Adiabatic Tracking of Quantum Many-Body Dynamics

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The nonadiabatic dynamics of a many-body system driven through a quantum critical point can be controlled using counterdiabatic driving, where the formation of excitations is suppressed by assisting the dynamics with auxiliary multiple-body nonlocal interactions. We propose an alternative scheme which circumvents practical challenges to realize shortcuts to adiabaticity in mesoscopic systems by tailoring the functional form of the auxiliary counterdiabatic interactions. A driving scheme resorting on two-body short-range interactions is shown to generate an effectively adiabatic dynamics. The results promise feasible experimental protocols for an efficient control of the real-time dynamics of a wide variety of driven many-body systems in an experiment.

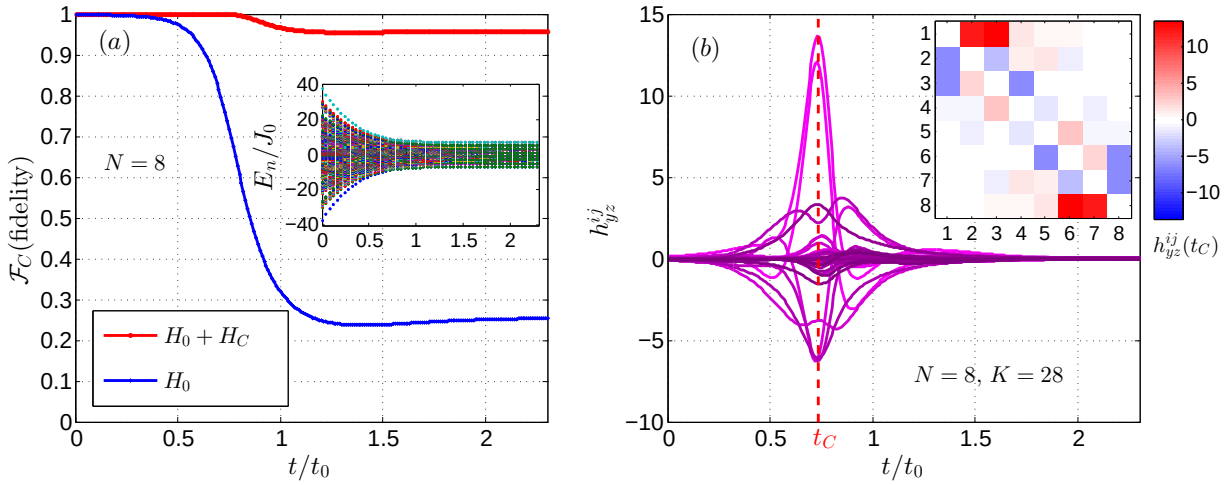

Figure 1: (a) Time evolution of the counterdiabatic fidelity during a shortcut to the adiabatic driving of an $N = 8$ linear Ising chain. (b) Real-time flow of coupling constants $h^{yz}_{ij}(t)$. A color map displaying the amplitude of the coupling constants at the critical point as a function of the site indices is shown in the inset. The vertical dashed line denotes the critical time t_C at which the system undergoes a quantum phase transition.

References:

[1] A. del Campo, M. M. Rams, and W. H. Zurek, Phys. Rev. Lett. **109**, 115703 (2012).

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