TT 11 Correlated Electrons - Spin Systems and Itinerant Magnets: Theory

Zeit: Samstag 08:45–10:30 Raum: TU H2053

TT 11.1 Sa 08:45 TU H2053

Derivation of the quantum-nonlinear-σ-model for antiferromagnets in a uniform magnetic field — •Nils Hasselmann and Peter Kopietz — Institut für Theoretische Physik, Universität Frankfurt, Robert-Mayer-Strasse 8, 60054 Frankfurt/Main

We reconsider the derivation of the quantum-nonlinear-σ-model for antiferromagnets in a magnetic field. The standard assumption is that the term $(\partial_\tau \mathbf{n})^2$ in the action is replaced in presence of a magnetic field $\mathbf{H}$ by $(\partial_\tau \mathbf{n} - i\mathbf{H}\times\mathbf{n})^2$. Here, $\mathbf{n}$ (with $\mathbf{n}^2 = 1$) represents the staggered moments while τ is the imaginary time. We show that this result is incorrect in that it does not take account of the fact that a uniform magnetic field generates a finite uniform magnetization. We present the correct form of the non-linear-σ-model describing the gapless spin excitations near the antiferromagnetic ordering wavevector.

TT 11.2 Sa 09:00 TU H2053

String Picture of a Frustrated Quantum Magnet and Dimer Model — •Ying Jiang and Thorsten Emig — Institut für Theoretische Physik, Universität zu Köln, Zülpicher Str. 77, 50937 Köln

We study the effect of quantum dynamics on geometrically frustrated magnets for a transverse field Ising model at finite temperatures. We develop a microscopic derivation of the Landau-Ginzburg-Wilson (LGW) action for this model and show that it can be interpreted as the free energy of a 3D elastic lattice of non-crossing strings. As a first application, we quantitatively predict the phase diagram and correlations, confirming excellently a key prediction of recent simulations about the existence of unusual phase transitions and an ordered phase. We discuss implications of our string picture for the understanding of the effect of quenched disorder in such quantum frustrated systems.

TT 11.3 Sa 09:15 TU H2053

Renormalization of spin-wave velocity and frustration in Heisenberg Quantum antiferromagnets — •Frank Krüger and Stefan Scheidl — Institut für Theoretische Physik, Uni Köln

Frustrated quantum antiferromagnets exhibit nontrivial quantum phase transitions which are the subject of extensive current research. We characterize the Néel phase for a two-dimensional Heisenberg model as a function of spin S and the frustration between nearest and next-nearest exchange couplings on a square lattice. We extend the renormalization group approach by Chakravarty, Halperin and Nelson [Phys. Rev. B **39**, 2344 (1989)] to account for the discrete lattice structure. As a consequence, we obtain a renormalization of the spin-wave velocity and the frustration strength, which become significant well before the Néel order becomes instable.

TT 11.4 Sa 09:30 TU H2053

Quantum Fluctuations and Excitations in Magnetic Quasicrystals — •Stefan Wessel[1] and Igor Milat[2] — [1]Institut für Theoretische Physik III, Universität Stuttgart, 70550 Stuttgart — [2]Institut für Theoretische Physik, ETH Zürich, 8093 Zürich, Schweiz

We study the effects of quantum fluctuations and the excitation spectrum for the antiferromagnetic Heisenberg model on the octagonal tiling, a two-dimensional quasicrystal structure. Using a combination of quantum Monte Carlo and numerically solved spin-wave theory, a non-trivial inhomogeneous magnetic ground state is found. A hierarchical structure in the values of the staggered moments is observed which arises from the self-similarity of the quasiperiodic lattice. The magnetic excitation spectrum consists of magnon-like low-energy modes, as well as dispersionless high-energy states of multifractal nature. The dynamical spin structure factor exhibits linear-soft modes at low energies, self-similar structures with bifurcations emerging at intermediate energies, and flat bands in high-energy regions. This generic model is a first step towards understanding magnetic quasicrystals such as the recently discovered Zn-Mg-Ho icosahedral structure.

TT 11.5 Sa 09:45 TU H2053

Kollektive Spinanregungen in der Gutzwillernäherung des Hubbardmodells — •Falk Günther und Götz Seibold — BTU Cottbus

Auf der Grundlage der spinrotationsinvarianten Slave-Boson-Formulierung des Hubbarmodells untersuchten wir die kollektiven Anregungen eines itineranten Ferromagneten. Die Entwicklung des Enregiefunktionals um den Sattelpunkt bis zur 2. Ordnung erlaubt die Berechnung dynamischer Korrelationasfunktionen in einer RPA-ähnlchen Näherung. Das ferromagnetische Anregungsspektrum wurde untersucht und die Dispersionsrelation der Spindichtewellen ermittelt. Im Vergleich zur HF-Theorie stellten wir stark eingeschränkte Phasenbereiche für das Auftreten von Ferromagnetismus fest.

TT 11.6 Sa 10:00 TU H2053

Tunneling Transport Through Single Molecular Magnets — •Christian Romeike, Maarten R. Wegewijs, and Herbert Schoeller — Institut für Theoretische Physik A, RWTH Aachen

We investigate tunneling transport through a single molecular magnet Mn_{12}. It is known that the low temperature properties ($T \approx 1K$) can be described by a spin Hamiltonian incorporating an easy axis anisotropy and the effect of quantum tunneling of magnetization (QTM). We study using master equations how the high spin ($S = 10$) and the QTM influence the electron transport. We find negative differential conductance effects and complete current suppression for finite bias voltage in many possible situations. Our results apply to molecular magnets that are described by the same type of Hamiltonian.

TT 11.7 Sa 10:15 TU H2053

Control of Local Relaxation Behavior in Closed Bipartite Quantum Systems — •Harry Schmidt and Günter Mahler — Institut für Theoretische Physik 1, Universität Stuttgart, Pfaffenwaldring 57, D-70550 Stuttgart

We investigate the decoherence of a spin 1/2 weakly coupled to an environment of many spins 1/2 with and without coupling. The total system is closed, its state is pure and evolves under Schrödinger dynamics. Nevertheless, the considered spin reaches a quasi-stationary equilibrium state.

We find that this state depends strongly on the coupling to the environment on the one hand and on the coupling within the environmental spins on the other. In particular we focus on spin star geometries with interaction $\hat{H}^{\text{int}} = \sum_{i,j}\sum_{\nu} \gamma_{ij}^{(\nu)}\, \hat{\sigma}_i \otimes \hat{\sigma}_j^{(\nu)}$ with random γ_{ij} to investigate the effect of intra-environmental coupling on the central spin. By changing the dynamics of the environment its effect as a bath on the central spin is changed and may even be adjustable to some degree. The relaxation behavior is related to the distribution of the energy eigenvectors of the total system.