TT 43: TR: Nanoelectronics II - Spintronics and Magnetotransport 2 (jointly with HL and MA)

Time: Wednesday 19:00–20:15 Location: HSZ 03

TT 43.1 Wed 19:00 HSZ 03

Spin polarized transport in metallic magnetic single electron transistors — •Stephan Lindebaum and Jürgen König — Theoretische Physik, Universität Duisburg-Essen and CeNIDE, 47048 Duisburg, Germany

We study the electronic transport through a ferromagnetic single electron transistor (fmSET), realized by a metallic island weakly coupled to two ferromagnetic leads. The polarization directions of the ferromagnets enclose a noncollinear angle. In the considered system, charging and spin effects play an important role. For example the accumulated spin on the island precesses due to a many-body exchange field, which arises as a consequence of virtual tunneling processes from the metallic island to the magnetic leads in presence of strong Coulomb interaction on the central electrode.

To analyze the system we perform a perturbative analysis of the transport properties up to first order in the tunnel-coupling strength, but without doing any approximation for the Coulomb charging energy. A diagrammatic real-time transport theory enables us to derive kinetic equations for the island charge and spin degrees of freedom.

The theory covers both the linear and nonlinear transport regimes. The electric current through the fmSET and its conductance are analyzed in detail, while we explicitly investigate the influence of the exchange field on the transport parameters.

TT 43.2 Wed 19:15 HSZ 03

Adiabatic pumping through an interacting quantum dot with time-dependent magnetisation — •Nina Winkler[1], Michele Governale[2], and Jürgen König[1] — [1]Theoretische Physik and CeNIDE · Universität Duisburg-Essen — [2]School of Chemical and Physical Sciences and MacDiarmid Institute for Advanced Materials and Nanotechnology · Victoria University of Wellington · New Zealand

We investigate adiabatic charge and spin transport through a system composed of a quantum dot with Coulomb interaction, weakly tunnel coupled to one normal and one ferromagnetic lead with time-dependent magnetisation. Adiabatic pumping is typically studied in systems in which the properties of the scattering region are changed, e.g. gate voltages to vary the tunnel couplings and the level position of the quantum dot. In general, it is also possible to generate a current by varying in time the lead properties, e.g. the direction of the magnetisation solely [1]. We study the adiabatically pumped charge and spin current up to second order in the tunnel-coupling strength when pumping by varying the direction of the lead magnetisation periodically in time. To this aim, we extend a diagrammatic real-time approach for adiabatic pumping through quantum dots with ferromagnetic leads [2,3] to allow for time-dependent magnetisations. We perform a systematic expansion in both frequency and tunnel-coupling strength, treating the on-site Coulomb interaction on the quantum dot exactly.

[1] M.V. Costache *et al.*, Phys. Rev. Lett. **97**, 216603 (2006).
[2] J. Splettstoesser *et al.*, Phys. Rev. B **74**, 085305 (2006).
[3] J. Splettstoesser *et al.*, Phys. Rev. B **77**, 195320 (2008).

TT 43.3 Wed 19:30 HSZ 03

Rectification effects in spin chains — •Kevin van Hoogdalem and Daniel Loss — Klingelbergstrasse 82, CH-4056 Basel, Switzerland

We study spin transport in non-itinerant one-dimensional quantum systems. Inspired by possible applications in spintronics, we consider rectification effects in both ferromagnetic (FM) and antiferromagnetic (AF) spin chains. We find that the crucial ingredients in designing a system that displays a non-zero rectification current are an anisotropy in the exchange interaction of the spin chain combined with an offset magnetic field. For both FM and AF systems we can exploit the gap in the excitation spectrum that is created by a bulk anisotropy to obtain a measureble rectification effect at realistic magnetic fields. For AF systems we also find we can achieve a similar effect by considering a specific sort of impurity, obtained by altering two neighboring bonds in the Heisenberg Hamiltonian.

TT 43.4 Wed 19:45 HSZ 03

Relaxation mechanisms of the Persistent Spin Helix — •Matthias C. Lüffe[1], Janik Kailasvuori[2], and Tamara S. Nunner[1] — [1]Fachbereich Physik & Dahlem Center for Complex Quantum Systems, FU Berlin, Germany — [2]MPI für Physik komplexer Systeme, Dresden, Germany

The Persistent Spin Helix has been predicted and recently observed as an unusually long-lived helical texture of spin polarization in a semiconductor quantum well where the Rashba- and linear Dresselhaus spin-orbit couplings are of equal strengths. In order to understand the decay in time of this object, we derive and solve semiclassical spin diffusion equations which take spin-dependent impurity scattering, cubic Dresselhaus spin-orbit coupling and, in particular, electron–electron interactions into account. We find that for reported experimental parameters the temperature-dependent lifetime of the persistent spin helix is largely determined by the interplay of cubic Dresselhaus spin-orbit coupling and electron–electron interactions. On the basis of this insight we propose for an experimental starting point a spatially damped spin profile which then evolves towards a truly persistent spin helix even in the—to some extent unavoidable—presence of cubic Dresselhaus spin-orbit interactions.

TT 43.5 Wed 20:00 HSZ 03

Design of nanostructures with maximal magnetoresistance using genetic algorithms — •Daungruthai Jarukanont — University of Kassel, Kassel, Germany

We present a theoretical study of spin-dependent electron transport through organic spin-valves, modeled by an organic molecule sandwich between two ferromagnetic electrodes. The calculations of spin-currents are based on the non-equilibrium Green's function and the Keldysh formalism at low bias. The electrodes are described by tight binding model of 3D semi-infinite leads, while molecules are method independent. We examine the influence of molecular details to spin-currents, and magnetoresistance(MR). The genetic algorithm is perform as an optimization to find the electronics structure of molecules with high values of MR. Example of molecular choices such as alkanethiols, 1,4-benzenedithiol with different molecule-electrode interactions are analyzed.