MA 28: Focused Session: Spin Transport and Coherence in Emerging Materials

Time: Wednesday 14:45–17:45 Location: HSZ 101

Topical Talk MA 28.1 Wed 14:45 HSZ 101

Gate-tunable magnetic exchange and giant g-factor fluctuations in InAs nanowire quantum dots — Szabolcs Csonka[1], Lukas Hofstetter[1], Frank Freitag[1], •Christian Schönenberger[1], Thomas S. Jespersen[2], Martin Aagesen[2], and Jesper Nygard[2] — [1]Department of Physics, Univ. of Basel, CH-4056 Basel, Switzerland — [2]Nano-Science Center, Niels-Bohr Institute, Univ. of Copenhagen, DK-2100 Copenhagen, Denmark

We use the spin-1/2 Kondo effect to measure the field-induced splitting of the spin-doublet, and hence the g-factor. We do this in hybrid quantum dots using both normal (N), ferromagnetic (F) and superconducting (S) contacts. Unlike to previous studies, the g-factors of neighboring states can scatter between 2 and 18 and can therefore be even larger than in the bulk (g=15). We demonstrate further the electric gate tunability of the g-factor in a single charge state. When using F contacts, a zero-field splitting is induced. This prox-imity induced exchange field has recently been measured for the first time by Hauptmann et al. (Nature Physics Vol 4, (2008)) in carbon nanotubes. Here, we show the same effect in a semiconducting nanowire, demonstrating that this effect is universal. Employing a pair of S and F contacts, the proximity-induced exchange shows up as a minigap in superconducting spectroscopy.

This work has been supported by the Swiss NSF, the NCCR on Nanoscale Science, and the Danish Natural Science Research Council. S. Csonka is a grantee of the Marie Curie Fellowship.

Topical Talk MA 28.2 Wed 15:15 HSZ 101

Spin transport theory in carbon-based materials — •Reinhold Egger — Universität Düsseldorf

This talk discusses aspects of spin transport in carbon-based materials, in particular carbon nanotubes and graphene. The influence of spin-orbit couplings and the case of ferromagnetic contacts with non-collinear magnetizations will be studied. We also discuss the spin effects in graphene when magnetic barriers are present.

Topical Talk MA 28.3 Wed 15:45 HSZ 101

Visualizing heat transport in quantum magnets — Marian Otter[1], Dmitry Fishman[1], Viktor V. Krashnikov[1], Maxim S. Pshenichnikov[1], Romualt Saint-Martin[2], Alexander Revcolevschi[2], and •Paul H.M. van Loosdrecht[1] — [1]Zernike Institute for Advanced Materials, Nijenborgh 4, 9747 AG Groningen, The Netherlands — [2]Laboratoire de Chimie des Solides, Universite& Paris-Sud, 91405 Orsay Cedex, France

Low dimensional quantum magnets show an unusually high thermal conductivity originating from the magnetic excitations in these compounds. The conductivity is highly anisotropic and dwarfs the usual phonon contribution, making low dimensional quantum magnets highly relevant for heat management in electronic devices. The present work focuses on optical methods to study and control the heat conduction in magnetically low dimensional cuprate systems as for instance found in the magnetic chain compounds SrCuO2 and Sr2CuO3, and the so-called telephone number ladder compounds (La,Sr,Ca)14Cu24O41. Magnon heat conduction can be visualized using time resolved luminescence microscopy techniques, yielding direct information on both the magnitude and the anisotropy of the heat diffusion in these materials, even when in thin film form. In addition a more bulk sensitive optical 'time of flight' technique will be discussed.

This work is supported by the NOVMAG EU-FP6 project (proj. nr. 032980, www.novmag.eu)

15 Min. break

MA 28.4 Wed 16:30 HSZ 101

Optically induced spin coherence by linear polarized light in InGaAs — •Klaus Schmalbuch[1,3], Stefan Göbbels[1,3], Marten Patt[1,3], Paul Schlammes[1,3], Christian Rodenbücher[1,3], Markus Hagedorn[1,3], Gernot Güntherodt[1,3], Thomas Schäpers[2,3], Mihael Lepsa[2,3], and Bernd Beschoten[1,3] — [1]II. Physikalisches Institut, RWTH Aachen, Templergraben 55, 52056 Aachen — [2]Institut für Bio- und Nanosysteme IBN-1, Forschungszentrum Jülich, 52425 Jülich — [3]JARA - Fundamentals of Future Information Technology

Optical orientation is a well established technique to optically excite electron spins in semiconductors. In conventional all-optical pump-probe experiments a circularly polarized pump beam is used to generate spin-polarized electrons by transferring angular momentum from the photons to the electrons.

We present a new method for the generation of a coherent spin ensemble by linearly polarized laser pulses. The dependency of this spin polarization on the direction of the linear pump polarization is measured by time-resolved Faraday rotation. We show that the spin polarization originates from internal magnetic fields due to bulk inversion asymmetry in zinc-blende semiconductors and quantitatively monitors the internal Dresselhaus fields.

Work supported by DFG through FOR 912

MA 28.5 Wed 16:45 HSZ 101

Spin resonance of electrons confined in low dimensional SiGe heterostructures — •Ferdinand Lipps, Fabio Pezzoli, Mathieu Stoffel, Armando Rastelli, Vladislav Kataev, Oliver G. Schmidt, and Bernd Büchner — IFW Dresden, D-01171 Dresden,

Different kind of SiGe quantum dots (Pyramids, Domes, Barns) were grown with MBE. Due to strain induced in the silicon a confinement of electrons is caused. We performed ESR measurements at 9.56GHz on those low dimensional SiGe heterostructures in order to study the coherence times and relaxational processes of the confined spins. Shape of the dots as well as variations in spacing between stacked layers of dots critically influence the induced strain in the Si. This directly reflects in the confinement of spins and therefore their coherence times determined with ESR. Illumination with light above and below the Si bandgap generates additional electron-hole pairs. We discuss the relationship between shape of dots and resulting spin coherence and relaxation times of the confined spins as measured by ESR.

MA 28.6 Wed 17:00 HSZ 101

The Spin Polaron in the one-dimensional Kondo lattice model at partial fillings of the conduction band using the density matrix renormalization group — •Sebastian Smerat[1,3], Ian P. McCulloch[4], Herbert Schoeller[2,3], and Ulrich Schollwöck[1,3] — [1]Insitut für theoretische Physik C, RWTH Aachen University — [2]Insitut für theoretische Physik A, RWTH Aachen University — [3]JARA-Fundamentals of Future Information Technology — [4]School of physical Sciences, University of Queensland, Australia

We study the spectral properties of the one-dimensional Kondo lattice model as function of the exchange coupling, the band filling, and the quasimomentum in the ferromagnetic and paramagnetic phase. Using the density-matrix renormalization group method, we compute the dispersion relation of the quasiparticles, their lifetimes, and the Z-factor. As a main result, we provide evidence for the existence of the spinpolaron at partial band fillings. We find that the quasiparticle lifetime differs by orders of magnitude between the ferromagnetic and paramagnetic phase and depends strongly on the quasimomentum.

MA 28.7 Wed 17:15 HSZ 101

Magnet heat transport of impurity doped spin chains — •N. Hlubek, C. Hess, U. Schaufuss, V. Kataev, C. Sekar, G. Krabbes, and B. Büchner — Leibniz-Institute for Solid State and Materials Research, IFW Dresden, 01171 Dresden, Germany

We investigate the magnetic thermal conductivity κ_{mag} of the spin chain material $CaCu_2O_3$ doped with non-magnetic Zn impurities. κ_{mag} of the pure compound is linear up to room temperature which is indicative of a T-independent scattering rate of the magnetic excitations [1]. Both, magnitude and T-dependence of κ_{mag} exhibit a very unusual doping dependence. At moderate Zn-doping the linear temperature dependence of κ_{mag} is preserved and the absolute value of κ_{mag} *increases*. A slight suppression of κ_{mag} occurs only at high Zn doping, where, surprisingly, the T-dependence of κ_{mag} changes from linearity to one with a higher power of T. In order to clarify this surprising behavior, we have performed a detailed study of the g-tensor of the impurities in the material by means of ESR experiments which reveals change of impurity type with increasing Zn-content.

[1] C. Hess et al., Phys. Rev. Lett. **98**, 027201 (2007).

MA 28.8 Wed 17:30 HSZ 101

Spin relaxation in graphene quantum dots — •Philipp Struck and Guido Burkard — University of Konstanz

The spin relaxation time T_1 in graphene quantum dots due to spin-orbit interaction is investigated. The calculations are performed in the framework of the Dirac theory, and both Rashba and Dresselhaus type spin-orbit coupling are taken intro account. We compare the results to previous calculations performed for GaAs. We also discuss how applied magnetic and electric fields can be used to influence the relaxation time for potential use in spin qubits.