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The study of quantum speed limit time in a quantum critical environment

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Abstract

Quantum theory sets a bound on the speed of quantum evolution. The shortest time needed for a quantum system to evolve from an initial state to the target state is known as the quantum speed limit time. The study of this time in open and closed quantum systems has been the subject of much work in quantum information theory. Quantum speed limit time is inversely related to the evolution rate of a quantum process. This relation is such that the speed of evolution decreases with increasing quantum speed limit time and vice versa. In this work we study the QSL time for the case in which a qubit interacts with a quantum critical environment. We choose the environment to be an Ising spin chain in a transverse field. It is observed that for the quantum speed limit time has a direct relation with quantum coherence of the initial state of the system. We will also study the effect of perturbation coupling on quantum speed limit time. It is observed that the quantum speed limit time decreases with increasing the coupling parameter. It is also observed that the quantum speed limit time decreases with increasing the number of spin in spin chain.

Keywords: Quantum speed limit, Open quantum system, Quantum critical environment

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