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Finite-time dynamical phase transitions in non-equilibrium relaxation

Tuesday, 20 September 2022 15:00 (45 minutes)

Thermal relaxation is a fundamental process in statistical mechanics, with numerous applications in Nature and industry. Nonetheless, the kinetics of relaxation is well understood only close to equilibrium. Far-from-equilibrium relaxation, by contrast, is a genuine non-equilibrium problem that offers fascinating open questions, and a variety of unexpected phenomena.

In my talk, I will discuss a particular class of such phenomena, namely finite-time dynamical phase transitions. These transitions occur during thermal relaxation after an instantaneous quench of the free energy landscape. They manifest themselves as finite-time cusp singularities in the probability distributions of thermodynamic observables. The transitions are due to sudden switches in the dynamics, and they are characterised by dynamical order parameters.

To classify these transitions, I will introduce a dynamical Landau theory that applies to a range of systems with scalar, parity-invariant order parameters. Close to criticality, the theory reveals an exact mapping between dynamical and equilibrium phase transitions, and implies critical exponents of mean-field type. Beyond the mean-field treatment, interactions between nearby saddle points may lead to critical, spatiotemporal fluctuations of the order parameter, and thus give rise to novel, dynamical critical phenomena.

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