DY 44 Critical Phenomena and Phase Transitions III

Time: Thursday 14:30–16:00 Room: HÜL 186

Invited Talk DY 44.1 Thu 14:30 HÜL 186

Spin liquids: from frustrated magnets to quantum dimer models — •Frederic Mila — Institute of Theoretical Physics, Ecole Polytechnique Federale de Lausanne, BSP Unil, CH-1015 Lausanne (Switzerland)

The search for Resonating Valence Bond (RVB) spin liquids has been extremely active since the discovery of high temperature superconductivity in a family of cuprates and the proposal by Anderson that doping RVB spin liquids might lead to superconductivity. Very significant progress has been made recently on two fronts: 1) Experimentally, with the synthesis of compounds which seem to resist any kind of ordering down to the lowest accessible temperatures; 2) Theoretically, with the numerical proof that the Quantum Dimer Model on the triangular lattice has an RVB phase. In this talk, I will review both aspects of the field, and I will discuss the possible relationships between Quantum Dimer Models and realistic effective models of Mott insulators.

DY 44.2 Thu 15:00 HÜL 186

Anomalous superferromagnetic relaxation behavior in ordered magnetic structures — •Stefanie Russ and Armin Bunde — Institut für Theoretische Physik III, Universität Giessen, D-35392 Giessen

We perform Monte-Carlo simulations to study the anomalous magnetic relaxation behavior of single-domain ferromagnetic nanoparticles under the combined forces of diploar interaction and anisotropy effects, located at the sites of a simple cubic lattice. The anisotropy axes are orientated along the z-axes. We study how the system relaxes from two ordered states where all dipoles are orientated (a) along the antiferromagnetic ground-state and (b) along the z-direction of the lattice. We introduce appropriate order parameters $O_{||}$ and $O_{\perp}$ along the z-direction and in the xy-plane, respectively, to describe both, relaxation and final structure.

We find that below a critical temperature T_c, different structures are reached in both cases, which are described by the same value of $O_{||}$ but by different values of $O_{\perp}$. We discuss the possibility of obtaining a superferromagnetic state and compare the results with experiments on ultrafine magnetic particles.

DY 44.3 Thu 15:15 HÜL 186

Critical Dynamics of Magnets with Random Anisotropy — •Reinhard Folk[1], Maxim Dudka[2], Yurij Holovatch[2], and Günter Moser[3] — [1]Institute for Theoretical Physics University Linz Austria — [2]Institute for Condensed Matter Physics National Academy of Sciences of Ukraine Lviv Ukraine — [3]Molecular Biology University of Salzburg Salzburg Austria

We investigate the relaxational critical dynamics with non-conserved order parameter coupled to the energy density (model C critical dynamics) for three-dimensional magnets with disorder in a form of a random anisotropy axis. For a random distribution of cubic symmetry, the static asymptotic critical behaviour coincides with that of random site Ising systems. Therefore the asymptotic critical dynamics is governed by the dynamical exponent of the random Ising model. However, the disorder influences considerably the dynamical behaviour in the non-asymptotic regime. We perform a field-theoretical renormalization group analysis within the minimal subtraction scheme in two-loop order to investigate the asymptotic and effective critical dynamics of random anisotropy systems. The results demonstrate a rich non-monotonic behaviour of the dynamical effective critical exponent z_{eff}. The limiting case of a purely relaxational dynamics [1] is also considered. (Work supported by the Fonds zur Foerderung der wissenschaftlichen Forschung Project No. P16574)

[1] M. Dudka, R. Folk, Yu. Holovatch, and G. Moser, submitted to Condensed Matter Physics (Ukraine) 2005 (cond-mat/0506325)

DY 44.4 Thu 15:30 HÜL 186

Integral equation study of an ideal Ising mixture — •Wolfgang Fenz[1], Igor Omelyan[1,2], and Reinhard Folk[1] — [1]Institute for Theoretical Physics, Linz University, Altenberger Str. 69, A-4040 Linz, Austria — [2]Institute for Condensed Matter Physics, 1 Svientsitskii Street, UA-79011 Lviv, Ukraine

We construct an integral equation scheme for magnetic binary mixtures of an ideal soft-core Ising fluid and a soft-sphere fluid by mapping the system onto an equivalent nonmagnetic ternary mixture. We apply the multi-component Ornstein-Zernike equation together with a closure relation based on the soft mean spherical approximation and a field constraint for the Ising fluid component. Phase coexistence curves at constant pressure or temperature are calculated both by directly evaluating the chemical potentials via the bridge function [1], and by using a Maxwell-like construction. Our results are compared to Monte Carlo data obtained earlier [2], and we find that the second method yields much better agreement with the simulations.

Supported by the Austrian Fonds zur Förderung der wissenschaftlichen Forschung, project No P18592.

[1] L. L. Lee, J. Chem. Phys. 97, 8606 (1992)
[2] W. Fenz and R. Folk, Phys. Rev. E 71, 046104 (2005)
[3] W. Fenz, I. Omelyan, and R. Folk, to be published in Phys. Rev. E

DY 44.5 Thu 15:45 HÜL 186

Critical exponents of 3D Ising model from theory and Monte Carlo simulations of very large lattices — •Jevgenijs Kaupuzs — Institute of Mathematics and Computer Science, University of Latvia, LV-1459 Riga, Latvia

We report the results of extended Monte Carlo simulations of 3D Ising model near criticality for linear lattice sizes up to $L = 640$. Our aim is to verify the essentially different predictions for the values of the critical exponents made by the perturbative RG theory [1] and our method of grouping of Feynman diagrams [2]. Our basic method of analysis is to look how the effective critical exponents evaluated either at the critical or at a suitable pseudocritical coupling change with the lattice size. It allows us to control visually the systematic deviations in the results depending on the lattice sizes used in simulations and to evaluate the asymptotic values of the critical exponents by a suitable fit (extrapolation). The usually reported values of the critical exponents appear to be effective rather than asymptotic. Although the currently simulated effective values come closer to the RG ones, the plots of the effective exponents show a tendency to deviate from the RG values towards those found in [2]. We compare this behaviour with that of the effective exponent ν evaluated in [3] from the known experimental data for the superfluid fraction in liquid helium very close to the λ–transition point.

[1] J. Zinn–Justin, Quantum Field Theory and Critical Phenomena, Clarendon Press, Oxford, 1996
[2] J. Kaupužs, Ann. Phys. (Leipzig) **10**, 299 (2001)
[3] J. Kaupužs, Eur. Phys. J. B **45**, 459 (2005)