.

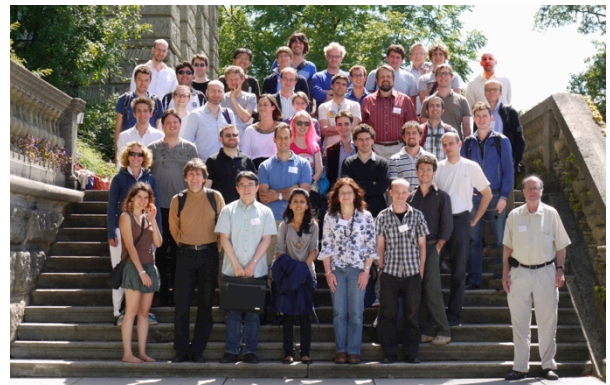
Workshop on Quantum Information and Foundations of Thermodynamics

9 - 12 August 2011, ETH Zurich

Approximately fifty researchers met in a four-day meeting in Zurich to share knowledge and discuss future directions for the field, on topics such as thermalization, heat engines, entropy measures in thermodynamics, the information-work relation, and thermodynamics of small systems.

Organizer: Renato Renner

Web: <http://www.qit.ethz.ch/workshops/QIFTW11>



International Conference on Quantum Information Processing and Communication (QIPC) 2011

September 5 - 9, 2011, ETH Zurich

The conference brought together leading scientists from more than 120 different universities in 30 different countries and also from companies such as IBM and idquantique and funding agencies such as the European Commission.

The conference program included 30 invited and 70 contributed talks and more than 100 poster presentations covering a broad range of topics from quantum information processing to quantum communication. A focus of the program was the discussion of physical realizations of quantum systems for information technology such as photons, single atoms, ions, molecules, nuclear and electron



spins, superconducting circuits, micro- and nano-mechanics, hybrid quantum systems. An industry session provided insight into commercial developments of current and future quantum technologies. Funding opportunities and future strategies were presented in a funding session featuring EU experts.

The conference was preceded by a school aimed at beginning graduate students held in the Swiss Alps at Berghaus Diavolezza from September 2-4, 2011. Seven lecturers have provide introductory lectures on quantum information science and technology to 47 students from all over the world. Both school and conference participants have greatly enjoyed the scientific and social program, the interaction with their colleagues as well as the great opportunities that Zurich and Switzerland had to offer to them.



Organizer: Andreas Wallraff
Website: www.qipc2011.ethz.ch

Frontiers in Quantum Gases, Bose-Einstein Condensation 2011

September 10 - 16, 2011, Sant Feliu de Guixols, Costa Brava, Spain

The latest developments in the field of quantum gases were discussed at this conference. It is held every two years and acts as major forum for a direct exchange between leading scientists working in the field of quantum gases. At the conference, the Scientific and Award Committees of the biannual Bose-Einstein Conference Series announced Prof. Gora Shlyapnikov and Dr. Ian Spielman as the recipients of the BEC Awards 2011, sponsored by TOPTICA Photonics AG.

The BEC Awards honor outstanding research in Experimental and/or Theoretical Physics of Quantum Degenerate Atomic Gases and were awarded for the first time. The senior prize recognizes work that is firmly established and has

significantly advanced the field of quantum degenerate gases. The junior prize recognizes outstanding work by a young scientist for independent research early in his or her academic career. Each prize consists of a 2500 Euro cash award, and a certificate citing the contributions of the recipients. The prizes are awarded under the auspices of the biannual BEC conference and are sponsored by TOPTICA Photonics AG

Organizer: Tilman Esslinger
Website: www.bec2011.ethz.ch

QCRYPT 2011: First Annual Conference on Quantum Cryptography

September 12 - 16, 2011, Zurich, Switzerland

With QCRYPT 2011 we initiated the first of a series of conferences on quantum cryptography aimed at bringing the entire community of quantum cryptographers - both theorists and experimentalists - together. The one-week conference, which was attended by 140 participants, featured 12 invited talks and 18 contributed talks which have been recorded and are available online. The conference was opened by Professor Olaf Kübler, a former president of ETH Zurich. Besides the scientific part of the conference, the participants enjoyed a vivid presentation of the history of the subject by Professors Charles Bennett and Gilles Brassard, who invented quantum cryptography and who recently received honorary doctorates from ETH Zurich. The QCRYPT conference series will continue in Singapore next year.

Organizer: Matthias Christandl
Website: <http://www.qcrypt2011.ethz.ch/>



4. Mini-sabbaticals

Each PhD student and postdoc associated with this NCCR will have the opportunity to work one week per year in another NCCR group of his/her choice. This step will promote collaboration and exchange between the younger researchers and will also serve the general education. These research stages will be centrally financed by the NCCR and are open for all young researchers working on NCCR-related projects in the participating research groups, even if the salary of these researchers is not directly coming from NCCR resources. Please contact your supervisor or the NCCR office for further information.

5. Agenda

Modeling Materials With Cold Gases Through Simulations

November 9. - 11, 2011, Zurich, Switzerland

Organizer: Lode Pollet

Website: <http://www.cecarn.org/workshop-5>

First Workshop on Cold Molecular Ions

Nov. 23-25, 2011, Sandbjerg Estate, DK:

The First Workshop on Cold Molecular Ions is dedicated to the task of advancing methods to prepare and control cold molecular ions and address new applications including molecular-ion based quantum technologies.

Organizers: Stefan Willitsch (University of Basel) and Michael Drewsen (University of Aarhus)

Website: <http://iota-cost.au.dk/>.

NCCR QSIT Site Visit

December 8 - 9, 2011, ETH Science City, HIT Building.

All group leaders are expected to participate at this event. Please bring along a student/post doc presenting a poster. Details will be communicated in due time.

31st International Conference on the Physics of Semiconductors – ICPS 2012

July 29 - August 3, 2012

Organizer: Klaus Ensslin

Website: <http://www.icps2012.ethz.ch/>

NCCR QSIT Student School

Jan 30 - Feb 1, 2012 and

NCCR QSIT General Meeting

February 1 - 3, 2012, Arosa, GR

Organizer: NCCR QSIT

Quantum Systems and Technology

June 17 - 22, 2012, Centro Stefano Franscini, Monte Verità, TI

Organizer: Gianni Blatter

Meeting of the Swiss Physical Society

June 21 - 22, 2012, ETH Zurich

with special sessions committed to the NCCR QSIT

6. New Appointments



After finishing his SNF professorship at ETH, **Stefan Wolf** has started on Oct. 1, 2011 as an Associate Professor at the Università della Svizzera Italiana (USI) in Lugano, TI. He is a member of the faculty of Informatics there, and is about to form a

group in Quantum Information and Cryptography. We wish him all the best at his new position.

Lode Pollet has left ETH to take up a W2 professorship at the LMU in Munich. Lode Pollet had first joined ETH as a postdoc in the group of Matthias Troyer in 2005. After two years in the US (University of Massachusetts and Harvard

University) from 2008-2010 he returned to ETH last year on an Ambizione fellowship of the Swiss National Science Foundation. His research on QSIT related topics has focused on the simulation of quantum many body systems, especially ultracold atoms in optical lattices where he collaborated closely with the experimental group of Tilman Esslinger. We congratulate him on his new position as a professor at one of the leading universities in Europe and wish him all the best for his scientific endeavors in Munich.



7. New collaborators



Stephan Baer has started his PhD in the Ensslin group on January 1st, 2011. He will work on quantum Hall states in confined geometries, i.e. large quantum dots. The goal is to observe effects of electron-electron interactions

via transport experiments through such complex quantum circuits.

On October 1, **Yuansen Chen** has started as a post-doc in the team of Gian Salis at IBM Research Zurich. He will be investigating spin dynamics and spin injection in quantum-confined electron gases.



Fabio Deon joined the group of Alberto Morpurgo on October 1, 2011. Fabio Deon did his PhD studies at the Scuola Normale in Pisa. He has worked on quantum dots electrostatically defined in InGaAs-based heterostructures, coupled to superconducting electrodes. Fabio is working at the University of Geneva on graphene nano-electronic devices.



Florian Dettwiler joined the group of Dominik Zumbühl on April 1st 2011 as a graduate student. He holds a Master of Science in Nanoscience from the

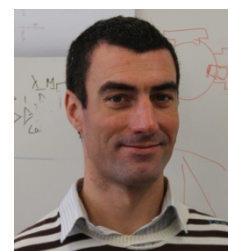
University of Basel and will work in the Project Quantum Spintronics on InAs dots - GaAs 2DEG hybrid systems.



Daniela Frauchiger works together with Stefan Wolf since October 1st as a PhD student. She did her Master degree in Renato Renner's group.



Dorothee Hug joined the Zumbühl group on June 1st, 2011 as a graduate student. She holds a Master of Science in Nanoscience from the University of Basel and works on Quantum Spintronics/Graphene.



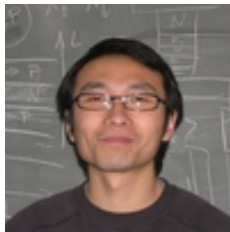
Ben Keitch is a post-doctoral research assistant in the group of Jonathan Home. He previously worked in trapped-ion quantum information research with David Lucas and Andrew Steane in Oxford, where he observed long-lived quantum coherence of a qubit stored in the odd-nuclear-spin isotope of calcium.

Andreas Kuhlmann joined the Richard Waburton's group as PhD student. Andreas completed his Diploma from The University of Wuerzburg in Germany. Andreas has built a new microscopy system for the low temperature spectroscopy of quantum dots. The group is looking for a post-doc to join in 2011.



Myrsini Lafkioti joined QSIT Aug 1st, 2011. She works as a post-doc in the group of Dominik Zumbühl on FQHE at $\nu=5/2$. She holds a Ph. D. in physics from the MPI Stuttgart.

Jian Li, is a new member of QSIT in the group of Markus Buttiker (Geneva). Jian Li received his PhD from the University of Hong Kong with a thesis on the role of disorder in topological insulators. In Geneva he worked with Alberto Morpurgo, Ivar Martin and Markus Buttiker on marginal topological properties of bilayer graphene and helped understand recent experiments on Bi_2Se_3 . Presently he works on Majorana interferometers.



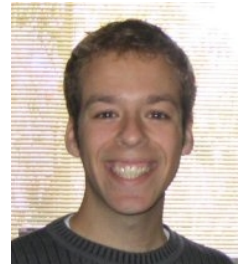
Since September **Andreas Nunnenkamp** is a postdoc in the group of Christoph Bruder. He works on topics at the intersection of condensed matter theory, quantum optics and quantum information, including nonlinear optomechanical systems, superconducting circuits, and ultracold atoms in optical lattices. Previously, he did a postdoc with Steven Girvin at Yale and was a graduate student of Keith Burnett and Dieter Jaksch at Oxford. When not doing physics he enjoys singing (presently with Neuer Basler Kammerchor) as well as hiking and cooking.

Christopher Portmann, became a member of the group of Renato Renner in April 2011. Since Sept 2011 he is a joint postdoc of Renato Renner and Hugo Zbinden.



In January 2011, **Matthew T. Rakher** joined the Treutlein group at Uni Basel. Matthew worked previously at UC Santa Barbara and NIST Gaithersburg in the U.S.A. At Uni Basel, he is

exploring hybrid quantum systems composed of ultracold atoms and solid-state devices.



Frank Ruess is an NCCR QSIT Posdoc working with Andreas Fuhrer at IBM Research - Zurich. His expertise lies in STM based hydrogen resist lithography and dopant device fabrication. At IBM he investigates the properties of magnetic dopants such as Mn in Si and SiGe field effect devices.

In January 2012, **Volkher Scholz** will start as a postdoc in the group of Matthias Christandl pushing the theoretical understanding of quantum tomography.



Federico Valmorra started on August 15, 2011, in the Faist group and will be working on THz graphene devices. He completed his master thesis in the Physics department of Bologna, performing his thesis work in the university of Hamburg on the topic of metamaterial with gain.