DY 7: Statistical physics far from thermal equilibrium

Time: Monday 14:30–16:15 Location: H5

DY 7.1 Mon 14:30 H5

Studies on a Quantum Work-Fluctuation Theorem — •Jens Teifel and Günter Mahler — Universität Stuttgart, 70550 Stuttgart, Pfaffenwaldring 57/IV

If an external force acts on a thermodynamic system on a finite time scale, it may be driven out of equilibrium. The Jarzynski relation, a classical fluctuation theorem, connects the work performed on the system and the difference of the free energy of the initial and final state, respectively. A quantum analogue has been established by S. Mukamel [Phys. Rev. Lett. 90, 170604 (2003)]. Here, we study different models of bipartite systems for which we prove that the Jarzynski relation holds.

DY 7.2 Mon 14:45 H5

Switching in time-periodic quantum systems with dissipation — •Waltraut Wustmann and Roland Ketzmerick — Institut für Theoretische Physik, Technische Universität Dresden, 01062 Dresden, Germany

A novel switching mechanism for open time-periodic quantum systems is demonstrated. We derive the consequences of isolated avoided crossings on the time-periodic stationary dynamics for weak system-bath coupling using a Floquet-Markov approach. For an asymmetric double well potential under variation of the driving amplitude the dominant probability switches from a state in the lower well to a state in the other well with a higher average energy. We propose an experimental demonstration with atoms in optical potentials and time-periodic magnetic fields.

DY 7.3 Mon 15:00 H5

Breakdown of Gallavotti-Cohen symmetry for stochastic dynamics — •Rosemary Harris[1], Attila Rákos[2], and Gunter Schütz[3] — [1]Universität des Saarlandes, Saarbrücken, Germany — [2]Weizmann Institute of Science, Rehovot, Israel — [3]Forschungszentrum Jülich, Jülich, Germany

We consider the behaviour of current fluctuations in the one-dimensional partially asymmetric zero-range process with open boundaries. Significantly, we find that the distribution of large current fluctuations does not satisfy the Gallavotti-Cohen symmetry and that such a breakdown can generally occur in systems with unbounded state space. We also discuss the dependence of the asymptotic current distribution on the initial state of the system.

DY 7.4 Mon 15:15 H5

Crossover from the pair contact process with diffusion to the directed percolation — •Su-Chan Park[1] and Hyunggyu Park[2] — [1]Institut für Theoretische Physik, Universität zu Köln, Köln, Germany — [2]Korea Institute for Advanced Study, Seoul, Korea

To figure out the universality class to which the pair contact process with diffusion (PCPD) belongs has become a controversial issue in the field of the absorbing phase transition since the reinvention of the model in 1997. The main question is whether the PCPD belong to the directed percolation (DP) universality class or not. To find out the answer to this question, the crossover behavior from the pair contact process with diffusion (PCPD) to the directed percolation (DP) is studied in one dimension by introducing a single particle annihilation/branching dynamics. The crossover exponent ϕ is estimated numerically as $1/\phi = 0.58$. Nontriviality of the PCPD crossover exponent strongly supports non-DP nature of the PCPD critical scaling, which is further evidenced by the anomalous critical amplitude scaling near the PCPD point. The universal nature of the crossover exponent is also confirmed by the study of the crossover from the PCPD to the parity conserving class, which evidences the existence of well-defined PCPD fixed point distinct from the DP.

DY 7.5 Mon 15:30 H5

Strongly Correlated Fermions after a Quantum Quench — •Salvatore Manmana[1,2,3], Stefan Wessel[1], Reinhard Noack[2], and Alejandro Muramatsu[1] — [1]Institut für Theoretische Physik III, Universität Stuttgart, Pfaffenwaldring 57, D-70550 Stuttgart — [2]AG Vielteilchennumerik, Fachbereich Physik, Philipps-Universität Marburg, D-35032 Marburg — [3]Institute of Theoretical Physics, EPFL, CH-1015 Lausanne (Switzerland)

Using the adaptive time-dependent density-matrix renormalization group method (adaptive t-DMRG), we study the time evolution of strongly correlated spinless fermions on a one-dimensional lattice after a sudden change of the interaction strength. For certain parameter values, two different initial states (e.g., metallic and insulating), lead to observables which become indistinguishable after relaxation. We find that the resulting quasi-stationary state is non-thermal. This result holds for both integrable and non-integrable variants of the system.

DY 7.6 Mon 15:45 H5

How microscopic fluctuations give rise to viscoplastic behavior in anisotropic solids — •Markus Hütter and Theo Tervoort — Institute for Polymers, Department of Materials, ETH Zurich, 8093 Zurich, Switzerland.

Temporal coarse-graining in the context of nonequilibrium thermodynamics is used to examine the interrelation between microscopic fluctuations and the viscoplastic behavior in anisotropic solids on the macroscopic scale. As a guideline to complete this task, the general equation for the nonequilibrium reversible-irreversible coupling (GENERIC) framework is used. The state of deformation in elasto-viscoplasticity can be described in terms of the elastic part of the deformation gradient as an internal variable, with its relaxation described by a so-called plastic strain rate tensor. To arrive at a closed set of evolution equations, a constitutive relation for the plastic strain rate tensor is needed. While this is often done phenomenologically on purely macroscopic grounds, we here illustrate a procedure to relate the plastic strain rate tensor to the rapid microscopic fluctuations of the deformation gradient. It is shown how common ansatzes for the plastic strain rate tensor for anisotropic amorphous solids and crystalline solids are obtained by temporal coarse-graining. A major benefit of such a procedure consists in guiding microscopic simulations. In particular, they must be used primarily for the determination of the kinetic coefficients, rather than for extracting the tensorial structure of the plastic strain rate tensor.

DY 7.7 Mon 16:00 H5

Time-dependent structure factors of a disordering system — •Robert Stück and Timo Aspelmeier — Institut für Theoretische Physik, Universität Göttingen

The non-equilibrium disordering dynamics of an initially phase-separated crystal via atom-vacancy exchanges is studied by investigating the time-dependent static structure factor. Just before complete disorder, it shows some anomalies such as an dip for periodic boundary conditions and a plateau for reflecting boundary conditions. For the plateau we found an analytic mean field solution which matches perfectly the simulation data. The dip can not be derived by a mean field approximation since it is due to correlations induced by the random walk of the vacancies. The nature of these correlations is studied numerically.