in a wide range of parameters covering the diffusive ($v_F q, \omega \ll \tau^{-1}$) and non-diffusive ($v_F q, \omega \gg \tau^{-1}$), the dirty ($\alpha_R k_F \ll \tau^{-1}$) and the clean ($\alpha_R k_F \gg \tau^{-1}$) limits. A description of the crossover between the different regimes is thus provided as well. On the basis of the derived microscopic expressions we study the propagating charge and spin-polarization modes in the clean, non-diffusive regime, which is achievable in the modern experiments.

TT 23.6 Thu 10:45 H19

Spin transport in Heisenberg antiferromagnets — •Michael Sentef, Marcus Kollar, and Arno Kampf — Theoretische Physik III, Elektronische Korrelationen und Magnetismus, Institut für Physik, Universität Augsburg, 86135 Augsburg, Germany

We study the dynamic spin conductivity of insulating antiferromagnets described by the XXZ Heisenberg model in two and three dimensions. Spin currents flow in response to a magnetic-field gradient or, in systems with spin-orbit coupling, perpendicular to a time-dependent electric field. Linear response theory provides the Kubo formula for the spin conductivity, which is then calculated within interacting spin-wave theory. We find that the dimensionality of the system plays a crucial role for the isotropic Heisenberg model: In $d = 3$ the regular part of the spin conductivity vanishes linearly in the zero frequency limit, whereas in $d = 2$ it approaches a finite zero frequency value.

[1] M. Sentef, M. Kollar, and A. P. Kampf, cond-mat/0612215 (2006).

15 min. break

TT 23.7 Thu 11:15 H19

Resonant spin polarization and spin current in a two-dimensional electron gas — •Mathias Duckheim and Daniel Loss — Department of Physics and Astronomy, University of Basel, CH-4056 Basel, Switzerland

A versatile scheme of spin control is electric dipole spin resonance (EDSR) where the radio-frequency fields driving the spins are electric[1], and not magnetic like in standard paramagnetic resonance. We present a theoretical study of EDSR in a disordered two-dimensional electron gas. We show that a very high spin polarization can be achieved in a sample where both Rashba and Dresselhaus spin orbit interactions are present rendering the spin splitting anisotropic. By choosing a particular geometry in a strong magnetic field the anisotropy of the spin splitting can be optimally exploited leading to a substantial enhancement of the spin susceptibility. Moreover, the generated spin polarization is intrinsically linked with an ac spin Hall current. The corresponding spin Hall conductivity displays a universal behavior in the high frequency limit and vanishes when the spin susceptibility is maximal. We show that the spin Hall current can be interpreted in terms of geometrical properties of the spin polarization.

[1] M. Duckheim and D. Loss, Nature Physics **2**, 195 (2006)

TT 23.8 Thu 11:30 H19

Zeeman ratchets: rectification of spin currents via magnetic fields — •Matthias Scheid[1], Dario Bercioux[1,2], and Klaus Richter[1] — [1]Institut für theoretische Physik, Unversität Regensburg, Germany — [2]Physikalisches Institut, Albert-Ludwigs-Universistät, Freiburg, Germany

We propose devices creating directed spin-polarized currents in a two-dimensional electron gas (2DEG) subject to a spatially varying magnetic field [1] and an external adiabatic driving. We consider ballistic, coherent transport through quantum confined systems, where the spatially dependent Zeeman term in the Hamiltonian gives rise to spin polarized currents inside the 2DEG. We explore several setups of these spin ratchets [2], which give rise to nonzero averaged net spin currents in the absence of net charge transport.

[1] A. Matulis, F. M. Peeters, and P. Vasilopoulos, Phys. Rev. Lett. **72**, 1518 (1994).
[2] M. Scheid, M. Wimmer, D. Bercioux, and K. Richter, phys. stat. sol. (c), in print (2006), cond-mat/0607380.

TT 23.9 Thu 11:45 H19

Universality in Voltage-driven Nonequilibrium Phase Transitions — •Michael Arnold and Johann Kroha — Physikalisches Institut, Nussallee 12, 53115 Bonn

We consider the non-equilibrium ferromagnetic transition of a mesoscopic sample of a resistive Stoner ferromagnet coupled to two paramagnetic leads. The transition is controlled by either the lead temperature T or the transport voltage V applied between the leads. We calculate the temperature and voltage dependence of the magnetization. In the particle hole symmetric case we find within mean-field theory that even at finite bias the magnetization does not depend on the position along the sample axis, although the charge density and other quantities do vary. This may be relevant for possible spintronics applications. In addition, we establish a generalized control parameter in terms of T and V which allows for a universal description of the temperature- and voltage-driven transition.

TT 23.10 Thu 12:00 H19

Theoretical study of the conductance of ferromagnetic atomic-sized contacts — •M. Häfner[1,2], J. Viljas[1,2], D. Frustaglia[3], F. Pauly[1,2], M. Dreher[4], P. Nielaba[4], and J. C. Cuevas[5,1,2] — [1]Institut für Theoretische Festkörperphysik, Universität Karlsruhe, D-76128 Karlsruhe — [2]FZ Karlsruhe, Institut für Nanotechnologie, D-76021 Karlsruhe — [3]NEST-CNR-INFM & SNS, I-56126 Pisa — [4]Fachbereich Physik, Universität Konstanz, D-78457 Konstanz — [5]Universidad Autónoma de Madrid, E-28049 Madrid

Different experiments on the transport through atomic-sized contacts made of ferromagnetic materials have produced contradictory results such as the observation of half-integer conductance quantization. We have studied theoretically the conductance of ideal atomic contact geometries of the ferromagnetic $3d$ materials Fe, Co, and Ni using a realistic tight-binding model. Our analysis [1] shows that in the absence of magnetic domains, the d bands of these transition metals play a key role in the electrical conduction. In the contact regime this fact leads to the following consequences: (i) there are partially open conduction channels and therefore conductance quantization is not expected, (ii) the conductance of the last plateau is typically above $G_0 = 2e^2/h$, (iii) both spin species contribute to the transport and thus there is in general no full current polarization, and (iv) both the value of the conductance and the current polarization are very sensitive to the contact geometry and to disorder. In the tunneling regime we find that a strong current polarization can be achieved.
[1] M. Häfner et al., cond-mat/0608132

TT 23.11 Thu 12:15 H19

Electron transport in quantum dots in the spin blockade regime — Carlos Lopez-Monis[1], Maria Busl[1,2], Jesus Inarrea[1,3], Gianaurelio Cuniberti[2], and •Gloria Platero[1] — [1]ICMM, CSIC, Cantoblanco, E-28049 Madrid — [2]Institut für Theoretische Physik, Universität Regensburg, D-93040 Regensburg — [3]Escuela Politecnica Superior, Universidad Carlos III, E-28911 Madrid

Recent experiments of transport through two weakly coupled quantum dots [1] show finite currents in the spin blockade region which is attributed to the hyperfine interaction between electronic and spin nuclei. We analyze the electronic spin transport through different quantum dot configurations in the regime where spin blockade occurs. We include in our description phonon-mediated hyperfine interaction between the electron and spin nuclei through the Overhauser effect, as the main source of spin-flip. Our model consists on rate equations for the electronic states occupations and nuclei spin polarizations which are treated in a self-consistent way [2]. We discuss the current as a function of an external magnetic field, where singlet and triplet interdot state crossings occur.

[1] K. Ono et al., Science 297 1313 (2002); K. Ono et al., Phys. Rev. Lett. 92, 256803 (2004).
[2] J. Inarrea et al., cond-mat/0609323; J. Inarrea et al., Physica Status Solidi (a), 203, 6 1148 (2006).