Non-equilibrium dynamics of quantum gases in optical lattices

The out-of-equilibrium dynamics of interacting many-body systems presents one of the most challenging problems in modern many-body physics with implications ranging from thermalization dynamics over transport properties to novel transient effects and the formation of order.
During the last years, ultracold atoms in optical lattices have emerged as a very versatile platform to study quantum many-body physics in a clean and well-controlled environment and can therefore act as a quantum simulator for condensed-matter systems. Due to the much slower timescales compared to electrons in a solid, atoms in optical lattices are especially suited to study out-of-equilibrium dynamics. In this talk, I will show how the unique control possibilities available for ultracold atoms have allowed us to realize states at Negative Absolute Temperatures as well as to study the real-time dynamics of a Quantum Phase Transition. Furthermore, I will present first results on the Many-Body Localization of interacting atoms in a disordered potential.