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TT 28.7 Thu 14:00 Poster A

Structural Characterisation and Spin-Dependent Transport of Single Wall Carbon Nanotubes — •Dominik Preusche Preusche[1], Silvia Schmiedmaier[1], Emiliano Pallecchi[1], SungHo Jhang[1], Benoit Witkamp[2], Herre van der Zant[2], and Christoph Strunk[1] — [1]Institut für Angewandte und Experimentelle Physik, Universität Regensburg — [2]TU Delft

We investigate spin-dependent transport in and characterise the structure of individual carbon nanotubes. Low temperature magnetoconductance was found to be also gate-dependent and showed spin-valve effect, Coulomb blockade and spin-1/2 Kondo effect. Furthermore, suspended nanotubes have been investigated with a TEM. In particular, their chiral indices can be identified by means of selected area electron diffraction. The micromagnetic properties of the ferromagnetic PdFe contacts as well as their hysteretic magnetic switching have been studied by means of Lorentz microscopy and SQUID measurements. When performed on the same nanotube, structural characterisation will facilitate the interpretation of the magnetoconductance measurements and allow more direct comparison with theoretical simulations.

TT 28.8 Thu 14:00 Poster A

Hall effect and magnetoresistance of single-walled carbon nanotubes — •sung-ho jhang[1,3], seung-hyun lee[1], ursula dettlaff[2], dongsu lee[1], siegmar roth[2], and yung-woo park[1] — [1]School of Physics, Seoul National University, Seoul, Korea — [2]Max-Planck-Institute for solid state research, Stuttgart, Germany — [3]Institute of Experimental and Applied Physics, University of Regensburg, Regensburg, Germany

We report Hall coefficient and magnetoresistance measurements on films and networks of single-walled carbon nanotubes(SWNTs). Four different types of SWNTs are prepared as films; Purified SWNTs synthesized either by HiPCO (High-Pressure CO Conversion) process or by laser ablation method (laser SWNTs), plus those SWNTs chemically treated by $SOCl_2$. $SOCl_2$-modified SWNTs show higher conductivity due to doping effect. The carrier density is determined to be $\sim 10^{22} cm^{-3}$ for HiPCO or $SOCl_2$-modified SWNTs, and $\sim 10^{21} cm^{-3}$ for laser SWNTs. Considering that theoretically predicted carrier density of metallic SWNT is $\sim 10^{22} cm^{-3}$ and that of semiconducting SWNT is $\sim 10^{20} cm^{-3}$, the difference in carrier density between HiPCO and laser SWNTs can be originated from the difference in the ratio of metallic and semiconducting SWNTs in both films. While Hall coefficient is positive in the whole temperature range of 1.4-300K for HiPCO and $SOCl_2$-modified SWNTs, Hall coefficient of laser SWNTs shows a sign change around T = 15K. The magnetoresistance of SWNTs studied in high magnetic fields up to 33T, and in a temperature range of 0.4-300K will be also presented.

TT 28.9 Thu 14:00 Poster A

Electronic Transport through C_{60} — Tobias Böhler, •Achim Edtbauer, 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 and low temperature the experiment shows evidence that the conductance of a single C_{60} molecule between gold contacts is in the order of 0,1 G_0. This can be seen in opening and closing curves, by statistical analysis (conductance histograms) and by the presence of time-dependent fluctuations of the conductance. The differential conductance of individual contacts measured - for those values of conductance which in the statistical measurements have shown to be the preferred ones - reveal fluctuations on the voltage scale of several mV. We discuss the typical behavior of the different conductance regimes. Only for very few contacts the differential conductance indicates the excitation of vibrational modes. [1] T. Böhler et al. Nanotechnology 15 (2004) 465

TT 28.10 Thu 14:00 Poster A

Conductivity through single Ferrocenedithiol molecules — •Jedrzej Schmeidel[1], Gernot Gardinowski[1], Herbert Pfnür[1], Christoph Tegenkamp[1], Volodymyr Maslyuk[2], Ingrid Mertig[2], and Mads Brandbyge[3] — [1]Institut für Festkörperphysik, Leibniz-Universität Hannover, 30167 Hannover, Germany — [2]Theoretische Physik, Martin-Luther-Universität Halle-Wittenberg , 06099 Halle, Germany — [3]Mikroelektronik Centret, Technical University of Denmark, Kongens Lyngby, Denmark

We have investigated systematically the fabrication and characterization of metallic nanometer–sized(nm) gaps suitable for conductivity measurements of single molecules. Epitaxially grown Ag nanostructures with a thickness down to 10 monolayers on Si(100) were used for a controlled gap formation by electromigration (EM). The gaps obtained range from several nm down to sub–nm, as revealed by lateral conductivity measurements and by scanning tunneling microscopy done under ultra high vacuum conditions. After adsorption of a single ferrocenedithiol (FDT) molecule in between the gap by self-assembly the zero bias resistance is around 40kOhm. In addition, the dI/dV curve shows molecular contributions which can be attributed to ferrocene induced states near the Fermi edge. In particular, the zero bias resistance is calculated correctly using the TRANSIESTA code. As pre-optimized structures for transport calcuations, the adsorption parameters obtained from VASP are used, assuming a thiolate bound configuration of one molecule in between defect-free Ag contacts.

TT 28.11 Thu 14:00 Poster A

Contacting organic molecules using micro transfer printing — •Stefan Baechle, Artur Erbe, and Elke Scheer — Universität Konstanz, FB Physik, Germany

The formation of metal molecule contacts is one of the main challenges in the fabrication of electronic devices based on the functionality of single molecules. A variety of techniques has already been demonstrated. Most of these processes rely on evaporation of metals or self-organisation of molecules on metals. It has proven to be difficult to separate artifacts from the contacting technique from molecular properties. Therefore contacting techniques, which rely on completely different mechanisms for the formation of the metal molecule contact, are of great importance. Here we demonstrate the fabrication of micron sized contacts using micro transfer printing. The dependence of the conductivity on the area of the contact is studied in order to understand the quality of the contact to individual molecules.

TT 28.12 Thu 14:00 Poster A

Mechanically variable contacts to alkane molecules — •Simon Verleger, Artur Erbe, and Elke Scheer — Universität Konstanz, FB Physik, Germany

Metal-molecule contacts using the mechanically controlled break junction method are demonstrated. The contacted molecules are alkanedithiols. The thiol groups attached to each end ensure chemisorption of the molecules to the gold electrodes. Thus a mechanically stable contact is generated, which can then be tuned by varying the distance between the electrodes. All measurements are performed in a liquid cell containing the molecular solution. We observe clear features in the conductivity as a function of the electrode distance, which can be associated with the exact positioning of the molecules with respect to the electrodes. From this we conclude that we observe transport through a number of molecules. In future experiments this approach will be used to fabricate contacts to single molecules by using molecules with specific chemical properties.

TT 28.13 Thu 14:00 Poster A

Chemical binding of short, thiolated DNA molecules to gold surfaces — •Shou-Peng Liu[1], Benjamin Bornemann[2], Artur Erbe[1], Andreas Marx[2], and Elke Scheer[1] — [1]Universität Konstanz, FB Physik, Germany — [2]Universität Konstanz, FB Chemie

The electrical properties of DNA are currently investigated using various contacting techniques. The ability of the linker group to chemically anchor the DNA molecule on the metal electrodes is of great importance in these experiments. Such a link provides a mechanically and electrically stable connection, which is important for testing the current flowing through the molecules. In this work we present fluorescence microscopy characterization of the immobilization of short DNA molecules on gold. C5-thiol-modified uridine protected with a trimethylsilylethyl-group to prevent the thiol group from oxidation is used. These molecules are found to bind specifically to gold evaporated on a polyimide substrate. Test measurements with unprotected molecules (C5-CH_2-SH) show no specific binding of the molecules, as well as measurements with molecules without any thiol modification.

TT 28.14 Thu 14:00 Poster A

Peculiarities of non-equilibrium conductance fluctuations —

•Wanyin Cui[1,2], Peter vom Stein[1], Christoph Wallisser[1], and Roland Schäfer[1] — [1]Forschungszentrum Karlsruhe, Institut für Festkörperphysik, Germany — [2]Physikalisches Institut, Universität Karlsruhe, Germany

The quantum mechanical nature of conduction electrons leads to so-called universal conductance fluctuations in mesoscopic wires. We present new experimental results in the non-linear response regime at finite bias voltage. While earlier studies focused on the size of the fluctuation var(G) in the differential conductance, the present work takes a closer look at the critical magnetic field B_c (defined as the half width of the autocorrelation function) as well. A significant decrease of the fluctuation amplitude on a small voltage scale ($V_{\rm dc} \leq 2V_{\rm Th}$, $V_{\rm dc}$ and $V_{\rm Th}$ refer to voltage drop and Thouless energy, respectively) for all investigeted samples is observed. It is accompanied by an increase of B_c for the majority of our samples. Both facts might point to a loss of phase coherence due to self-heating. However, for $V_{\rm dc} > 2V_{\rm Th}$ an overall reduction of B_c is found indicating a further spreadout of the phase coherent region responsible for the fluctuations. The results are discussed with regard to recent theoretical work on non-equilibrium fluctuations.

TT 28.15 Thu 14:00 Poster A

Influence of defects on conductance fluctuations in metallic nanowires — •Michael Wolz, Vojko Kunej, Christian Debuschewitz, and Elke Scheer — Universität Konstanz, Fachbereich Physik, Universitätsstraße 10, D-78457 Konstanz

The goal of the project is to investigate the influence of individual artificial defects on the conductance fluctuations of metallic nanowires. Clear and reproducible conductance fluctuations have been measured.

A STM working in a conventional cryostat at 4 K and in magnetic fields up to 1 T has been developed for creating the defects. In order to position the sample with respect to the STM tip the system is equiped with a x-y-table. On nanostructures which have been fabricated by electron beam lithography and reactive ion etching [1] the succsessful positioning of the stm-tip above the wire is demonstrated. The accessibility of the samples by the STM-tip is realized by shadow evaporation of the metal (Au) onto the substrate.

First low-temperature measurements with additional defects produced with the STM will be presented.

[1] T. Hoss et al., Physica E 14 (2002) 341

TT 28.16 Thu 14:00 Poster A

Super-Poissonian current noise in coupled single-electron transistors — •Björn Kubala[1], Göran Johansson[2], and Jürgen König[1] — [1]TP III, Ruhr-Universität Bochum, Germany — [2]MC2, Chalmers University Göteborg, Sweden

Non-Poissonian noise has been explored theoretically and experimentally in a variety of systems. Here, we investigate zero-frequency noise in networks of coupled single-electron transistors (SETs) within a real-time diagrammatic theory [1]. We calculate noise including all contributions up to second order in the coupling strength, whereby incorporating sequential and standard cotunneling processes, but also renormalization processes and cotunneling involving several transistor islands. For a single SET we reproduce results of orthodox and cotunneling theories and find the familiar suppression of noise in double-barrier systems.

The capacitative coupling of two SETs in parallel, however, permits an investigation of novel correlation effects, e.g., a bunching of electrons also found in semiconductor systems [2]. We identify a number of different mechanisms causing super-Poissonian noise, which could be experimentally investigated in coupled SETs.

[1] B. Kubala, G. Johansson, and J. König, Phys. Rev. B **73**, 165316 (2006).

[2] S. S. Safonov, A. K. Savchenko, D. A. Bagrets, O. N. Jouravlev, Yu. V. Nazarov, E. H. Linfield, and D. A. Ritchie, Phys. Rev. Lett. **91**, 136801 (2003).

TT 28.17 Thu 14:00 Poster A

Conductance fluctuations in inhomogeneous mesoscopic systems — •Alexander Kohler and Wolfgang Belzig — Universität Konstanz, D-78464 Konstanz, Germany

In mesoscopic systems the conductance is influenced by quantum interference effects, such as the weak localization correction and the universal conductance fluctuations. These conductance fluctuations have been observed in magnetic fields and are in some cases independent of sample size and impurity concentration. However, the magnetic field dependence is sensitive to the geometry of the wire and other inhomogeneities. Furthermore it is observed that conductance fluctuations in experiments change only slightly upon rearrangements of the disorder [1].

We investigate systems with a spatially inhomogeneous impurity concentration using standard diagrammatic methods. We find an oscillatory contribution (depending on the layer thickness) to the weak localization correction, reflecting the symmetry of the different diffusion modes in the wire. Complementary to the analysis of [2], we also study the influence of the motion of a single scatterer on the conductance fluctuations of a mesoscopic wire. Such effects can be probed by locally depleting a sample with an AFM.

[1] Elke Scheer, PhD thesis, Universität Karlsruhe, 1995.
[2] Feng, Lee, and Stone, Phys. Rev. Lett. **56**, 1960 (1986).

TT 28.18 Thu 14:00 Poster A

Superconducting microstrip transmission line resonator for flux qubit readout — •Thomas Niemczyk, Susanne Hofmann, Achim Marx, and Rudolf Gross — Walther-Meissner-Institut für Tieftemperaturforschung, Bayerischen Akademie der Wissenschaften, Walther-Meissner Str. 8, 85748 Garching, Deutschland

Coupling superconducting quantum bits to high-quality superconducting resonators opens the fascinating field of cavity quantum electrodynamics (cQED) based on superconducting circuits. Exciting first experiments have recently been performed in Yale [1] with superconducting charge qubits. For cQED experiments using superconducting flux qubits strong coupling between the magnetic field in a suitable resonator and the flux in the qubit is required. We present the design and realization of a high-Q superconducting microstrip resonator for application in c-QED. The resonator is based on the microstrip SQUID amplifier introduced by Mück et al. [2]. We will introduce the fundamental mode of operation of the microstrip resonator and discuss the results of extended simulations of the device parameters and performance. The geometry of the device should allow for a strong qubit-cavity-coupling up to 200 MHz. A first series of superconducting microstrip resonators has been fabricated by Hypres, Inc. We will present the experimental characterization of the S-parameters of various resonators with different resonance frequency and external coupling capacitors.

[1] A. Wallraff *et al.* Nature **431**, 162 (2004).
[2] M. Mück and J. Clarke, J. Appl. Phys. **88**, 6910 (2000)
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TT 28.19 Thu 14:00 Poster A

Dynamics of quantum coherence in a spin-1 Heisenberg chain — •Jakob Meineke and Joachim Ankerhold — Physikalisches Institut, Albert-Ludwigs-Universität Freiburg, Hermann-Herder-Straße 3, 79104 Freiburg

We study the non-equilibrium dynamics of a one-dimensional spin-1 chain (XXZ Heisenberg model) of finite length. This model can be used to describe many-body-correlations in ultra-cold Rydberg-gases in optical lattices. Our goal is to understand the dynamics of collective modes of the interacting atoms. Of special interest are Förster-like transfer processes, which involve coherent exchange of energy and ultimately lead to an entanglement state of the entire ensemble. We present results obtained by exact diagonalization and by semiclassical methods related to the non-linear sigma-model.

TT 28.20 Thu 14:00 Poster A

Limitation of entanglement due to spatial qubit separation — •Roland Doll, Martijn Wubs, Peter Hänggi, and Sigmund Kohler — Institut für Physik, Universität Augsburg, Universitätsstrasse 1, 86135 Augsburg

We consider spatially separated qubits coupled to a thermal bosonic field which acts as a heat bath and, thus, causes decoherence. By taking the spatial separation of the qubits explicitly into account, the reduced qubit dynamics becomes intrinsically non-Markovian. For pure dephasing we solve the dynamics exactly and explicitly. We first focus on the entanglement of two Bell states which for vanishing separation are known as robust and fragile entangled states. The robustness of two-qubit decoherence-free subspaces depends on temperature, qubit-field coupling strength, and qubit separation. Our exact results are then generalized to an arbitrary number of qubits. We show for weak qubit-bath coupling that a standard Bloch-Redfield approach fails to describe the reduced dynamics even at long times and predicts spurious decoherence-free subspaces. We derive a master equation that does not suffer from such deficiencies. It allows us to directly attribute