GOETHE UNIVERSITÄT FRANKFURT AM MAIN
Fachbereich Physik
Institut für Theoretische Physik

CONDENSED MATTER THEORY SEMINAR

Subject: **Quenches and relaxation in multi-mode cavity quantum electrodynamics**

Speaker: **Prof. Dr. Giovanna Morigi (Universität des Saarlandes)**

Date & time: **Friday, February 2nd, 2018 at 3.15 p.m.**

Venue: **Seminar room 1.114**

Atoms in high-finesse optical resonators interact via the photons they multiply scatter into the cavity modes. The dynamics is characterized by dispersive and dissipative optomechanical long-range forces, which are mediated by the cavity photons, and exhibits a steady state for certain parameter regimes. In standing-wave cavities the atoms can form stable spatial gratings. Moreover, their asymptotic distribution is a Maxwell-Boltzmann whose effective temperature is controlled by the laser parameters. In this work we show that in a two-mode standing-wave cavity the stationary state possesses the same properties and phases of the Generalized Hamiltonian Mean Field model in the canonical ensemble. This model has three equilibrium phases: a paramagnetic, a nematic, and a ferromagnetic one, which here correspond to different spatial orders of the atomic gas and can be detected by means of the light emitted by the cavities. We then characterize the dynamics of this self-ordering process when the cavity modes are quasi-resonantly driven by laser fields via scattering by the atoms. The lasers are simultaneously applied and uniformly illuminate the atoms, their frequencies are chosen so that the atoms are cooled by the radiative processes, their intensity is either suddenly switched or slowly ramped across the self-ordering transition. Numerical simulations for different ramp protocols predict that the system exhibits long-lived metastable states, whose occurrence strongly depends on initial temperature, ramp speed, and number of atoms. Finally, we discuss on the possible extension of teh Kibble-Zurek paradigma to the description of heat production for slow quenches in these long-range interacting systems.