DY 44: Critical Phenomena and Phase Transitions

Time: Wednesday 15:30–17:15 Location: H47

DY 44.1 Wed 15:30 H47

Finite-size scaling of free-energy barrier in droplet formation and nucleation-like processes — •Johannes Zierenberg, Philipp Schierz, and Wolfhard Janke — Institut für Theoretische Physik, Universität Leipzig, Germany

We study the nucleation free-energy barrier of the droplet formation process upon a temperature change. Employing generalized-ensemble methods allows us to directly access estimates of the free-energy barrier from energy probability distributions. Phenomenological arguments reveal that in this scenario the free-energy barrier scales with $N^{1/2}$, confirmed by an extensive finite-size scaling analysis. The same scaling is supposed to remain true for other nucleation-like processes such as polymer aggregation.

DY 44.2 Wed 15:45 H47

Multifractal finite-size scaling at the Anderson transition in the unitary symmetry class — •Jakob Lindinger, Andreas Buchleitner, and Alberto Rodriguez — Physikalisches Institut, Albert-Ludwigs-Universität Freiburg, Hermann-Herder-Str. 3, 79104 Freiburg

We carry out a full characterization of the Anderson transition in the unitary symmetry class. We apply multifractal finite-size scaling [A. Rodriguez, L. J. Vasquez, K. Slevin, R. A. Römer, Phys. Rev. B 84, 134209 (2011)] to the 3-D Anderson model subjected to a homogeneous magnetic field, and estimate the critical parameters as well as the multifractal exponents with high precision using wavefunction data of systems up to $L^3 = 120^3$, obtaining the critical exponent $\nu = 1.460(1.452, 1.468)$. We examine the scaling of the probability density function of wavefunction intensities and explore the possibility of finding a fingerprint of the transition in the correlation function of the phase of the complex wavefunctions.

DY 44.3 Wed 16:00 H47

Analytical continuation of perturbation series in the context of phase transitions — •Sören Sanders — Institut für Physik, Carl von Ossietzky Universität - D-26111 Oldenburg, Germany

Critical phenomena occuring at continuous phase transitions render a (low-order) perturbative description invalid; to obtain knowledge beyond the phase transition an analytical continuation is required. A recently proposed scheme to obtain nonperturbative physics from low-order perturbation theory utilizing hypergeometric functions [1] is applied in this context [2] and shown to vastly outperform well-established methods such as Shanks transformation and Padé approximation.

[1] H. Mera, T. G. Pedersen, and B. K. Nikolić, Phys. Rev. Lett. **115** (2015) 143001. [2] S. Sanders, C. Heinisch and M. Holthaus, EPL, **11** (2015) 20002.

DY 44.4 Wed 16:15 H47

Driven Markovian Quantum Criticality — •Jamir Marino[1] and Sebastian Diehl[2] — [1]Institut für Theoretische Physik Universität zu Köln — [2]Institut für Theoretische Physik Universität zu Köln

We identify a new universality class in one-dimensional driven open quantum systems with a dark state. Salient features are the persistence of both the microscopic non-equilibrium conditions as well as the quantum coherence of dynamics close to criticality. This provides a non-equilibrium analogue of quantum criticality, and is sharply distinct from more generic driven systems, where both effective thermalization as well as asymptotic decoherence ensue, paralleling classical dynamical criticality. We quantify universality by computing the full set of independent critical exponents within a functional renormalization group approach.

DY 44.5 Wed 16:30 H47

Condensation of methane in Metal Organic Frameworks (MOFs): Interfaces between dilute coexisting phases — •Mojtaba Eshraghi, Nicolas Höft, and Jürgen Horbach — Universitätstraße 1, 40225-Düsseldorf, Germany

Metal-Organic Frameworks (MOFs) are nanoporous crystalline materials where metal oxide complexes are connected to each other by organic linkers[1]. Grandcanonical Monte Carlo simulations in conjunction with advanced sampling methods are used to study the condensation of CH_4 in the MOF systems of IRMOF-1 and IRMOF-8. Two different types of condensation transitions are found, each of them ending in a critical point[2]: (i) a fluid-fluid transition at higher densities (the analog of the liquid-gas transition in the bulk) and (ii) a phase transition at low densities on the surface of the MOF structure. For the latter transition, interfaces between coexisting phases are analyzed in terms of the critical scaling of the interfacial free energy and capillary wave fluctuations.

References

1. H. Li, M. Eddaoudi, M. O'Keeffe, and O. M. Yaghi, *Nature* **402**, 276 (1999).
2. N. Höft and J. Horbach, *J. Am. Chem. Soc.* **137**, 10199-10204 (2015).

DY 44.6 Wed 16:45 H47

Planar order in the 3D plaquette gonihedric Ising model — Marco Mueller[1], Desmond A. Johnston[2], and •Wolfhard Janke[1] — [1]Institut für Theoretische Physik, Universität Leipzig, Postfach 100 920, D-04009 Leipzig, Germany — [2]Department of Mathematics and the Maxwell Institute for Mathematical Sciences, Heriot-Watt University, Riccarton, Edinburgh, EH14 4AS, Scotland

We conduct a careful multicanonical simulation of the isotropic 3D plaquette ("gonihedric") Ising model and confirm that a planar, "fukinuke" type order characterises the low-temperature phase of the model. From consideration of the anisotropic limit of the model we define a class of order parameters which can distinguish the low- and high-temperature phases in both the anisotropic and isotropic cases. We also show that the order parameter like behaviour of the standard magnetic susceptibility χ_m observed in previous Metropolis simulations was an artefact of the algorithm failing to explore the phase space of the macroscopically degenerate low-temperature phase.

D.A. Johnston, M. Mueller, and W. Janke, Mod. Phys. Lett. B **29** (2015) 1550109;
M. Mueller, W. Janke, and D.A. Johnston, Nucl. Phys. B **894** (2015) 1;
W. Janke, M. Mueller, and D.A. Johnston, J. Phys.: Conf. Ser. **640** (2015) 012002.

DY 44.7 Wed 17:00 H47

Phase Transitions of Disordered Traveling Salesperson Problems solved with Linear Programming and Cutting Planes — •Hendrik Schawe and Alexander K. Hartmann — Institut für Physik, Carl-von-Ossietzky Universität Oldenburg, Oldenburg (Germany)

The Traveling Salesperson problem asks for the shortest cyclic tour visiting a set of cities given their pairwise distances and belongs to the NP-hard complexity class, which means that typical instances are not solveable in polynomial-time (if P $\neq$ NP holds), i.e. it is *hard*. Though that does not mean, that there are not subsets of the problem which are typically *easy* to solve. To examine a transitions from an easy to a hard phase, we study an ensemble of random configurations of cities in an Euclidean plane, characterized by a parameter σ, which governs the strength of the randomness. The instances are treated using a linear programming approach with selected cutting planes. We observe several phase transitions from easy to hard phases, depending on the types of cutting planes used. These transition are related to physical properties of the shortest tours and analyzed using finite-size scaling techniques.