Highly Adiabatic Time-Optimal Quantum Driving at Low Energy Cost

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Abstract

Time-efficient control schemes for manipulating quantum systems are of great importance in quantum technologies, where environmental forces rapidly degrade the quality of pure states over time. In Ref. [1], we recently formulated an approach to time-optimal control that circumvents the boundary-value problem that plagues the quantum brachistochrone equation [2]. In this conference, we show how driven systems, in the form of a Landau-Zener type Hamiltonian [3], can be efficiently maneuvered in a highly adiabatic manner and with a low energy cost. Specifically, quasi-adiabatic dynamics with less than 0.1% deviation from the full adiabatic path can be attained at the quantum speed limit. Furthermore, as shown in Figure 1, the associated energetic cost is orders of magnitude lower than the cost of implementing a counterdiabatic field [4]. In the seek for energy-efficient control protocols [5], the proposed scheme lends itself as a "low-cost" alternative to transitionless driving.

References

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Figures

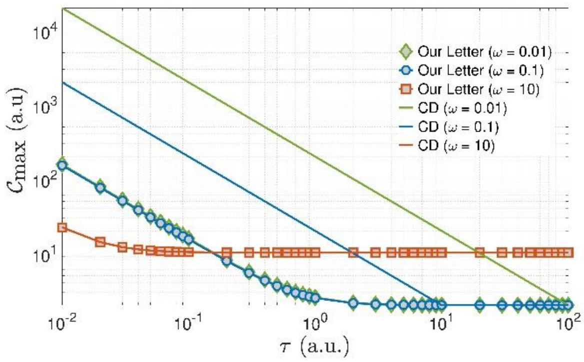

Figure 1: Maximum value of the energy required for implementing the proposed control scheme versus the cost of implementing the counterdiabatic (CD) method as a function of the protocol time.