PHYSIK

THEORETISCH PHYSIKALISCHES KOLLOQUIUM

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Non-equilibrium quantum matter with ultracold Rydberg atoms

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The ability to understand and control dynamical many-body quantum systems is an outstanding challenge in physics. It holds the key to extending our quantitative understanding of matter to out-of-equilibrium scenarios and has the potential to open many new applications, e.g., the discovery of fundamentally new materials, optimization of chemical processes and realization of powerful new architectures for computation. However, predicting and experimentally testing how complex non-equilibrium quantum effects come about from microscopic physics has proven remarkably difficult.
The last few years however have seen the emergence of a number of new experimental platforms for many-body physics that are genuinely non-equilibrium in nature. In our experiments we study the dynamics of ensembles of optically trapped ultracold atoms that are continuously excited to high-lying Rydberg states by laser fields. In these systems, the interplay between driving, dissipation and the strong, long-range interactions between the atoms can give rise to crucial new effects far beyond what is found in thermal equilibrium. In this talk I will present some of our recent results concerning the dynamics of quantum spin systems following a quench and the rich non-equilibrium phase structure of driven-dissipative open quantum systems. In the transient regime, I will show how population decay is a crucial aspect of the nonlinear dynamics that drives the system to a self-organised stationary state that exhibits scale invariance as well as a strong response to perturbations. This establishes a well-controlled experimental platform for uncovering general principles governing non-equilibrium dynamics where we can manipulate the underlying quantum interactions and watch how complex quantum systems evolve in exceptionally clean settings.

Gäste sind herzlich willkommen.

Die Dozenten der Theoretischen Physik

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