we introduce auxiliary bosons and fermions; a site with one electron corresponds to a site occupied by an auxiliary fermion, and an empty site is represented by a boson. The fermionic degrees of freedom are then formally integrated, providing an effective action for the bosonic field. This effective action is solved analytically in the specific case of a square lattice at half filling in the regime $t \ll V$. The ground state is a charge ordered insulator. We show analytically that in the continuum limit the low energy excitations are collective solitonic excitations. Our results confirm some results which have been previously obtained from numerical simulations [1]. They also provide a systematic analytical scheme which might allow us to describe fractional charge excitations of frustrated electronic systems [2].

[1] P.M.R. Brydon, J.X. Zhu, and A.R. Bishop, cond-mat/0509764
[2] P. Fulde, K. Penc, and N. Shannon, Ann. Phys. (Berlin) 11, 892 (2002)

TT 30.3 Thu 11:00 EB 202

Heisenberg Spin-1 Chains and Ladders with Bilinear-Biquadratic Interactions in a Magnetic Field — •Salvatore R. Manmana[1], Tamás A. Toth[1], Andreas Läuchli[2], and Frédéric Mila[1] — [1]Institute of Theoretical Physics (CTMC), EPF Lausanne, CH-1015 Lausanne, Switzerland — [2]IRRMA, PPH-Ecublens, CH-1015 Lausanne, Switzerland

We investigate the magnetic properties of Heisenberg spin-1 chain and ladder systems with bilinear-biquadratic interactions in a magnetic field by applying the density matrix renormalization group method (DMRG) and a variational wavefunction ansatz. For the chains, the magnetization and the dominating spin and quadrupolar correlation functions are computed in the various regions of the zero-field phase diagram. In the critical quadrupolar phase ($\pi/4 < \theta < \pi/2$), the magnetization curve is dominated by a pronounced kink at finite values of the field and the magnetization. After giving a sketch of the zero-field phase diagram of the ladder systems, we present results for various sets of parameters, aiming to gain insight into magnetization properties in the presence of frustration.

TT 30.4 Thu 11:15 EB 202

Quantum fluctuations in high field magnetisation of 2D squarelattice J_1-J_2 antiferromagnets (exchanged with TT 8.8) — Peter Thalmeier[1], Michael Zhitomirsky[2], •Burkhard Schmidt[1], and Nic Shannon[3] — [1]Max-Planck-Institut für Chemische Physik fester Stoffe, Dresden, Germany — [2]Commisariat à l'Energie Atomique, DSM/DRFCM/SPSMS, Grenoble, France — [3]H H Wills Physics Laboratory, Bristol, United Kingdom

The square lattice J_1–J_2 Heisenberg model with spin $S = 1/2$ has three magnetic and two nonmagnetic phases. It describes a number of recently found layered vanadium oxide perovskites. We discuss the magnetisation curve and high-field susceptibility using spin-wave theory and exact diagonalisation in the whole J_1–J_2 plane. We compare both results and find good overall agreement in the sectors of the phase diagram with magnetic order. Close to the nonmagnetic regions the magnetisation curve shows strong deviations from the classical linear behaviour caused by large quantum fluctuations and spin-wave approximation breaks down. On the FM side ($J_1 < 0$) where one approaches the quantum gapless spin nematic ground state this region is surprisingly large. We find that inclusion of second order spin-wave corrections does not lead to fundamental improvement. Quantum corrections to the tilting angle of the ordered moments are also calculated. They may have both signs, contrary to the always negative first order quantum corrections to the magnetisation. Finally we investigate the effect of the interlayer coupling and find that the quasi-2D picture remains valid up to $|J_\perp/J_1| \sim 0.3$.

TT 31: Transport: Nanoelectronics I - Quantum Dots, Wires, Point Contacts 2

Time: Thursday 11:45–13:00 Location: EB 202

TT 31.1 Thu 11:45 EB 202

Time-Dependent Transport Phenomena and the History Dependence of the Time-Dependent Current — •Elham Khosravi[1], Stefan Kurth[1], Gianluca Stefanucci[2], and Eberhard Gross[1] — [1]Institut für Theoretische Physik, Freie Universität Berlin,Berlin, Germany — [2]Department of Physics, University of Rome Tor Vergata, Rome, Italy

We propose a time-dependent approach to investigate transport phenomena within open boundary time-dependent density functional theory which is based on a numerical algorithm for the time propagation of the non-interacting time-dependent Schrödinger or Kohn-Sham equation. The algorithm is used to study time-dependent transport phenomena such as bound state oscillations, transients, AC effects, electron pumps. It has been shown [Phys. Rev. B 75, 195115 (2007)] that the presence of at least two bound states in the biased electrode-device-electrode system of non interacting electrons, leads to persistent oscillations in the total current. Here we study how the amplitude of oscillations depends on the applied bias or gate voltage and on the initial state.

TT 31.2 Thu 12:00 EB 202

Correlation effects in charge and spin transport properties of quantum impurity models — •Thomas Schmidt[1], Andrei Komnik[1], and Alexander Gogolin[2] — [1]Physikalisches Institut, Universität Freiburg — [2]Imperial College, London, UK

We have investigated the spin and charge transport properties of the Anderson impurity model (AIM) under non-equilibrium conditions. While in the non-interacting case the spin-resolved full counting statistics (FCS) is described by a purely binomial distribution, a small Coulomb interaction U induces correlated electron-pair transport which changes the FCS profoundly. In order to address the complementary large-U domain, we analysed the strong-coupling Kondo fixed point and derived an exact result for a special choice of parameters. The results agree for all regimes. Finally, we propose an experimental setup based on a Hanbury Brown and Twiss interferometer in which these effects can be observed.

Invited Talk TT 31.3 Thu 12:15 EB 202

Electronic transport through nanostructures — •Peter Schmitteckert — Institut für Nanotechnologie, Forschungszentrum Karlsruhe, Karlsruhe Institute of Technology

The Density Matrix Renormalization Group (DMRG) method is now a well established method to study interacting, low-dimensional quantum systems. In this talk I review various approaches within the DMRG method to obtain the conductance of strongly interacting nanostructures attached to non-interacting leads. First I discuss the embedding method where the transmission amplitude is calculated from the ground state stiffness, which is then used to obtain the conductance. Next I review the Kubo approach within DMRG. By switching to a momentum space representation of the leads, this approach allows the study of systems with very small energy scales, including Kondo physics. These calculations can also be used to extract exact functionals to be used within the framework of Density Functional Theory (DFT). Then I present the approach of calculating the nonequilibrium differential conductance from real-time simulations within DMRG with special emphasis on the Interacting Resonant Level model. Finally I discuss the Lippmann-Schwinger approach to obtain multi-particle scattering states.

TT 31.4 Thu 12:45 EB 202

Is spin-charge separation observable in transport experiments? — •Tobias Ulbricht[1] and Peter Schmitteckert[2] — [1]Institut für Theorie der Kondensierten Materie, Karlsruhe Insitute of Technology, Germany — [2]Institute of Nanotechnology, Karlsruhe Insitute of Technology, Germany

We consider a one-dimensional chain consisting of an interacting area coupled to non-interacting leads. Within the area, interaction is mediated by a local onsite repulsion. Using real time evolution within the Density Matrix Renormalization Group (DMRG) scheme, we study the dynamics of wave packets in a two-terminal transport setup. In contrast to previous works, where excitations were created by adding potentials to the Hamiltonian, we explicitely create right moving single particle excitations in the left lead as the starting condition.