Institute of Technology (EPFL), CH-1015 Lausanne, Switzerland

We performed low temperature measurements of magnetoconductance and non linear conductance for multiwall carbon nanotubes. Signatures of phase coherent diffusive transport are the weak localization dip and universal conductance fluctuations. At very low temperature, "anomalous" Coulomb blockade is observed: we find a superposition of several diamonds patterns in the Vsd-Ugate plane with different size. The stability diagrams are more regular than in previous studies, but qualitatively different from that observed in single wall carbon nanotubes. We attribute this behavior to the effect of the inner shells on the charging process and propose a model where the nanotube is represented by two quantum dots in parallel.

TT 6.9 Mon 16:15 H19

One dimensional organometallic wires: electronic structure and transport properties — •Volodymyr Maslyuk[1], Alexei Bagrets[2], Mads Brandbyge[3], and Ingrid Mertig[1] — [1]Martin-Luther-Universität Halle-Wittenberg, Physical Department, Halle, Germany — [2]Institute of Nanotechnology, Forschungszentrum Karlsruhe, Germany — [3]NanoDTU, MIC-Department of Micro and Nanotechnology, Technical University of Denmark, Lyngby, Denmark

During the last years, organometallic systems have attracted increasing attention. The small size of the molecules and the spin degree of freedom allow us to consider them as independent logic units and think about new electronic devices with unforeseen properties. Here, we focus on multi-decker metal-cyclopentadienyl Met(C5H5) and metal-benzene Met(C6H6) molecules. Recently, we have predicted that a one-dimensional vanadium-benzene wire is a half-metallic ferromagnet and finite V(C6H6) clusters coupled to magnetic leads are working as spin-filter [1]. Moreover, our bias dependence calculations show conservation of the half-metallic properties in a wide voltage window. Using density functional theory and the non-equilibrium Green's-function method, implemented in the TranSIESTA code [2], we have investigated the electronic and transport properties of 1D organometallic wires coupled with Co(100) electrodes. We have also investigated the electron transport through the molecules in the case of antiparallel magnetic configuration of the electrodes and predict an impressive magnetoresistance effect. [1] V. Maslyuk et al., Phys. Rev. Lett 97, 097201 (2006). [2] M. Brandbyge et al. Phys. Rev. B 65, 165401 (2002).

TT 6.10 Mon 16:30 H19

Cotunneling and non-equilibrium magnetization in magnetic molecular monolayers — •Florian Elste[1] and Carsten Timm[2] — [1]Institut für Theoretische Physik, Freie Universität Berlin, Germany — [2]Department of Physics and Astronomy, University of Kansas, USA

We study the interplay of electronic transport through monolayers of magnetic molecules and their non-equilibrium magnetic moment. A master-equation approach going beyond the sequential-tunneling approximation is applied to study the Coulomb-blockade regime. While the current is very small in this case, the magnetization can be switched by an amount of the order of the saturation magnetization by a small change of bias voltage, and without causing the flow of a large current. Inelastic cotunneling processes manifest themselves as steps in the differential conductance, which are accompanied by much larger changes in the magnetization. In addition, the magnetization in the Coulomb-blockade regime exhibits strong signatures of sequential-tunneling processes de-exciting molecular states populated by inelastic cotunneling. We also consider the case of a magnetic single-molecule transistor, finding that cotunneling processes lead to the occurrence of magnetic sidebands below the Coulomb-blockade threshold. In the context of spintronics applications, we investigate effects of additional spin relaxation. Our results show that sufficiently fast spin relaxation washes out the fine structure in the differential conductance and in the magnetization. At the same time, fast spin relaxation, while in general undesirable, can lead to a highly-polarized current in the presence of a magnetic field.

TT 6.11 Mon 16:45 H19

Der Einfluß von Berry-Phasen auf die Leitfähigkeit eines einzelnen Jahn-Teller Moleküls — •Maximilian G Schultz, Tamara S Nunner und Felix von Oppen — Institut f. Theoretische Physik, FU Berlin, Arnimallee 14, 14195 Berlin

Wir studieren die elektronischen Transporteigenschaften eines oktaedrischen Moleküls im Grenzfall schwacher Kopplung an zwei metallische Elektroden. Die Berry-Phase des $E \otimes e$ Jahn-Teller Effekts impliziert eine nichttriviale Auswahlregel in der Tunnelmatrix; die Jahn-Teller Verzerrung selbst induziert starke Verschiebungen im Spektrum der molekularen Schwingungen. In der Mastergleichung, mit der elektronischer Transport durch das System beschrieben wird, entstehen dadurch absorbierende Zustände, die den stationären Strom durch die Elektroden unterdrücken. Dies führt zu einer negativen differentiellen Leitfähigkeit und einer starken Asymmetrie im dI/dV Diagramm bezüglich der Gate-Spannung.

TT 7: Quantum Coherence and Quantum Information Systems II

Time: Monday 14:00–16:00 Location: H20

TT 7.1 Mon 14:00 H20

Use of dynamical coupling for improved quantum state transfer — •Andriy Lyakhov and Christoph Bruder — University of Basel, Switzerland

Efficient short-distance quantum state transfer is an important problem in quantum information processing. One of the most promising solutions is to use chains constructed from qubits that are statically coupled to each other [1]. Here, we propose a method to improve quantum state transfer in such transmission lines. The idea is to localize the information on the last qubit of a transmission line by dynamically varying the coupling constants between the first and the last pair of qubits. We also show that this method increases the fidelity of the state transfer and that this effect is stable to static disorder in the coupling constants and dynamical fluctuations in the coupling/decoupling functions [2].

[1] S. Bose, Phys. Rev. Lett. 91 207901 (2003)
[2] A. O. Lyakhov and C. Bruder, Phys. Rev. B 74, 235303 (2006)

TT 7.2 Mon 14:15 H20

A 2D array of Cooper pair boxes as a candidate for a protected qubit — •Jörg-Hendrik Bach, Alexander Shnirman, and Gerd Schön — Institut für theoretische Festkörperphysik, Universität Karlsruhe, 76131-Karlsruhe

We consider a 2-dimensional array of double-island Cooper pair boxes as a candidate for a protected qubit. Two types of couplings are implemented in the array. These are inductive nearest-neighbour couplings along the array's rows and capacitive nearest-neighbour couplings between the array's columns. Projected onto the doubly degenerate ground states of the Cooper pair boxes the two couplings do not commute. Thus the system reduces effectively to an array of spin-1/2 particles with non-commuting row- and column couplings. This reminds of the system proposed by Doucot et al. [Phys. Rev. B 71, 024505 (2005)] in the context of protected quantum computing. Similarities and differences to this system are pointed out; furthermore, the influence of the third level of the Cooper pair box is investigated.

TT 7.3 Mon 14:30 H20

Macroscopic quantum tunneling in globally coupled series arrays of Josephson junctions — •Mikhail V. Fistul — Theoretische Physik III, Ruhr-Universität Bochum, D-44801, Bochum Germany

A quantitative analysis of an escape rate for switching from the superconducting state to a resistive one in series arrays of globally coupled Josephson junctions will be presented. A global coupling is provided by an external shunting impedance. Such an impedance can strongly suppress both the crossover temperature from the thermal fluctuation to quantum regimes, and the macroscopic quantum tunneling (MQT) in short Josephson junction series arrays [1]. However, in large series arrays we obtain an enhancement of the crossover temperature, and a giant increase of the MQT escape rate [2]. The effect is explained by excitation of a *spatial-temporal charge instanton* distributed over a whole structure. The model gives a possible explanation of recently published experimental results on an enhancement of the MQT in single crystals of high-T_c superconductors [3].