Approximate counter-diabatic driving protocols for non-integrable quantum systems

Mohit Pandey, Dries Sels and David. K. Campbell

October 30, 2017

11.0 STRONGLY CORRELATED SYSTEMS, INCLUDING QUANTUM FLUIDS AND SOLIDS (DCMP): 11.1.6 Non-Equilibrium Physics with Cold Atoms and Molecules, Rydberg Gases, and Trapped Ions (DAMOP, DCMP)

Noise and decoherence caused by the environment are two major challenges in applying adiabatic protocols to quantum technologies. Counter-diabatic (CD) driving protocols, which are also known as "shortcuts-to-adiabaticity," provide powerful alternatives for controlling a quantum system. These protocols allow one to change Hamiltonian parameters rapidly while still mimicking adiabatic dynamics. They have been shown to work well for a wide variety of systems, but it is exponentially hard to find exact CD protocols for non-integrable quantum many-body systems. We study a method to develop approximate CD protocols which avoids exponential sensitivity to perturbations of the Hamiltonian. Our finite-size scaling of CD Hamiltonians reveals remarkable differences between integrable and non-integrable quantum systems. We identify numerically different scaling regimes and show how they arise from the eigenstate thermalization hypothesis.