Controlling quantum systems using driving and dissipation

André Eckardt

Institut für Theoretische Physik, Technische Universität Berlin, D-10623 Berlin

The combination of dissipation, as it results from the coupling to an environment, and driving will guide a quantum system into a non-equilibrium steady state (NESS). I will present two recent proposals for the robust engineering of target states beyond the strict constraints of thermal equilibrium. The first one concerns superconducting circuits, where high-frequency time-periodic driving is employed to effectively (Floquet-) engineer artificial magnetic fields. Here we can show that (and how) standard approaches of reservoir engineering can be generalized to cool the system into its effective ground state [1]. In the second example, we study a bosonic lattice system in contact with a heat bath, whose temperature lies well above the equilibrium condensation temperature, as it can be realized with ultracold atoms in optical lattices. We show that when additionally switching on a strong local drive at intermediate frequencies, where resonant excitations tend to heat the system, a non-equilibrium Bose condensate will be formed. This counterintuitive effect can be explained by the formation of a small subspace of quantum-scar-like states that are protected from heating.

References:

[1] F. Petiziol, A. Eckardt, *Phys. Rev. Lett.* **129**, 233601 (2022), arXiv:2205.15778.
[2] A. Schnell, L.-N. Wu, A. Widera, A. Eckardt, arXiv:2204.07147 (20229