TT 41: CE: Low-dimensional Systems - Models 2

Time: Friday 10:15–12:30 Location: H21

TT 41.1 Fri 10:15 H21

Spatial Fluctuation effects on Orbital Selective Mott Transitions — •Hunpyo Lee[1], Yu-Zhong Zhang[1], Harald Jeschke[1], Roser Valenti[1], and Hartmut Monien[2] — [1]Institut für Theoretische Physik, Goethe-Universität Frankfurt, Max-von-Laue-Straße 1, 60438 Frankfurt am Main, Germany — [2]Bethe Center for Theoretical Physics, Universität Bonn, 53115 Bonn, Germany

Orbital selective Mott transitions have been extensively studied on an anisotropic two-band Hubbard model in the framework of dynamical mean field theory with various impurity solvers. Effects of interband hybridization, spin flip and pair-hopping processes, anisotropy in the Hund's rule coupling and bandwidth, crystal field splitting, and inclusion of more bands have been already addressed in the past. In the present work we investigate the role of spatial fluctuations. By considering the dynamical cluster approximation and employing the continuous time quantum Monte Carlo method, we obtain a rich phase diagram of the anisotropic two-band Hubbard within a 4-site cluster. We analyze the cluster size dependence of the phase diagram by also performing 2-site cluster calculations and discuss possible Slater versus Mott physics.

TT 41.2 Fri 10:30 H21

Nonequilibrium electron spectroscopy of Luttinger liquids — So Takei, •Mirco Milletari, and Bernd Rosenow — Max-Planck-Institut für Festkörperforschung, Stuttgart

We theoretically study a Luttinger liquid (LL) driven out of equilibrium by injection of high-energy electrons. The electrons enter the LL locally, far away from any contacts, and at a fixed energy. Their spectral properties are detected at another spatial point some distance away by evaluating the average tunneling current from the LL into a resonant level with tunable energy. For energies slightly below the injection energy, the dependence of the detected current on the difference between injection and detection energies is described by a power law whose exponent depends continuously on the Luttinger parameter. In contrast, for tunneling into the chiral LL edge of a fractional quantum Hall state from the Laughlin sequence, we find that the detected current grows linearly with the energy difference, independent of the LL parameter determined by the inverse filling fraction. We develop a diagrammatic approach for the standard (non-chiral) LL which provides an intuitive physical picture for how the electrons can relax inside the wire.

TT 41.3 Fri 10:45 H21

Frustrated local moment models for Fe-pnictide magnetism — •Burkhard Schmidt, Mohammad Siahatgar, and Peter Thalmeier — Max-Planck-Institut für Chemische Physik fester Stoffe, Dresden

The low energy spin excitations of the Fe pnictide parent compounds have been determined by inelastic neutron scattering and interpreted within the local moment $J_{1a,b}$-J_2 Heisenberg model with orthorhombic symmetry. This has led to alternative exchange models that strongly differ in the size of anisotropy. Although the compounds are itinerant the localised spin model can explain basic features of the excitations. The inherent frustration of this model leads to quantum fluctuations and possible moment reduction. We investigate this question in detail using spin wave approximation and partly exact diagonalisation Lanczos calculations for finite clusters. We find that the orthorhombic anisotropy stabilizes the columnar AF phase and its moment. For the exchange models proposed from inelastic neutron scattering we can exclude a strong influcence of frustration on the moment size. We also investigate dependence of magnetisation and susceptibility on field and temperature.

TT 41.4 Fri 11:00 H21

Phase diagram of the kagomerized Kitaev model — •Michael Kamfor[1], Julien Vidal[2], Sébastien Dusuel[3], and Kai Phillip Schmidt[1] — [1]Technische Universität Dortmund, Lehrstuhl für Theoretische Physik I, Germany — [2]Université Pierre et Marie Curie Paris 06, France — [3]Lycé Saint-Louis, 75006 Paris, France

One of the simplest spin models exhibiting topological order and Z2-anyonic Abelian as well as non-Abelian excitations is the Kitaev model on a trivalent 2D-lattice. The two kinds of anyons live in different phases of the system. The model can be transformed with Majorana fermionization onto free fermions in a static gauge field and is thus exactly solvable. The originally defined Kitaev model leads to an effective square lattice in the isolated dimer limit. We introduce a new kind of Kitaev model where the limit of isolated dimers yields an effective kagome lattice. We investigate the phase diagram for certain gauges depending on the three-spin coupling for both Kitaev models. Interestingly the phase diagram strongly depends on the gauge choice and shows a rich amount of distinct Abelian and non-Abelian phases.

15 min. break

TT 41.5 Fri 11:30 H21

Breakdown of the topologically-ordered Z(3) Toric Code — •Marc Daniel Schulz[1], Sébastien Dusuel[2], Julien Vidal[3], and Kai Phillip Schmidt[1] — [1]Lehrstuhl für Theoretische Physik I, Otto-Hahn-Strasse 4, TU Dortmund, 44221 Dortmund, Germany — [2]Lycée Saint-Louis, 44 Boulevard Saint-Michel, 75006 Paris, France — [3]Laboratoire de Physique Théorique de la Matière Condensée, CNRS UMR 7600, Université Pierre et Marie Curie, 4 Place Jussieu, 75252 Paris Cedex 05, France

The standard Toric Code invented by Kitaev is an exactly solvable two-dimensional spin 1/2 model which exhibits an topologically ordered ground state and is strongly debated in the context of topological quantum computation. The elementary excitations are Z(2) Abelian anyons which are completely local because they are protected by conservation laws. Here we investigate an extension of the Toric Code to Z(3) anyons which yields a higher degeneracy of the groundstate and is thus a more favorable candidate towards a realization of a topological quantum memory. Our major aim is to understand the breakdown of a topologically ordered state with Z(3) anyonic excitations. To this end we study the influence of an external 'magnetic field' which leads to dynamic and interacting Z(3) anyons. As a consequence, one expects a rich phase diagram with interesting phase transitions out of the topological phase. We use perturbative continous unitary transformations to derive an effective low-energy describtion for the relevant elementary excitations in order to study this question.

TT 41.6 Fri 11:45 H21

The effect of surface curvature on conductivity in 3D topological insulators — •Jan Dahlhaus, Chang-You Hou, Anton Akhmerov, and Carlo Beenakker — Instituut-Lorentz, Universiteit Leiden, The Netherlands

The surface spectrum of a three-dimensional (3D) topological insulator consists of massless Dirac fermions. Their movement on the surface has to follow a geodesic trajectory, akin to a photon in curved space. In this work, we study electron scattering due to surface roughness which is modeled as curvature of the surface. The resulting effect on conductivity is estimated using the Boltzmann Equation. This scattering mechanism leads to a distinguishable signature of the conductivity on the electron density.

TT 41.7 Fri 12:00 H21

Pseudospin Resonance in two Coaxial Tubes — •Benedikt Scharf, Jaroslav Fabian, and Alex Matos-Abiague — Institut für Theoretische Physik, Universität Regensburg, 93040 Regensburg, Deutschland

In a 2DEG confined to two coaxial tubes the 'tube degree of freedom' can be described in terms of pseudospin-1/2 dynamics. The presence of tunneling between the two tubes leads to a collective oscillation known as pseudospin resonance. We employ perturbation theory to examine the dependence of the frequency of this mode with respect to a coaxial magnetic field for the case of small intertube distances. Coulomb interaction leads to a shift of the resonance frequency and to a finite lifetime of the pseudospin excitations. Depending on the material the presence of the coaxial magnetic field can give rise to pronounced peaks in the shift of the resonance frequency. For very large magnetic fields this shift vanishes due to the effects of Zeeman splitting. Finally, an expression for the linewidth of the resonance is derived. Numerical analysis of this expression suggests that the linewidth strongly depends on the coaxial magnetic field, which leads to several peaks of the linewidth as well as regions where damping is

almost completely suppressed. This work has been supported by the Deutsche Forschungsgemeinschaft via GRK 638 and GRK 1570.

TT 41.8 Fri 12:15 H21

Spectra of integrable Chalker-Coddington network models — •Michael Brockmann and Win Nuding — Bergische Universität Wuppertal, Germany

We study an integrable Chalker-Coddington model with $sl(2,1)$ supersymmetry. These systems can be represented as vertex models with staggering in both lattice directions. The objects of interest are the eigenvalues of the transfer matrices. For these objects a Bethe ansatz treatment was presented by Essler, Frahm and Saleur (2005).

So far the Bethe ansatz equations could only be solved numerically for large but finite lattices. Here we present an analytic treatment for arbitrary lattice sizes.