# DY 28: Phase transitions and Critical Phenomena II

Time: Thursday 14:00–16:00 Location: H47

**Topical Talk** DY 28.1 Thu 14:00 H47

**Static correlation functions of integrable quantum chains** — •Frank Göhmann — Bergische Universität Wuppertal, Germany

Recently the structure of the correlation functions of the Heisenberg-Ising chain has been completely resolved. After an appropriate regularization they all factorize into sums over products of the one-point function and a single special neighbour two-point function. This resembles the situation with free fermions, and, indeed, what is behind is a remarkable free fermionic structure on the space of (quasi-) local operators on the spin chain. It allows us, for instance, to calculate short-range correlators over the full phase diagram directly in the thermodynamic limit. Numerical values of the correlators can be obtained with arbitrary precision by solving simple and well-behaved integral equations. I shall explain the basic notions behind the factorization and I shall illustrate them with examples. I further advocate the hypothesis that factorization is the characteristic feature of possibly all integrable quantum chains.

DY 28.2 Thu 14:30 H47

**Ultrametricity and hierarchical clustering for Ising spin glasses** — •Alexander K. Hartmann[1] and Helmut G. Katzgraber[2] — [1]Institut of Physics, University of Oldenburg, Germany — [2]Department of Physics & Astronomy, Texas A&M University, USA

We present results from computer simulations [1], in particular Monte Carlo simulations using the parallel tempering approach, to test for ultrametricity [2] and clustering properties [3] in spin-glass models. We use a one-dimensional Ising spin glass with random power-law interactions where the universality class of the model can be tuned by changing the power-law exponent. We find [4] signatures of ultrametric behavior both in the mean-field and non-mean-field universality classes for large linear system sizes. Furthermore, we confirm the existence of nontrivial connected components in phase space via a clustering analysis of configurations.

[1] A.K. Hartmann, *Practical Guide to Computer Simulations*, (World Scientific, 2009)
[2] R. Rammal *et al.*, Rev. Mod. Phys. **58**, 765 (1986)
[3] G. Hed, A.K. Hartmann, D. Stauffer, and E. Domany, Phys. Rev. Lett. **86**, 3148 (2001)
[4] H.G. Katzgraber and A.K. Hartmann, Phys. Rev. Lett. **102**, 037207 (2009)

DY 28.3 Thu 14:45 H47

**Non-equilibrium phase transition in an exactly solvable driven Ising model with friction** — •Alfred Hucht, Sebastian Angst, and Dietrich E. Wolf — Fakultät für Physik, Universität Duisburg-Essen, D-47048 Duisburg

A driven Ising model with friction due to magnetic correlations has recently been proposed by Kadau et al. [1]. The non-equilibrium phase transition present in this system is investigated in detail using analytical methods as well as Monte Carlo simulations [2]. In the limit of high driving velocities $v$ the model shows mean field behavior due to dimensional reduction and can be solved exactly for various geometries. The simulations are performed with three different single spin flip rates: the common Metropolis and Glauber rates as well as a multiplicative rate. Due to the non-equilibrium nature of the model all rates lead to different critical temperatures at $v > 0$, while the exact solution matches the multiplicative rate. Finally, the cross-over from Ising to mean field behavior as function of velocity and system size is analysed in one and two dimensions.

[1] D. Kadau et al., Phys. Rev. Lett. 101, 137205 (2008)
[2] A. Hucht, Phys. Rev. E 80 (in press), arXiv:0909.0533

DY 28.4 Thu 15:00 H47

**Microcanonical phase diagrams of short-range ferromagnets** — •Michael Kastner[1] and Michel Pleimling[2] — [1]National Institute for Theoretical Physics, Stellenbosch 7600, South Africa — [2]Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061-0435, USA

A phase diagram is a graph in parameter space showing the phase boundaries of a many-particle system. Commonly, the control parameters are chosen to be those of the (generalized) canonical ensemble, such as temperature and magnetic field. However, depending on the physical situation of interest, the (generalized) microcanonical ensemble may be more appropriate, with the corresponding control parameters being energy and magnetization. We show that the phase diagram on this parameter space looks remarkably different from the canonical one. The general features of such a microcanonical phase diagram are investigated by studying two models of ferromagnets with short-range interactions. The physical consequences of the findings are discussed, including possible applications to nuclear fragmentation, adatoms on surfaces, and cold atoms in optical lattices.

DY 28.5 Thu 15:15 H47

**Polymers in crowded environment under stretching force: globule-coil transitions** — •Wolfhard Janke[1] and Viktoria Blavatska[1,2] — [1]Institut für Theoretische Physik, Universität Leipzig, Postfach 100 920, 04009 Leipzig, Germany — [2]Institute for Condensed Matter Physics of the National Academy of Sciences of Ukraine, 79011 Lviv, Ukraine

We study flexible polymer macromolecules in a crowded (porous) environment, modeling them as self-attracting self-avoiding walks on site-diluted percolative lattices in space dimensions $d = 2$ and 3. The influence of stretching force on the polymer folding and properties of globule-coil transitions are analyzed. Applying the pruned-enriched Rosenbluth chain-growth method (PERM), we estimate the transition temperature $T_\Theta$ between collapsed and extended polymer configurations and construct the phase diagrams of the globule-coil coexistence when varying temperature and stretching force. The transition to a completely stretched state, caused by applying force, is discussed as well.

[1] V. Blavatska and W. Janke, Phys. Rev. E **80**, 051805 (2009).

DY 28.6 Thu 15:30 H47

**First-order-like Behavior at the Adsorption Transition of Short Polymers in the Microcanonical Ensemble** — •Monika Möddel[1], Wolfhard Janke[1], and Michael Bachmann[2] — [1]Institut für Theoretische Physik, Universität Leipzig — [2]Institut für Festkörperforschung, Theorie II, Forschungszentrum Jülich

The understanding of the cooperative effects of structure formations at substrates requires systematic studies of mesoscopic aspects. We perform such a study focusing on the adsorption transition [1,2]. This is conveniently and to our knowledge for the first time done by a detailed microcanonical analysis [2] of densities of states obtained by extensive multicanonical Monte Carlo computer simulations.

For short chains and strong surface attraction, the microcanonical entropy turns out to be a convex function of energy in the transition regime, indicating that surface-entropic effects are relevant. Albeit known to be a continuous transition in the thermodynamic limit of infinitely long chains, the adsorption transition of polymers with finite length thus exhibits a clear signature of a first-order-like transition, with coexisting phases of adsorbed and desorbed conformations.

[1] M. Möddel, M. Bachmann, and W. Janke, J. Phys. Chem. B 113, 3314 (2009).
[2] M. Möddel, M. Bachmann, and W. Janke, preprint.

DY 28.7 Thu 15:45 H47

**Conformal invariance and Schramm Loewner evolution (SLE) in the 2d random field Ising magnet** — •Jacob Stevenson — Johannes Gutenberg-Universität Mainz

Random field Ising magnets have no thermodynamic phase transition in two dimensions, however there is strong evidence that connected spin domains percolate at a finite random field strength. Thus even though the total magnetization remains zero, the domains diverge in length scale. We examine ground state domain walls near this percolation transition finding strong evidence that they are conformally invariant and that they satisfy Schramm (stochastic) Loewner evolution ($SLE_\kappa$) with parameter $\kappa = 6$. These stringent requirements, which hold for normal 2d percolation, permit exact calculation of properties such as the fractal dimension of domain walls and allow the powerful techniques of conformal field theory to be aimed at the random field Ising magnet.