TT 8 Posters Transport

Zeit: Freitag 14:00–18:00 Raum: Poster TU C

TT 8.1 Fr 14:00 Poster TU C

Spin transport in disordered single-wall carbon nanotubes — •Nitesh Ranjan, N. Nemec, and G. Cuniberti — Molecular Computing Group, Universität Regensburg, D-93040 Regensburg, Germany

The effects of vibrations on the linear conductance of single-wall carbon nanotubes can be described by the Anderson model of disorder [1]. Indeed, there are also indications that multi-wall carbon nanotubes effectively behave as a disordered single-wall system as far as transport properties are concerned [2]. With this motivation, we investigate spin transport in ferromagnetically contacted disordered single-wall carbon nanotubes (within the tight binding model) in the coherent regime. Different models for the ferromagnetic leads are employed ranging from wide-band leads to fcc(111) surfaces (as in the case of cobalt). Results as a function of disorder strength and Fermi energy in the leads are given for realistics tube lengths of several hundred nanometers.

[1] M. Gheorghe *et. al*, cond-mat/0411192, (2004).
[2] R. Egger and A. O. Gogolin, Phys. Rev. Lett. **87**, 066401 (2001).

TT 8.2 Fr 14:00 Poster TU C

Vibrational effects on the linear conductance of carbon nanotubes — •Rafael Gutierrez[1], Marieta Gheorghe[1], Alessandro Pecchia[2], Aldo Di Carlo[2], and Gianaurelio Cuniberti[1] — [1]Institute for Theoretical Physics, University of Regensburg, D-93040 Regensburg — [2]INFM and Dept. of Electrical Engineering, University of Rome "Tor Vergata", I-00133 Rome

Carbon nanotubes (CNTs) has become a paradigm for studying electronic transport on low dimensions. They have a high potential for applications in the emerging field of molecular electronics. The main body of research on electronic transport in CNTs in the last decade has mainly focused on elastic transport. The influence of vibrational excitations on charge propagation in CNTs has not been however addressed in detail. We present a density-functional-based study on the influence of structural lattice fluctuations on the *elastic* electronic transport in carbon nanotubes in the linear response regime. Structural distortions are considered as a random field; the linear conductances can be calculated after appropriate averaging over this field. Results obtained from a frozen-phonon-like approximation are compared with classical molecular dynamics simulations. We demonstrate that the average effect of structural fluctuations can be captured by the Anderson model of disorder. Further, the influence of single vibrational modes on the electronic transport can be extracted with our approach as well as the role of zero-point quantum fluctuations.

TT 8.3 Fr 14:00 Poster TU C

DMRG calculations of non-equilibrium transport in one dimensional strongly correlated lattice models — •Günter Schneider and Peter Schmitteckert — Institut für Theorie der Kondensierten Materie,Universität Karlsruhe, D-76128 Karlsruhe

We study non equilibrium transport in one dimensional strongly correlated lattice models using real time dynamics within Density Matrix Renormalization Group (DMRG). In particular we calculate the finite bias conductance beyond Landauer-Büttiker theory for various model nano structures.

TT 8.4 Fr 14:00 Poster TU C

Percolative Transport in $Ag_{2+\delta}Se$ with High Silver Excess — •M. von Kreutzbruck[1], K. Allweins[1], B. Mogwitz[2], C. Korte[2], J. Janek[2], and L. Kienle[3] — [1]Institut für Angewandte Physik, Justus-Liebig-Universität Giessen, Heinrich-Buff-Ring 16, D-35392 Giessen — [2]Physikalisch-Chemisches Institut, Justus-Liebig-Universität Giessen, Heinrich-Buff-Ring 58, D-35392 Giessen — [3]Max-Planck-Institut für Festkörperforschung, Heisenbergstraße 1, D-70569 Stuttgart

Since the appearance of an unusual linear and large magnetoresistance (MR) effect in the narrow gap silver chalcogenides $Ag_{2+\delta}Se$ and $Ag_{2+\delta}Te$ shown by Xu et al. in 1997 research has drawn much attention to establish new routes for the design of magnetoresistive sensors. We investigated the galvanomagnetic transport properties of polycrystalline Ag_xSe thin films with silver excess in the range from $x = 1.5$ to 18. The results prove that the silver excess controls the transition from linear magnetoresistance (MR) behaviour to the quadratic ordinary MR and the temperature for the metal-semiconductor transition. We observe for $2 < x < 2.3$ a steep rise of the conductivity and interpret this result as a consequence of the percolation of nanoscale silver networks within the semiconducting matrix. To verify our model we performed an estimation on the basis of a FEM-model of both cubic silver selenide grains with nanoscopic silver films in the grain boundary and silver precipitates within the narrow-band matrix. The simulation proves the presence of the coexistence of silver paths on the nanoscale and single silver precipitates, which is also indicated by first TEM investigations.

TT 8.5 Fr 14:00 Poster TU C

Spin relaxation in Quantum Dots induced by Nyquist Noise — •Florian Marquardt[1] and Veniamin A. Abalmassov[2] — [1]Department of Physics, Yale University, New Haven 06520, USA — [2]Institute of Semiconductor Physics SB RAS and Novosibirsk State University, 630090 Novosibirsk, Russia

We analyze the spin relaxation rate T_1^{-1} for an electron inside a quantum dot that is subject to the Nyquist voltage fluctuations of the confining metallic gates. In combination with spin-orbit coupling, this leads to a relaxation rate that depends on the direction of the magnetic field and the impedance matrix of the gate circuit, providing possibilities for distinguishing this mechanism from other sources of relaxation.

[1] F. Marquardt and V. A. Abalmassov, cond-mat/0404749 (2004)

TT 8.6 Fr 14:00 Poster TU C

Periodic Field Emission from an Isolated Nano-Scale Electron Island — •D.V. Scheible[1], C. Weiss[2], J.P. Kotthaus[1], and R.H. Blick[3] — [1]Center for NanoScience and Fakultät für Physik der Ludwig-Maximilians-Universität, Geschwister-Scholl-Platz 1, 80539 München, Germany — [2]Institut für Physik, Carl von Ossietzky Universität, 26111 Oldenburg, Germany — [3]Department of Electrical & Computer Engineering, University of Wisconsin-Madison, 1415 Engineering Drive, Madison, Wisconsin 53706

We observe field emission from an isolated nano-machined gold island. The island is able to mechanically oscillate between two facing electrodes, which provide recharging and detection of the emission current. We are able to trace and reproduce the transition from current flow through a rectangular tunneling barrier to the regime of field emission. A theoretical model via a master-equation reproduces the experimental data and shows deviation from the Fowler-Nordheim description due to the island's electric isolation.

[1] D. V. Scheible et al., Phys. Rev. Lett. 93, 186801 (2004).

TT 8.7 Fr 14:00 Poster TU C

Zero-Bias Anomaly in Disordered Multiwall Carbon Nanotubes — •N. Kang, L. Lu, Z. W. Pan, and S. S. Xie — Institute of Physics, Chinese Academy of Science, Beijing, People's Republic of China

Multiwall carbon nanotubes (MWNTs) provide a unique system for studying electron-electron (e-e) interaction effects in disordered wires. We have studied tunneling of electrons into MWNTs as a function of voltage and temperature. The conductance of MWNTs exhibits a strong suppression at low energies, showing a sign of strong e-e correlation. At high energy, the differential conductance obeys a power law behavior, which is predicted by the environmental quantum fluctuation theories. At lower energy, we observed a crossover to an exponential dependence, in accordance with recent theoretical calculation. For an analytic description of our data at low temperatures, it would require a nonperturbative theory for the e-e interaction, being consistent with our previous transport measurements on the same batch of MWNTs [1,2].

[1] N. Kang, et al., Phys. Rev. B 66, 241403 (2002). [2] N. Kang, et al., Phys. Rev. B 67, 33404 (2003).

TT 8.8 Fr 14:00 Poster TU C

Nonequilibrium transport in nanostructured palladium-nickel alloy films — •Jakob Brauer[1], Heiko B. Weber[1], and Hilbert v. Löhneysen[2,3] — [1]Forschungszentrum Karlsruhe, Institut für Nanotechnologie — [2]Forschungszentrum Karlsruhe, Institut für Festkörperphysik — [3]Physikalisches Institut, Universität Karlsruhe

We investigated electronic transport properties of short nanostructured metallic bridges. Our samples consisted of short palladium-nickel alloy films contacted by thick gold electrodes acting as reservoirs, thereby establishing a nonequilibrium electronic distribution under applied bias[1]. The nickel concentration of the alloy was chosen near the onset of ferromagnetic ordering. The motivation for this was to study the interplay between electronic nonequilibrium distribution and exchange splitting. We measured the dependency of the resistance on magnetic field, bias and temperature. Our data show a zero-bias anomaly, which depends on the magnetic field in a nontrivial fashion.

[1] H.B. Weber *et al.*, PRB 63 (2001) 165426

TT 8.9 Fr 14:00 Poster TU C

Theoretical analysis of the conductance histograms of Au atomic contacts — •Markus Dreher[1], Jan Heurich[2], Carlos Cuevas[2], Elke Scheer[1], and Peter Nielaba[1] — [1]Physics Department, University of Konstanz, 78457 Konstanz, Germany — [2]Institut für Theoretische Festkörperphysik, University of Karlsruhe, 76128 Karlsruhe, Germany

Many experiments have shown that the conductance histograms of metallic atomic-sized contacts exhibit a peak structure, which is characteristic for the corresponding material. The origin of these peaks still remains as an open problem. In order to shed some light on this issue, we present a theoretical analysis of the conductance histograms of Au atomic contacts. We have combined classical molecular dynamics simulations of the breaking of nanocontacts with conductance calculations based on a tight-binding model. This combination gives us access to crucial information such as contact geometries, forces, minimum cross section, total conductance and transmission coefficients of the individual conduction channels.

The ensemble of our results suggests that the low temperature Au conductance histograms are a consequence of a subtle interplay between mechanical and electrical properties of these nanocontacts. At variance with other suggestions in the literature, our results indicate that the Au conductance histograms are not a simple consequence of conductance quantization or of existence of exceptionally stable radii.

TT 8.10 Fr 14:00 Poster TU C

Electron transport in metallic multi-island geometries: Coulomb blockade and quantum fluctuations — •Björn Kubala[1], Göran Johansson[2], and Jürgen König[1] — [1]Theoretische Physik III, Ruhr-Universität Bochum, 44780 Bochum, Germany — [2]MC2, Chalmers University of Technology, S-412 96 Göteborg, Sweden

Experiments on coupled single-electron transistors investigate, how charging effects on one island are modified by capacitive and tunnel coupling to other islands [1]. We developed a method to study electron transport through such systems, driven by finite thermal or voltage bias. Based on real-time transport theory [2], all diagrams up to second order in tunneling coupling are automatically generated and evaluated. This computational approach captures all different sequential and cotunneling processes.

In particular, we find a class of cotunneling processes involving correlated tunneling onto two different islands. These can be linked to tunneling rates for an SET in a noisy environment -constituted by another SET- as calculated within a $P(E)$ theory. We will discuss applications to different setups and strength and limitations of our method.

[1] R. Schäfer et al., cond-mat/0205223; Physica E 18, 87, (2003); K. W. Lehnert et al., Phys. Rev. Lett. 91, 106801 (2003).

[2] H. Schoeller and G. Schön, Phys. Rev. B 50, 18 436 (1994); J. König, H. Schoeller, and G. Schön, Phys. Rev. Lett. 78, 4482 (1997).

TT 8.11 Fr 14:00 Poster TU C

Competition of Coherence and Decoherence: the Phase Diagram of the Non-Equilibrium Kondo Model — •Stefan Kehrein — Theoretische Physik III - Elektronische Korrelationen und Magnetismus, Institut für Physik, Universität Augsburg

We study the Kondo effect in quantum dots in a non-equilibrium state due to an applied dc-voltage bias. Using the method of infinitesimal unitary transformations (flow equations), we develop a perturbative scaling picture that naturally contains both equilibrium coherent and non-equilibrium decoherence effects (cond-mat/0410341). The competition of these effects determines the phase diagram of the non-equilibrium Kondo model, and e.g. establishes a large single-channel Kondo physics dominated regime for asymmetrically coupled quantum dots. We present results for the conductance, the local density of states and the spin-spin correlation function at various points in this phase diagram.

TT 8.12 Fr 14:00 Poster TU C

Density of states of interacting electrons in quasi one-dimensional metallic wires — •Wolfgang Körner[1], Peter Schwab[2], and Hermann Grabert[1] — [1]Albert-Ludwigs-Universität Freiburg — [2]Universität Augsburg

Based on the quasiclassical Green's function approach [1] we determine the tunneling density of states $\rho(\varepsilon)$ of a diffusive metallic nanowire in presence of electron-electron interactions. The perturbative result by Altshuler and Aronov, $\rho(\varepsilon) \propto \varepsilon^{-1/2}$, is extended to the nonperturbative regime near the Fermi edge where $\rho(\varepsilon) \propto \sqrt{\varepsilon}\exp(-\varepsilon_0/\varepsilon)$, in accordance with calculations based on the nonlinear σ-model [2]. Further extensions, including contributions from the spin triplet channel, will also be discussed.

[1] P. Schwab and R. Raimondi, Ann. Phys. (Leipzig) **12**, 471-516 (2003)

[2] J. Rollbühler and H. Grabert, Phys. Rev. Lett. **87**, 126804 (2001)

TT 8.13 Fr 14:00 Poster TU C

A Gate-Controlled Atomic Quantum Switch — •Fangqing Xie[1], Laurent Nittler[1], Stefan Brendelberger[1], Christian Obermair[1], and Thomas Schimmel[1,2] — [1]Institute for Applied Physics, University of Karlsruhe, D-76128 Karlsruhe, Germany — [2]Institute of Nanotechnology, Forschungszentrum Karlsruhe, D-76021 Karlsruhe Germany

An atomic-scale quantum conductance switch is demonstrated which allows to open and close an electrical circuit by the controlled and reproducible reconfiguration of silver atoms within an atomic-scale junction [1]. The only movable parts of the switch are the contacting atoms. The switch is entirely controlled by an external electrochemical voltage applied to an independent third gate electrode. Controlled switching was performed between a quantized, electrically conducting "on-state"exhibiting a conductance of $G_0 = 2e^2/h\,(\approx 1/12.9k\Omega)$ or preselectable multiples of this value and an insulating "off-state"[2].

[1] F.-Q. Xie, L. Nittler, Ch. Obermair and Th. Schimmel, Phys. Rev. Lett. 93, 128303 (2004).

[2] F.-Q. Xie, Ch. Obermair and Th. Schimmel, Solid State Communications 132, 437-442 (2004).

TT 8.14 Fr 14:00 Poster TU C

Supersymmetry for disordered systems with interaction — •Georg Schwiete[1] and Konstantin B. Efetov[1,2] — [1]Institut für Theoretische Physik III, Ruhr-Universität Bochum — [2]L. D. Landau Institute for Theoretical Physics, Moscow

Considering disordered electron systems we suggest a scheme that allows to include an electron-electron interaction into a supermatrix sigma-model [1]. The method is based on replacing the initial model of interacting electons by a fully supersymmetric model. Although this replacement is not exact, it is a good approximation for a weak short range interaction and arbitrary disorder. The replacement makes the averaging over disorder and further manipulations straightforward and we come to a supermatrix sigma-model containing an interaction term. The structure of the model is rather similar to the replica one, although the interaction term has a different form. We study the model by perturbation theory and renormalization group calculations. We check the renormalizability of the model in the first loop approximation and in the first order in the interaction. In this limit we reproduce the renormalization group equations known from earlier works. We hope that the new supermatrix sigma-model may become a new tool for non-perturbative calculations for disordered systems with interaction.

[1] G. Schwiete, K. Efetov, cond-mat/0409546

TT 8.15 Fr 14:00 Poster TU C

Cotunneling and coherent tunneling through quantum dots — •Bernhard Wunsch, Michael Tews, and Daniela Pfannkuche — 1. Institut für Theoretische Physik, Universität Hamburg

We study transport through a quantum dot coupled to two electronic reservoirs. Including all transport processes up to fourth order in tunneling [1] we go systematically beyond a master equation approach with transition rates obtained from Fermi's Golden rule. Thus we are able to describe transport structures within the coulomb blockade regime due to cotunneling which allow to measure the excitation spectrum of the dot. In particular we identify peaks in the differential conductance inside the coulomb blockade which are due to a sequential tunneling process out of an excited state allowed by a previous inelastic cotunneling event[1]. Furthermore we investigate the effect of coherent tunneling, where different transport channels may interfere with each other and the quantum dot may be in a superposition of eigenstates [3].

[1] J. König, J. Schmid, H. Schoeller, and G. Schön, Phys. Rev. B **54** 16820 (1996)
[2] M. Tews, Annalen der Physik **13** 249-304 (2004)
[3] D. Boese, W. Hofstetter, and H. Schoeller, Phys. Rev. B **66** 125315 (2002)

TT 8.16 Fr 14:00 Poster TU C

Switching an Electrical Current with Atoms: the Reproducible Operation of a Multi-Atom Relay — •Fangqing Xie[1], Christian Obermair[1], and Thomas Schimmel[1,2] — [1]Institute for Applied Physics, University of Karlsruhe, D-76128 Karlsruhe, Germany — [2]Institute of Nanotechnology, Forschungszentrum Karlsruhe, D-76021 Karlsruhe, Germany

The demonstration of a multi-atom quantum point contact relay is reported, which can be reversibly switched between a quantized conducting "on-state"and an insulating "off-state"by applying an electrochemical control potential to a separate, third electrode, the control or gate electrode [1,2]. The transition occurs directly from the conducting "on-state"at $5\,G_0$ ($G_0 = 2e^2/h$ being the conductance quantum) to the insulating "off-state". No stable intermediate levels are observed during the switching process, indicating a reproducible bistable reconfiguration of one single multi-atom contact rather than a deposition and dissolution of different parallel contacts. The results demonstrate the feasibility and reproducible operation of a configurable electronic device based on a multi-atom contact, which exhibits the functionality of an atomic relay or a transistor, opening intriguing perspectives for electronics and logics on the atomic scale.

[1] F.-Q. Xie, Ch. Obermair and Th. Schimmel, Solid State Communications 132, 437-442 (2004).
[2] F.-Q. Xie, L. Nittler, Ch. Obermair and Th. Schimmel, Phys. Rev. Lett. 93, 128303 (2004).

TT 8.17 Fr 14:00 Poster TU C

Aharonov-Bohm Interferometry with Quantum Dots — •Stefan Legel[1], Jürgen König[2], Jan Martinek[3], and Gerd Schön[1] — [1]Universität Karlsruhe — [2]Ruhr-Universität Bochum — [3]Institute of Molecular Physics, PAS, Poznan, Poland

The manifestations of quantum coherence are in the foundations of the physics of mesoscopic systems. The presence of quantum coherence is detectable through interference experiments.

We study electron transport through a closed Aharonov-Bohm interferometer containing two single-level quantum dots. We address the question how electron-electron interaction on the dots affects the coherence of the transport. The method of real-time transport theory enables us to treat these systems both in equilibrium as well as in non-equilibrium. A perturbation expansion in the coupling strength of the quantum dots to the leads allows us to make predictions for the signatures of quantum interference in the conductance of the considered systems in first and second order (so-called cotunneling) in the coupling strength.

TT 8.18 Fr 14:00 Poster TU C

Adiabatic Pumping through interacting Quantum Dots — •Janine Splettstoesser[1,2], Michele Governale[1], Rosario Fazio[1], and Jürgen König[2] — [1]Scuola Normale Superiore, Pisa — [2]Ruhr-Universität Bochum

There has been much recent experimental and theoretical interest in adiabatic quantum pumping through mesoscopic electronic devices such as quantum dots. A systematic framework exists to analyze such a system in the non-interacting limit starting from the so-called Brouwer's formula. In interacting systems a general formalism to describe adiabatic pumping is not available until now. Using the nonequilibrium-Green-function approach for transport through interacting systems (by Jauho, Wingreen and Meir), we write a formula to calculate adiabatic pumping through an interacting quantum dot.

TT 8.19 Fr 14:00 Poster TU C

Conductance Measurements on Ferromagnetic Breakjunctions — •Cécile Bacca, Magdalena Hüfner, H.-F. Pernau, and Elke Scheer — Fachbereich Physik, Universität Konstanz

We investigate lithographically fabricated breakjunctions of ferromagnetic metals. With the help of a three-point bending mechanism, the bridges can be opened to a single-atom contact, broken to a vacuum-tunnel contact and closed again repeatedly at low temperatures ($T \leq$ 4.2K). We observe steps in the conductance that are due to atomic rearrangements in the contact region [1] and calculate the preferred conductance value of a single Co atom with and without magnetic field. In addition we observe very high magnetoconductance effects up to 150% for single-atom or 500% for tunnel contacts in magnetic fields up to 5 T and perpendicular to the sample plane. However, the details of the magnetoconductance curves are not yet fully understood. In order to separate the contributions of the different possible effects (magnetostriction, TMR, BMR, AMR,...) we analyse the magnetoconductance as a function of the symmetry of the contact, of the free-standing bridge length, and for different materials (Co, Ni). In parallel we calculate [2] the magnetization state as a function of the geometry of the contact, the film thickness and its magnetic history. [1] J.M. Krans et al. Nature 375, 767 (1995)

[2] M.J. Donahue and D.J. Porter, OOMMF's User Guide (see http://math.nist.gov/oommf)

TT 8.20 Fr 14:00 Poster TU C

Exactly solvable model of three interacting particles in an external magnetic field — E. P. Nakhmedov[1,2], •K. Morawetz[1,2], M. Ameduri[3], A. Yurtsever[4], and C. Radehaus[1] — [1]Chemnitz University of Technology, 09107 Chemnitz, Germany — [2]Max Planck Institute for the Physics of Complex Systems, Nöthnitzer Str. 38, 01187 Dresden, Germany — [3]Weill Cornell Medical College in Qatar, Qatar Foundation, Doha, Qatar — [4]Azerbaijan Academy of Sciences, Institute of Physics, H. Cavid 33, 370143 Baku, Azerbaijan

The quantum mechanical problem of three identical particles, moving in a plane and interacting pairwise via a spring potential, is solved exactly in the presence of a magnetic field. Calculations of the pair–correlation function, mean distance and the cluster area show a quantization of these parameters. Especially the pair-correlation function exhibits a certain number of maxima given by a quantum number. We obtain Jastrow prefactors which lead to an exchange correlation hole of liquid type, even in the presence of the attractive interaction between the identical electrons.

[1] E. P. Nakhmedov, K. Morawetz, M. Ameduri, A. Yurtsever, C. Radehaus, Phys. Rev. B 67 (2003) 205106

TT 8.21 Fr 14:00 Poster TU C

Spin-dependent transport through quantum dots with three ferromagnetic leads — •Daniel Urban, Matthias Braun, and Jürgen König — Institut für Theoretische Physik III, Ruhr-Universität Bochum

We examine a single-level quantum dot weakly tunnel-coupled to three ferromagnetic leads. A current between two leads gives rise to spin accumulation and spin blockade. Two effects allow to modify the spin on the dot by changing the magnetization direction of the floating third lead.

The first of these effects is anisotropic spin damping. Spin components in the direction of the third lead have an increased lifetime. The second is an exchange field arising in the presence of ferromagnetism and Coulomb interaction [1]. It causes precession of the accumulated spin [2].

Transport through the system depends on the spin on the dot and can thus be controlled by the third lead in a transistor-like manner.

[1] J. König and J. Martinek, Phys. Rev. Lett. **90**, 16 (2002).
[2] M. Braun and J. König and and J. Martinek, to appear in Phys. Rev. B, (2004), cond-mat/0404455.

TT 8.22 Fr 14:00 Poster TU C

Transport properties of ferromagnetically filled multiwall carbon nanotubes — •H. Vinzelberg, M. Milnera, I. Mönch, D. Elefant, A. Leonhardt, J. Schumann, and B. Büchner — Leibniz Institute for Solid State and Materials Research (IFW) Dresden, Helmholtzstr. 20, D 01069 Dresden, Germany

In conventional semiconductor electronics the spin of the electrons is an unused quantity. However, spin dependent devices have a significant potential for data storage technology and future electronics. Due to their large spin-flip scattering length carbon nanotubes (CNTs) represent a promising candidate for spin dependent electronic devices. High magnetoresistance effects were recently discovered on ferromagnetically contacted CNTs. Ferromagnetically filled multiwall CNTs (MWCNTs) exhibit interesting magnetic properties. However, transport measurement results exist only on as grown two dimensional arrays of aligned Fe-filled MWCNTs. Here we investigate single ferromagnetically filled MWCNT devices produced by using an AC-electrophoresis deposition on predefined Au- or Ti- microfinger structures. The measured magnetotransport data show a broad spectrum of behaviour: positive and negative magnetoresistance, oscillations and shoulders.

TT 8.23 Fr 14:00 Poster TU C

Absence of fractional conductance quantization in ferromagnetic atomic contacts — •Michael Häfner[1], Diego Frustaglia[2], and Juan-Carlos Cuevas[1,3] — [1]Institut für Theoretische Festkörperphysik, Universität Karlsruhe, 76128 Karlsruhe, Germany — [2]Quantum Transport and Information, Scuola Normale Superiore, 56126 Pisa, Italy — [3]Departamento de Física Teórica de la Materia Condensada C-V, Universidad Autónoma de Madrid, 28049 Madrid, Spain

In this work we present a theoretical analysis of the current through atomic contacts of magnetic materials (Co and Ni). Several experimental groups have recently reported the observation of half-integer conductance quantization in nanowires of these materials. This suggests that the current in these contacts is completely spin polarized and all the contributing channels are perfectly transmissive. In order to analyze these surprising observations, we have performed conductance calculations of Ni and Co atomic junctions based on a tight-binding model. Contrary to these experiments, we find that the conductance is in general neither quantized nor spin polarized. We show that the transport is mainly dominated by both the s and d bands close to the Fermi energy. These bands give rise to several conduction channels that are partially open. Typically, both spin bands give a significant contribution to the transport suggesting that the fractional conductance quantization should not appear in ferromagnetic atomic contacts.

TT 8.24 Fr 14:00 Poster TU C

Thermopower of single-molecule devices — •Jens Koch[1], Felix von Oppen[1], Yuval Oreg[2], and Eran Sela[2] — [1]Institut für Theoretische Physik, Freie Universität Berlin, Arnimallee 14, 14195 Berlin — [2]Department of Condensed Matter Physics, Weizmann Institute for Science, Rehovot 76100, Israel

We investigate the thermopower of single molecules weakly coupled to metallic leads. We model the molecule in terms of the relevant electronic orbitals and phonons corresponding to either internal vibrations or to oscillations of the molecule as a whole. The thermopower is computed by means of rate equations including both sequential-tunneling and cotunneling processes.

The sign of the thermopower reveals whether electronic transport through the molecule occurs via the LUMO or the HOMO. It is found that the thermopower is sensitive to higher-order processes such as cotunneling. Under certain conditions, it allows one to access the electronic and phononic excitation spectrum of the molecule in a linear-response measurement. In particular, we find that phonon features are more pronounced for weak lead-molecule coupling.

TT 8.25 Fr 14:00 Poster TU C

Theory for transport through a single magnetic molecule: endohedral N@C$_{60}$ — •Florian Elste and Carsten Timm — Institut für Theoretische Physik, Freie Universität Berlin, Arnimallee 14, D-14195 Berlin, Germany

We present a theory for transport through a single magnetic N@C60 molecule in a break junction, weakly coupled to the metallic leads. Since transport through a single C_{60} molecule has been demonstrated and the synthesis of endohedral fullerenes is also feasible, such an experiment is possible with present-day technology. Employing a density-matrix formalism we derive rate equations for the occupation probabilities of the many-particle states of the molecule. We calculate the current-voltage characteristics and predict novel interesting structures in the differential conductance dI/dV, which are very different from what is seen for electrons coupled to molecular vibrations. Our results reveal Coulomb-blockade behavior as well as a fine structure of the Coulomb-blockade peaks in dI/dV due to the exchange coupling of the C_{60} spin to the spin of the encapsulated nitrogen atom.

TT 8.26 Fr 14:00 Poster TU C

Electronic Transport Measurements on Mass-Selected Silicon Clusters — •Jochen Grebing, Felix von Gynz-Rekowski, Bernd Briechle, Gerd Ganteför, and Elke Scheer — University of Konstanz, 78467 Konstanz, Germany

We present a setup to study electronic transport properties of single or a few clusters.
Using a magnetron sputter source, clusters can be produced and then be soft-landed on opened adjustable metallic electrodes fabricated with a MCB technique [1]. By closing the junction a single or a few clusters shall be contacted and their electronic transport properties, i.e. current-voltage curves, shall be examined *in situ*. According to theoretical calculations a nonlinear behavior is expected for a bias > 0.5 V for Si_4 clusters contacted with Al leads [2]. A systematic investigation of this system shall provide information to verify these calculations. As a further project these Si_4 clusters shall be gated using a sandwich MCB technique which is currently being developped.

[1] MCB: **M**echanically **C**ontrollable **B**reakjunction
[2] C. Roland et al., Phys. Rev. B **66**, 035332 (2002)

TT 8.27 Fr 14:00 Poster TU C

Electronic Transport through C$_{60}$ — •Tobias Böhler, Jochen Grebing, and Elke Scheer — FB Physik - Universität Konstanz

The electronic transport through a single or a few C_{60} molecules is studied experimentally with the help of the mechanically controllable break-junction (MCB) technique [1]. The tip electrodes of the MCB are fabricated of aluminum or gold. The molecule is evaporated onto an opened break-junction under UHV conditions and at low temperatures. At room temperature the experiment shows evidence that the conductance of a single C_{60} molecule between gold contacts is in the order of a tenth of G_0. This can be seen in opening and closing curves and also in time-dependent fluctuations of the conductance. However, the thermal fluctuations of the electrodes hamper the acquisition of meaningful current-voltage characteristics. Therefore we present an improved setup to measure the differential conductance at low temperatures.

[1] T. Böhler et al. Nanotechnology 15 (2004) 465

TT 8.28 Fr 14:00 Poster TU C

Influence of laser irradiation on the transport in molecular wires — •S. Welack, U. Kleinekathöfer, and M. Schreiber — Institut für Physik, Technische Universität Chemnitz, 09107 Chemnitz

New features of molecular wires can be observed when they are irradiated by laser fields. This can be done by periodically oscillating light fields but also by short laser pulses. Here we restrict ourselves to periodic laser fields though the current propagation method is well suited for short laser pulses as well. The theoretical foundation used for these investigations is the density matrix formalism based on a splitting of the full system into a relevant part and a thermal bath. Recently we have developed a formalism which is based on a time-convolutionless projection-operator approach which includes the interaction with time-dependent laser fields non-perturbatively and is valid at low temperatures [1]. This theory including further extensions is used in the current project for the determination of electron transport through molecular wires. Similar to studies of other groups [2] the coupling between the leads and the wire shall be treated perturbatively. From the population dynamics the current through the molecular wire is determined.

[1] U. Kleinekathöfer, J. Chem. Phys. **121**, 2505 (2004).
[2] J. Lehmann, S. Kohler, V. May and P. Hänggi, J. Chem. Phys. **121**, 2278 (2004).

TT 8.29 Fr 14:00 Poster TU C

Electronic and Optoelectronic Properties of Single-Molecule Junctions — •Joachim Reichert[1], Cao Qi[1], Harald Fuchs[1], Ivan Stich[2], and Dominik Marx[3] — [1]Physikalisches Institut, Westfälische Wilhelms-Universität Münster, D - 48149 Münster — [2]Center for Computational Material Science, Slovak University of Technology, Ilkovicova 3, 812 19 Bratislava — [3]Lehrstuhl für Theoretische Chemie, Ruhr-Universität Bochum, D - 44780 Bochum

Recent developments and advances in atomic-scale imaging and manipulation techniques enables access to a new field of single molecule experiments. Electronic transport measurements through single organic molecules which are immobilized by self assembling techniques between two metallic electrodes (e.g. mechanically controlled breakjunction [1]) as well as tunnelling experiments through molecular films with STM have proven the ability of organic molecules to act as functional parts in nanoscale-devices. Especially scanning near-field optical microscopy (SNOM) with its ability to apply an optical field to a molecular system in a controlled manner enlarges the range of experimental available properties in metal-anchored molecular junctions. With a combination of these techniques we want to study the electronic/optoelectronic properties of single molecules covalently linked between a metallic substrate and a SNOM-tip to improve the understanding of electronic transport through single molecules.

[1] J. Reichert, R. Ochs, D. Beckmann, H.B. Weber, M. Mayor, H. v. Löhneysen, Phys.Rev.Lett. 88, 176804 (2002). [2] H.-U. Danzebrink, U. C. Fischer, NATO ASI Series 242, 255, 303 (1993).

TT 8.30 Fr 14:00 Poster TU C

Discrete low-bias conductance fluctuations in molecular break-junctions — •Jan U. Würfel, Mark Elbing, Marcel Mayor, and Heiko B. Weber — Institut für Nanotechnologie, FZ Karlsruhe

We investigate the electronic transport properties of gold-molecule-gold junctions using the mechanically-controllable break-junction (MCBJ) technique. We have shown in former studies that under certain conditions single-molecule contacts could be achieved [1]. Here, we study the longterm stability (up to days) of stable and reproducible contacts, which show discrete transitions in the conductance at low bias (∼ 10 mV). Some of the conductance values could be identified as integer multiples of a fixed value. This may suggest an integer number of molecules contributing. The findings are discussed.

[1] Phys. Rev. Lett., **88**, 176804 (2002)

TT 8.31 Fr 14:00 Poster TU C

A perturbative expansion of shot noise in quantum dots and molecules — •Matthias Hettler[1], Jasmin Aghassi[1,2], Axel Thielmann[1], Jürgen König[3], and Gerd Schön[1,2] — [1]Forschungszentrum Karlsruhe, Institut für Nanotechnologie,76021 Karlsruhe, Germany — [2]Institut für Theoretische Festkörperphysik , Universität Karlsruhe, 76128 Karlsruhe, Germany — [3]Institut für Theoretische Physik III, Ruhr-Universität Bochum, 44780 Bochum, Germany

We study current and shot noise in perturbation theory in the coupling of a mesoscopic object (e.g. quantum dot or molecule) to metallic electrodes. We explicitly account for the electronic interactions and the resulting many-body states of the molecule/quantum dots, and allow for relaxation of the excited states. We present in some detail the diagrammatic technique that allows for the computation of the noise to second order in the molecule-electrode coupling. In particular, we discuss the influence of co-tunneling processes as well as the effect of intermolecular (interdot) couplings and relaxation on the shot noise. Furthermore, we find the Fano factor to be very sensitive to the tunnel-coupling strength, which may serve as a spectroscopic tool for the various coupling strengths.

TT 8.32 Fr 14:00 Poster TU C

Nanoscale electrodes on cleaved edge semiconductor surfaces for molecular electronics applications — •Sebastian Strobel[1], Sebastian Luber[1], Dieter Schuh[1], Werner Wegscheider[2], and Marc Tornow[1] — [1]Walter Schottky Institut, TU München, 85748 Garching, Germany — [2]Institut für Angewandte und Experimentelle Physik, U Regensburg, 93040 Regensburg, Germany

Current efforts in molecular electronics target at novel concepts for future nano-electronics thereby aiming at a fundamental understanding of charge transfer mechanism in (bio-) molecular "wires" such as DNA. Starting point is the preparation of suitable nanogap - electrodes that serve as electrical contacts to the molecules.

We present a novel strategy based on a semiconductor heterostructure grown by molecular beam epitaxy that consists of a AlGaAs layer into which a thin layer of GaAs (5 - 20 nm) is embedded. After cleaving the structure an atomically flat plane is obtained. Subsequent selective etching of the GaAs layer perpendicular to that plane and evaporation of a few nanometer thick metal film yields the nano-gap electrodes.

We successfully bridged nano-gap electrodes with single, 30 nm diameter colloidal Au nano-particles by AC electric trapping. The resulting drop in resistance of up to seven orders of magnitude verified the electrical functionality of our devices. First measurements on electrodes functionalized with organic self-assembled monolayers will be presented.

TT 8.33 Fr 14:00 Poster TU C

Multiphoton photofieldemission in electromigrated nanogaps — •S. Dantscher[1], D. Wolpert[1], W. Pfeiffer[1], J. U. Würfel[2], and H. B. Weber[2] — [1]Physikalisches Institut, Universität Würzburg, Am Hubland, 97074 Würzburg — [2]FZ Karlsruhe, Institut für Nanotechnologie, PO-Box 3640, 76021 Karlsruhe

The combination of nanocontacts and laser excitation offers the possibility of studying photoinduced nonequilibrium transport phenomena and therefore also electron dynamics on the nanometer scale. Using the method of electromigration, contacts with electrode distances in the range of several nanometers can be produced. For relatively large gaps no tunnel current is detectable, i.e. with a moderate applied DC bias, that avoids field emission, these junctions carry no significant current.

We have investigated photocurrents in such contacts under illumination with ultrashort femtosecond laserpulses. The use of a microscope objective as focusing element provides focal radii down to $2\mu m$ resulting in maximum intensities during the pulses of $10^{10} W/cm^2$. Under these conditions and with bias voltages in the range of ± 5V photo induced currents are detected. The intensity dependences exhibit power laws with exponents up to 3, indicating that multiphoton excitation is responsible for the detected current. Moreover the multiphoton order depends on the actual junction parameters, such as the applied bias. This suggests that the photocurrent flows in the nanogap. The observed bias dependence is attributed to photofieldemission, i.e. the multiphoton photocurrent is influenced by the static field distribution in the gap. In addition, also dynamic field effects might affect the signals.

TT 8.34 Fr 14:00 Poster TU C

Molecular conductance at finite voltage: bias driven evolution of Kohn-Sham-orbitals — •Max Koentopp, Ferdinand Evers, Florian Weigend, Mark Elbing, Rolf Ochs, Marcel Mayor, and Heiko Weber — Institut für Nanotechnologie, Forschungszentrum Karlsruhe, 76021 Karlsruhe, Germany

Ground state density functional theory calculations yield the exact electron density if the exact exchange-correlation functional is employed.

The evolution of the equilibrium density with parametric changes in the Hamiltonian, e.g. realized by a change in the electrostatic potential, can provide crucial information about transport properties, like the Coulomb blockade.

To test our ideas, we perform model calculations using TURBOMOLE for a diode molecule, which exhibits a structure of a double quantum dot and has been investigated experimentally [1]. In particular, we investigate the origin of the characteristic peak structure in the differential conductance. Our results are consistent with the interpretation that the stepwise increase of the conductance occurs when the number of occupied levels of one of the dots, that have an energy above the lowest unoccupied level of the other dot, increases by one.

[1] M. Elbing, R. Ochs, M. Mayor, H. Weber, M. Koentopp, F. Evers, F. Weigend, Proc. Nat. Acad. Sci. USA, submitted.

TT 8.35 Fr 14:00 Poster TU C

Manipulating a molecule's conformation with gates: a molecular switch — •Andreas Arnold, Max Koentopp, Ferdinand Evers, and Oliver Rubner — Institut für Nanotechnologie, Forschungszentrum Karlsruhe, 76021 Karlsruhe, Germany

Molecules can undergo a conformational change when being charged. For molecules connected to external leads their excess charge becomes a parameter that can be tuned by means of a gate. Therefore, the molecular conformation can be controlled at will, which may proove useful for potential applications, e. g. a molecular switch. We present a calculation based on density functional theory using TURBOMOLE for the model system bipyridine. Our calculation shows, that the equilibrium angle between the two benzene rings can indeed be controlled by the gate voltage. In particular, adding an excess charge of 2 electrons to the molecule takes the system from a strongly tilted, low conductance state over into an almost planar, high conductance configuration.

TT 8.36 Fr 14:00 Poster TU C

Perfekte Quanteninformationsbertragung in Spinketten — •Peter Karbach und Joachim Stolze — Institut für Physik, Universität Dortmund, 44221 Dortmund

Gekoppelte Spins 1/2 werden in der Quanteninformationsverarbeitung viel diskutiert, in letzter Zeit zunehmend auch als Mittel zum *Transport* von Quanteninformation. Hierbei spielen eindimensionale Systeme (Spinketten) naturgemäß eine besonders wichtige Rolle. Die kürzlich gefundene *perfekte* Abbildung eines Zustands zwischen dem ersten und letzten Spin einer speziellen inhomogenen XX-Kette (Christandl et al., PRL **92**, 187902 (2004)) kann verallgemeinert werden auf die „Spiegelung“ eines Zustands zwischen den beiden Hälften der Kette (Albanese et al. quant-ph/0405029). Wir zeigen, wie die beiden einzigen bisher bekannten Ketten mit perfekter Spiegelung eines Zustands nahezu beliebig verallgemeinert werden können. Hierzu muss nur das Einteilchen-Energiespektrum der Spinkette in der Darstellung wechselwirkungsfreier spinloser Fermionen gewisse Eigenschaften besitzen. Wir diskutieren Beispiele perfekt spiegelnder Spinketten und demonstrieren deren Eigenschaften; z.B. sind alle Autokorrelationen dieser Systeme für beliebige Temperaturen strikt periodisch.

TT 8.37 Fr 14:00 Poster TU C

Long Josephson junctions as vortex qubits — •A. Kemp, A. N. Price und A. V. Ustinov — Physikalisches Institut III, Universität Erlangen-Nürnberg, Erwin-Rommel-Str 1., 91058 Erlangen, Germany

We have investigated the properties of Josephson vortices in annular Josephson junctions of circumference comparable to the Josephson penetration depth, at millikelvin temperatures. The fluctuation-induced activation of these vortices exhibits a systematic magnetic field and temperature dependence. We evaluate the height of the potential barrier between two spatially separated vortex states in long heart-shaped junctions. Reproducibility of the initial vortex state is guaranteed through the use of current injectors. Such injected fluxons are manipulated by means of homogeneous magnetic fields produced by microstrips carrying rectangular pulses. Low temperature microwave transmission characteristics show that such microstrips offer the possibility to control the barrier height of a vortex qubit on sub-nanosecond timescales.

TT 8.38 Fr 14:00 Poster TU C

Driven two-level system in a photonic crystal — •Geesche Boedecker and Carsten Henkel — Institut für Physik, Universität Potsdam, Am Neuen Palais 10, 14469 Potsdam

We discuss a specific system-reservoir model with strong coupling and long-range temporal memory in the bath. The model can be physically realized with a coherently driven two-level system embedded in a photonic crystal. The problem differs from the usual spin-boson setting in several respects: the bath is essentially at zero temperature, its spectral density is zero in some finite frequency interval (photonic bandgap), and the two-level system is only coupled to near-resonant bath modes (rotating wave approximation). Its emission spectrum has been characterized only in the weak coupling limit in the quantum optics literature. We discuss here numerically exact simulation schemes for this non-Markovian problem and compare them to approximations based on the path integral formulation.

TT 8.39 Fr 14:00 Poster TU C

Bi- and tripartite entanglement in a flux-qubit triangle — •Johannes Ferber and Frank Wilhelm — LMU München, Department für Physik, and CeNS

We are investigating a system of three superconducting flux qubits, inductively coupled by a surrounding loop or via shared lines.

We derive the possible coupling strength between the qubits and determine the energy level structure. We show, that for a proper and physical choice of parameters, the system shows strong three-qubit entanglement, quantified by the 3-tangle of the system [1].

Systems consisting of three qubits provide the possibility of examining quantum nonlocality using GHZ-states in a potentially more convenient way than the two-qubit Bell inequality. Based on our results, we discuss the feasibility of such a GHZ-experiment using flux qubits. Moreover, we outline applications of three-bit interactions to the acceleration of quantum algorithms.

[1] V. Coffmann, J. Kundu, and W. K. Wooters, Phys. Rev. **A 61**, 052306 (2000).

TT 8.40 Fr 14:00 Poster TU C

Continuous measurement of two spin qubits in quantum dots — •Holger Schaefers and Walter T. Strunz — Physikalisches Institut, Albert-Ludwigs-Universität Freiburg, Hermann-Herder-Str. 3, 79104 Freiburg, Germany

We investigate two electron spin qubits in quantum dots. The spins are measured by separate currents through the dots. Our approach is based on quantum trajectories , widely used in quantum optics, here adapted to describe conditional quantum dot dynamics in a fermionic environment. We use the quantum trajectory approach to simulate the quantum dynamics conditioned on the continuous measurement outcome, here the electron currents through the dots. We investigate counting statistics of the currents with respect to signatures of entanglement of the spins.

TT 8.41 Fr 14:00 Poster TU C

Fabrication of superconducting qubit stuctures — •Georg Wild, Tobias Heimbeck, Heribert Knoglinger, Karl Madek, Matteo Mariantoni, Christian Probst, Achim Marx, and Rudolf Gross — Walther-Meissner-Institut, Bayerische Akademie der Wissenschaften, 85748 Garching, Germany

Solid state based quantum bits (qubits) promise to be producible using present day micro- and nanofabrication technologies thus allowing scalability up to systems comprising a large number of qubits. Superconducting qubits are advantageous because of the superconducting energy gap. Superconducting qubits based on Josephson junctions where the Josephson coupling energy is larger than the charging energy are usually called flux qubits. We are fabricating flux qubits with different designs based on Al/Al_2O_3 tunnel junctions. Measurements on various test structures (Josephson junctions, SQUIDs, qubits) help to analyze and further optimize the system parameters and to compare the different qubit variants. Flux qubits require an external magnetic field bias generating half a flux quantum in the ring defining the qubit to reach the degeneracy point. To shift this degeneracy point to zero field a π-shift element has to be inserted into the ring. We have started to develop a process to fabricate π-shifters based on superconductor/ferromagnet/superconductor Josephson junctions where a thin ferromagnetic NiPd layer is embedded between two Nb layers. This work was supported by the Sonderforschungsbereich 631 of the Deutsche Forschungsgemeinschaft.

TT 8.42 Fr 14:00 Poster TU C

Low temperature setup for characterization of superconducting qubits — •Karl Madek, Tobias Heimbeck, Heribert Knoglinger, Matteo Mariantoni, Christian Probst, Georg Wild, Achim Marx, and Rudolf Gross — Walther-Meissner-Institut, Bayerische Akademie der Wissenschaften, 85748 Garching, Germany

In recent years interest in quantum computing has been continously growing. Because of the superconducting energy gap superconducting devices are promising candidates for quantum bits suggesting sufficiently large decoherence times. In order to experimentally investigate superconducting qubits well shielded low temperature measurement setups are required. We have established a dilution unit with several layers of mumetal and cryoperm shields and several stages of low pass filters at different temperatures in the biasing lines. A semirigid coaxial cable with thermally anchored attenuators is used for microwave spectroscopy on superconducting devices. Furthermore, the whole setup is placed in a shielded room. Measurements of the escape rate of Josephson junctions out of the zero voltage state using a current ramping technique serve to evaluate the quality of the shielding. The observation of a crossover from the quantum tunneling regime to the thermal regime shows the negligibility of noise. This work was supported by the Sonderforschungsbereich 631 of the Deutsche Forschungsgemeinschaft.

TT 8.43 Fr 14:00 Poster TU C

Quantum state transfer in arrays of flux qubits — •Andriy Lyakhov and Christoph Bruder — Department of Physics and Astronomy, University of Basel, Klingelbergstrasse 82, CH-4056, Basel, Switzerland

In this work, we describe a possible experimental realisation of Bose's idea to use spin chains for short distance quantum communication [1]. Josephson arrays have been proposed and analyzed as transmission channels for systems of superconducting charge qubits [2]. Here, we consider a chain of persistent current qubits [3], that is appropriate for state transfer with high fidelity in systems containing flux qubits. We calculate the fidelity of state transfer for this system. In general, the Hamiltonian of this system is not of XY-type, and we analyze the magnitude and the effect of the terms that break XY-symmtry.

[1] S. Bose, Phys. Rev. Lett. **91**, 207901 (2003).
[2] A. Romito, R. Fazio, and C. Bruder, quant-ph/0408057.
[3] L.S. Levitov *et al.*, cond-mat/0108266.

TT 8.44 Fr 14:00 Poster TU C

Probing superconducting phase qubits — •Jürgen A. Lisenfeld, Christian Coqui, Alexander Lukashenko, Alexander Kemp, Abdufarrukh A. Abdumalikov, and Alexey V. Ustinov — Physikalisches Institut III, Universität Erlangen-Nürnberg, 91058 Erlangen, Germany

Solid-state quantum bits based on current-biased Josephson junctions have recently been shown as very promising. They require appropriate galvanic isolation of the junctions from the bias leads which can be achieved by the use of superconducting transformers. The resulting rf-SQUID has a double-well potential, where the discrete quantum levels in one well can be used as qubit states. State-dependent tunnelling to the other well changes the magnetic flux in the qubit, which is measured by a dc-SQUID. In current experiments, we investigate the operation of such qubits. Another crucial point is the coupling of qubits, which we study in a system of two capacitively coupled current-biased junctions. One effect which appears here is phase-locking, resulting in the formation of voltage steps in the current-voltage characteristics. Another feature of the coupled system is the appearance of entangled macroscopic quantum states, which we try to observe by using microwave spectroscopy.

TT 8.45 Fr 14:00 Poster TU C

Decoherence during Two-Qubit Gates — •Markus J. Storcz, Frank Hellmann, Calin Hrelescu, and Frank K. Wilhelm — Physics Department and CeNS, Ludwig-Maximilians-Universität München, Theresienstr. 37, D-80333 München

Superconducting solid-state quantum bits (qubits) are promising candidates for the realization of a *scalable* quantum computer. However, they are limited by decoherence due to the many extra degrees of freedom of a solid-state system.

We investigate a system of two qubits in a setup that is typical for *pseudospin* solid-state qubits such as charge or flux systems. We evaluate the decoherence properties and gate quality factors (GQF) in the presence of a common and two uncorrelated baths coupling to an arbitrary mixture of σ_z and σ_x and evaluate the decoherence rates and GQF for non-ideal, i.e. non identical qubits, realized in experimental setups. We emphasize the importance of symmetries to minimize decoherence during a quantum gate operation and explore memory effects of the environment between gate pulses.

Moreover, we investigate a setup of a chain of superconducting qubits with capacitive (flux qubits) or inductive (charge qubits) nearest neighbor coupling. Errors due to 1/f noise, which is picked up by the coupling elements, are anticipated to be the dominating source of errors in this setup. We propose to encode the qubits into a Decoherence Free Subspace (DFS) that provides full protection against coupling errors.

TT 8.46 Fr 14:00 Poster TU C

Quantum phase transitions in a 2-qubit system — •Henryk Gutmann[1], Frank Wilhelm[1], and Gergely Zaránd[2] — [1]Department für Physik and CeNS, LMU, 80333 München — [2]Department of Theoretical Physics, Budapest University of Technology and Economics, H-1521 Budapest, Hungary

For describing local as well as common decoherence effects we investigate a setup of two coupled spins influenced by two local bosonic baths as well as a common one. Here we are interested to go beyond the usual weak coupling regime, as we want to focus on the transition from quantum mechanical behaviour to classical localization of the spins, as well as the emergence and disappearance of entanglement. We start with a quite generic two-spin generalization of the spin-boson model, *i.e.* where the environmentral influences, the spin interactions and the spin Hamiltonian do not commute with each other. In order to eliminate the environmental Hamiltonian terms we unitarily transfer the spin-boson Hamiltonian onto the anisotropic Kondo model, using a technique given in Ref.[1]. Therefrom we derive scaling equations in first order perturbation theory. Considering the corresponding fixed point Hamiltonian we receive first qualitative insights in the different dissipative phase regimes. To get more reliable results we present higher order scaling equations by applying *operator product expansions* on the generated products of the renormalized spin couplings.

[1]: T.A. Costi and G. Zaránd, Phys. Rev. B **59**, 12398 (1999).

TT 8.47 Fr 14:00 Poster TU C

Electromagnetic Full-Wave Simulation of a Superconducting Microstrip Resonator — •M. Mariantoni[1], M.J. Storcz[2], W.D. Oliver[3], F.K. Wilhelm[2], A. Marx[1], and R. Gross[1] — [1]Walther-Meißner-Institut, Bayerische Akademie der Wissenschaften, D-85748 Garching, Germany — [2]Physics Department and CeNS, LMU München, D-80333 München, Germany — [3]MIT Lincoln Laboratory, Lexington, MA 02420, USA

A fundamental phenomenon in nature is the interaction between light and matter. This process can be observed letting interact a single photon with a single atom. In the last decade several experiments with quantum optical systems have been realized giving rise to a broad research activity in the field called cavity-Quantum-ElectroDynamics (cQED). We propose an experimental realization making use of solid state devices, the role of atom being played by a superconducting flux qubit. The flux qubit interacts with a microwave-photons field inside a cavity. The cavity is fabricated on-chip using a superconducting microstrip resonator. The properties of the microstrip resonator have been simulated making use of a microwave software based on the transmission-line-matrix method. The software has been adapted for simulating correctly superconducting films in the microwave regime. Particular attention has been paid to the internal quality factor of the resonator taking into account residual surface resistances as well as dielectric and radiation losses. Our simulations show that an internal quality factor of about 10^6 should be achievable. This work is supported by the DFG through SFB 631.

TT 8.48 Fr 14:00 Poster TU C

Noise in a non-adiabatic electron pump — •Michael Strass, Sigmund Kohler, and Peter Hänggi — Institut für Physik, Universität Augsburg

We investigate the electron transport in a two-terminal device consisting of two sites driven by an external AC field. The current and the associated noise are computed numerically within a Floquet approach which is also valid for non-adiabatic driving [1]. As a result, we find maxima of the pump current at the multi-photon resonances even if no voltage is applied. The transport in this setup can be optimized tuning the ratio of the intrasite coupling and the coupling of the sites to the leads. As a measure of the relative noise strength and therefore the transport properties, we study the Fano factor as a function of driving frequency and amplitude. At the multi-photon resonances, the Fano factor shows distinct minima.

The numerically exact solution is in addition compared to analytical results obtained within a high-frequency approximation [2]. This also provides a physical understanding of the current and noise suppressions observed for specific driving parameters. Possible experimental realizations of the system at hand are molecular wires in laser fields, quantum double-wells in heterostructures driven by electrical fields, and coupled quantum dots exposed to microwave radiation.

[1] S. Camalet, S. Kohler, and P. Hänggi, Phys. Rev. B **70**, 155326 (2004)
[2] S. Kohler, S. Camalet, M. Strass, J. Lehmann, G.-L. Ingold, and P. Hänggi, Chem. Phys. **296**, 243 (2004).

TT 8.49 Fr 14:00 Poster TU C

Fluctuations in meander-like superconducting nanostructures — •Andreas Engel[1], Andreas Schilling[1], Alexei Semenov[2], Heinz-Wilhelm Hübers[2], Konstantin Il'in[3], and Michael Siegel[3] — [1]Physik Institut der Universität Zürich, Winterthurerstr. 190, 8057 Zürich, Schweiz — [2]Deutsches Zentrum für Luft- und Raumfahrt, Rutherfordstr. 2, 12489 Berlin — [3]Institut für Mikro- und Nanoelektronische Systeme, Universität Karlsruhe, Hertzstrasse 16, 76187 Karlsruhe

In superconducting films or wires thermal and quantum fluctuations play an increasingly important role, once one or more dimensions become of the order of the superconducting coherence length or less. Examples are thermal and quantum phase-slips in one-dimensional superconducting wires [1]. We experimentally studied fluctuations in NbN superconducting meanders 5 nm thick and 84 nm wide, biased with transport currents very close to the critical current $I_c(T)$. In this operating regime such structures have been shown to be very fast and sensitive optical and near-infrared single-photon detectors [2]. The sensitivity is however limited by dark count events caused by superconducting fluctuations. We will discuss various fluctuation models and compare the temperature and current dependence with experimental results.

[1] C.N. Lau et al., Phys. Rev. Lett., **87**, 217003 (2001), and refs. therein.
[2] A. Semenov et al., Eur. Phys. J. AP, **21**, 171 (2003).

TT 8.50 Fr 14:00 Poster TU C

Full Counting Statistics in a Mach–Zehnder Interferometer — •Heidi Förster[1], Sebastian Pilgram[2], and Markus Büttiker[1] — [1]Département de Physique Théorique, Université de Genève — [2]Institute of Theoretical Physics, ETH Zürich

We investigate theoretically an electronic Mach–Zehnder interferometer under the influence of dephasing by coupling the interferometer arms to a fluctuating potential [1]. Here we deal with a one–channel quantum coherent transport problem, whereas counting statistics in many channel conductors is to leading order in the channel number independent of dephasing. Using the scattering matrix approach we write down a generating function, that is statistically averaged over the fluctuating potential. We discuss the effect of dephasing on the first three cumulants, and compare with the limiting cases of a fast and a slowly fluctuating potential. In the latter case we show the complete generating function under influence of dephasing.

[1] H. Förster, S. Pilgram, and M. Büttiker (in preparation)

TT 8.51 Fr 14:00 Poster TU C

Noise-assisted tunneling in a quantum dot: high-frequency shot noise measurement of a quantum point contact — Franck Balestro[1], Eugen Onac[1], Laurens W. van Beveren[1], Ronald Hanson[1], •Udo Hartmann[2], Yuli V. Nazarov[1], and Leo P. Kouwenhoven[1] — [1]Kavli Institute of Nanoscience Delft and ERATO Mesoscopic Correlation Project, Delft University of Technology, PO Box 5046, 2600 GA Delft, The Netherlands — [2]Physics Department and CeNS, Ludwig-Maximilians-Universität München, Theresienstr. 37, 80333 München, Germany

We measured tunneling through a quantum dot (QD) induced by shot noise of a quantum point contact (QPC). The influence of the bias voltage through the QPC and the transmission of it have been explored.

We provide a theoretical model based on the description of photon-assisted tunneling (PAT). In contrast to PAT, we do not describe the environment of the QD as a continuous wave source (e.g. a microwave) of irradiation. Instead, we apply a temperature-dependent P(E) theory to calculate tunneling rates through the QD.

TT 8.52 Fr 14:00 Poster TU C

Phase relaxation by a fluctuating gauge field — •Thomas Ludwig[1] and Alexander D. Mirlin[1,2] — [1]Institut für Nanotechnologie, Forschungszentrum Karlsruhe, 76021 Karlsruhe, Germany — [2]Institut für Theorie der Kondensierten Materie, Universität Karlsruhe, 76128 Karlsruhe, Germany

We investigate the effect of transverse gauge field fluctuations on the transport properties of a disordered electron system. In particular, we show that very slow fluctuations with frequencies smaller than the inverse dephasing time play an important role in suppressing the amplitude of mesoscopic conductance fluctuations. This is due to ensemble averaging by the measurement if the duration of the measurement is the longest time scale of the system. We also highlight the close connection between mesoscopic conductance fluctuations and weak localization.

TT 8.53 Fr 14:00 Poster TU C

Linear response approach to conductance of strongly correlated 1D systems: A DMRG study — •Dan Bohr[1,2] and Peter Schmitteckert[2] — [1]Department of Micro and Nanotechnology, Technical University of Denmark, DK-2800 Kgs. Lyngby — [2]Institut für Theorie der Kondensierten Materie,Universität Karlsruhe, D-76128 Karlsruhe

The calculation of transport properties has received much attention over the years. Recently improved experimental techniques has renewed the interest for studying transport properties of strongly correlated $1D$ quantum systems. We study the conductance through $1D$ interacting lattice systems using the Kubo formalism for conductance. In this work we calculate the conductance for the well-known non-interacting system, coupled to leads, as well as fully interacting systems coupled to leads. The first serves as a benchmark for the performance of DMRG (density matrix renormalization group) in this context as well as clarifying the finite size scaling needed to extract meaningfull results. We show that indeed DMRG can be used successfully in such calculations, and consider the accuracy of this approach.