DY 19: Statistical Physics 4 - organized by Barbara Drossel (Darmstadt), Sabine Klapp (Berlin) and Thomas Speck (Mainz)

Time: Tuesday 9:00–10:40 Location: DYb

DY 19.1 Tue 9:00 DYb

Universal properties of creep flow — •Marko Popovic[1,2], Tom de Geus[1], Wencheng Ji[1], Alberto Rosso[3], and Matthieu Wyart[1] — [1]Institute of Physics, EPFL, Lausanne — [2]MPI-PKS, Dresden — [3]LPTMS, CNRS, Univ. Paris-Sud, Universite-Saclay, 91405 Orsay, France

Amorphous solids, such as atomic glasses, colloidal suspensions, granular matter or foams, begin to deform plastically when exposed to external stress Σ. Steady state flow of these materials in absence of thermal fluctuations is usually described as $\dot{\epsilon} \sim (\Sigma - \Sigma_c)^\beta$ for stresses above critical stress Σ_c and vanishes below. In presence of thermal fluctuations flow persists below Σ_c but is exponentially suppressed. The transient plastic deformation, called creep flow, is much less understood despite its importance in practical applications. Creep flow often displays a power-law decay in time $\dot{\epsilon} \sim t^{-\mu}$ after which it can either arrest or yield at fluidisation time τ_f. Recently, various numerical values and laws have been suggested for μ and τ_f in experimental or numerical studies. We propose that the creep flow parameters μ and τ can be expressed in terms of the steady state flow parameters, both in athermal and thermally activated systems. We successfully tested all our predictions using different mesoscopic elasto-plastic models of amorphous solids and found them to be consistent with published experimental results.

DY 19.2 Tue 9:20 DYb

Universality of photon counting below a local bifurcation threshold — •Lisa Arndt and Fabian Hassler — JARA-Institute for Quantum Information, RWTH Aachen University, D-52056 Aachen, Germany

At a bifurcation point, a small change of a parameter causes a qualitative change in the dynamics of the system. Quantum fluctuations wash out this abrupt transition and enable the emission of photons below the classical bifurcation threshold. Close to the bifurcation point, the resulting photon counting statistics is determined by the instability. This talk discusses a generic method to derive a characteristic function of photon counting close to a bifurcation threshold that only depends on the dynamics and the type of bifurcation, based on the universality of the Martin-Siggia-Rose action. The method is exemplified for the cusp catastrophe without conservation laws, which can be implemented by an experimental setup using driven Josephson junctions.

DY 19.3 Tue 9:40 DYb

Fermionic Criticality Out-of-Equilibrium — •Bernhard Frank and Francesco Piazza — Max-Planck-Institut für Physik komplexer Systeme, Dresden, Germany

Coupling critical bosons to a Fermi surface provides a standard route for the formation of a non-Fermi liquid: Its correlation functions do not show features of Landau quasiparticles but exhibit anomalous power laws, which give rise to substantial deviations from Fermi liquid results. So far these systems have been extensively studied in thermal equilibrium, for instance in the context of strange metals. However, recent experiments combine semi-conductor devices with optical cavities and therefore mandatorily require a theoretical formulation that takes into account the intrinsically open nature of the photonic sector in order to understand the electronic many-body physics. In particular, associating the photon with the critical bosonic mode leads to non-Fermi liquids out-of-equilibrium. Here, we use Keldysh field theory to study the paradigmatic Ising-nematic model in two-dimensions within a simple driven-dissipative setup. Compared to the situation in the ground state one observes increased decay rates in the low-energy sector of the fermionic spectrum as well as a violation of the thermal fluctuation dissipation relation caused by the enhanced bosonic fluctuations generated by the drive.

DY 19.4 Tue 10:00 DYb

On the dynamics of the Forest Fire Model — •Diego Rybski[1,2] and Jan W. Kantelhardt[3] — [1]Potsdam Institute for Climate Impact Research – PIK, Member of Leibniz Association, P.O. Box 601203, 14412 Potsdam, Germany — [2]Department of Environmental Science Policy and Management, University of California Berkeley, 130 Mulford Hall #3114, Berkeley, CA 94720, USA — [3]Institute of Physics, Martin-Luther-University Halle-Wittenberg, 06099 Halle, Germany.

We investigate the Forest Fire Model in its version proposed by Henley (PRL 1993). Extracting the time series of shares of trees in the system, we investigate the temporal dynamics. For large tree growth probabilities p we find stable regions in which the system reaches a periodic attractor. With decreasing p the period of the attractor increments and for small values the system enters a chaotic regime as found in a Feigenbaum-Diagram. However, this chaotic regime also exhibits (quasi-)periodic fluctuations where the frequency is equal to p. On larger time-scales we observe a random walk behavior ($\approx 1/f^2$ scaling) which approaches white noise (approximately flat spectrum) for very long simulations, but $1/f$ noise only appears as a transition. The standard deviation of the fluctuations is proportional to $p^{1/2}$. Our results call for a new view on forest fire dynamics.

DY 19.5 Tue 10:20 DYb

Minority games played by arbitrageurs on the energy market — •Tim Ritmeester and Hildegard Meyer-Ortmanns — Jacobs University, Bremen, Germany

Along with the energy transition, the energy markets change their organization toward more decentralized and self-organized structures, striving for locally optimal profits. These tendencies may endanger the physical grid stability. One realistic option is the exhaustion of reserve energy due to an abuse by arbitrageurs. We map the energy market to different versions of a minority game and determine the expected amount of arbitrage as well as its fluctuations as a function of the model parameters. Of particular interest are the impact of heterogeneous contributions of arbitrageurs, the interplay between external stochastic events and nonlinear price functions of reserve power, and the effect of risk aversion due to suspected penalties. As conclusions from our results we propose economic and statutory measures to counteract a detrimental effect of arbitrage.