DY 29: Focus Session: Recent Progresses in Criticality in the Presence of Boundaries and Defects II (joint session DY/TT)

In recent years there has been a renewed interest in critical systems in the presence of boundaries or, more generally, defects. This attention is driven by different perspectives. Numerical studies of quantum spin models have reported in some cases unexpected boundary critical behavior. This, in turns, has led to a reconsideration of the classical surface critical behavior problem, with the discovery of so-far overlooked boundary phases. In this context, numerous recent studies have considered the so-called symmetry-protected topological gapless systems, and in particular their boundary states. At the same time, advances in conformal field theory, specifically the conformal bootstrap program, have addressed the problem of boundaries and defects in conformally-invariant theories. This Focus Session brings together some of the main actors in the aforementioned advancements in boundary critical phenomena.

Organized by Francesco Parisen Toldin (Aachen) and Stefan Wessel (Aachen)

Time: Wednesday 15:00–16:15 Location: A 151

Invited Talk DY 29.1 Wed 15:00 A 151

Conformal boundary conditions of symmetric quantum critical states — •Long Zhang — University of Chinese Academy of Sciences, Beijing 100190, China

Some quantum critical states cannot be smoothly deformed into each other without either crossing some multicritical points or explicitly breaking certain symmetries even if they belong to the same universality class. This brings up the notion of "symmetry-enriched" quantum criticality. While recent works in the literature focused on critical states with robust degenerate edge modes, we propose that the conformal boundary condition (b.c.) is a more generic characteristic of such quantum critical states. In the first part of this talk, we show that in two families of quantum spin chains, which generalize the Ising and the three-state Potts models, the quantum critical point between a symmetry-protected topological phase and a symmetry-breaking order realizes a conformal b.c. distinct from the simple Ising and Potts chains at both the physical and the entangling boundaries. Furthermore, we argue that the conformal b.c. can be derived from the bulk effective field theory, which realizes a novel bulk-boundary correspondence in symmetry-enriched quantum critical states. In the second part, we will show the effect of finite-entanglement scaling of matrix-product states on their conformal b.c. at both the physical and the entangling boundaries.

DY 29.2 Wed 15:30 A 151

Universal fragility of spin-glass ground-states under single bond changes — Mutian Shen[1], Gerardo Ortiz[2], Yang-Yu Liu[3], •Martin Weigel[4], and Zohar Nussinov[1] — [1]Department of Physics, Washington University, St. Louis, MO 63160, USA — [2]Department of Physics, Indiana University, Bloomington, IN 47405, USA — [3]Harvard Medical School, Boston, MA, 02115, USA — [4]Institut für Physik, Technische Universität Chemnitz, 09107 Chemnitz, Germany

We examine the effect of changing a single local bond on ground states of the Edwards-Anderson Ising spin-glass in two and three dimensions and with a Gaussian distribution of couplings. We find such ground states to be exceedingly fragile: altering the strength of only a single bond beyond a critical threshold value leads to a new ground state that differs from the original one by a cluster ("critical zero energy droplet") of flipped spins whose boundary and volume diverge with system size — an effect that is reminiscent of the more familiar phenomenon of disorder chaos. At the same time, these elementary clusters provide the lowest-energy macroscopic excitations in short-range spin-glasses above the lower critical dimension. The presence of such excitations with fractal boundaries provides a strong characterization of the spin-glass phase in these systems. Within numerical accuracy, the size of these clusters is governed by a nearly universal power-law distribution with exponents depending on the spatial dimension of the system. The critical coupling strengths follow a stretched Gaussian distribution that is largely set by the local coordination number of the lattice.

DY 29.3 Wed 15:45 A 151

Random Matrices and the Free Energy of Ising-Like Models with Disorder — •Nils Gluth, Thomas Guhr, and Fred Hucht — Fakultät für Physik, University of Duisburg-Essen, Duisburg, Germany

We consider an Ising model with quenched surface disorder, the disorder average of the free energy is the main object of interest. Explicit expressions for the free energy distribution are difficult to obtain if the quenched surface spins take values of ± 1. Thus, we choose a different approach and model the surface disorder by Gaussian random matrices. The distribution of the free energy is calculated. We chose skew-circulant random matrices and compute the characteristic function of the free energy distribution. We show numerically the distribution becomes log-normal for sufficiently large dimensions of the disorder matrices, and in the limit of infinitely large matrices the distributions are Gaussian. Furthermore, we establish a connection to the central limit theorem.

DY 29.4 Wed 16:00 A 151

The Griffiths phase and beyond: a large deviations study — •Lambert Münster[1], Alexander K. Hartmann[2], and Martin Weigel[1] — [1]Institut für Physik, TU Chemnitz, 09107 Chemnitz, Germany — [2]Institut für Physik, Carl von Ossietzky Universität Oldenburg, 26129 Oldenburg, Germany

The Griffiths phase is a temperature range in systems with quenched disorder that reaches from the critical temperature of the pure system to the corresponding critical temperature in the presence of disorder. In this phase, the possibility of large fluctuations in the disorder degrees of freedom leads to broad distributions in response functions. For example, inside the Griffiths phase of the two-dimensional bond-diluted Ising model the distribution of the magnetic susceptibility is expected to have an exponential tail [1]. A large-deviation Monte Carlo algorithm is used to sample this distribution [2,3], and the exponential tail is extracted over a wide range of the support down to probabilities of the order of 10^{-300}. A connection between the local fraction of ferromagnetic bonds and the size of the magnetic susceptibility is demonstrated numerically. Furthermore the distribution of the magnetic susceptibility is also investigated at the ferromagnetic phase transition, inside the ferromagnetic phase and at zero temperature, revealing interesting differences and similarities between the cases.

[1] A. J. Bray, Phys. Rev. Lett. **59**, 586 (1987).
[2] A. K. Hartmann, Phys. Rev. E **65**, 056102 (2002).
[3] K. Hukushima, Y. Iba, J. Phys. Conf. Ser. **95**, 012005 (2008).