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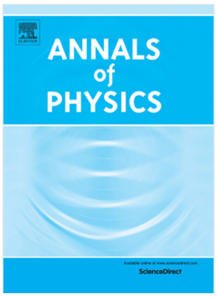

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Local quantum uncertainty guarantees the measurement precision for two coupled two-level systems in non-Markovian environment

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Abstract

Quantum Fisher information (QFI) is an important feature for the precision of quantum parameter estimation based on the quantum Cramér-Rao inequality. When the quantum state stratifies the von Neumann-Landau equation, the local quantum uncertainty (LQU), as a kind of quantum correlation, present in a bipartite mixed state guarantees a lower bound on QFI in the optimal phase estimation protocol [Phys. Rev. Lett. 110 (2013) 240402]. However, in the open quantum systems, there is not an explicit relation between LQU and QFI generally. In this paper, we study the relation between LQU and QFI in open systems which is composed of two interacting two-level systems coupled to independent non-Markovian environments with the entangled initial state embedded by a phase parameter θ. The analytical calculations show that the QFI does't depend on the phase parameter θ, and its decay can be restrained through enhancing the coupling strength or non-Markovianity. Meanwhile, the LQU is related to the phase parameter θ and shows plentiful phenomena. In particular, we find that the LQU can well bound the QFI when the coupling between the two systems is switched off or the initial state is Bell state.

Keywords: Quantum Fisher information, Quantum correlation, Open systems

1. Introduction

Quantum entanglement is a very important physical resource in quantum information [1], recently, it has been shown that the quantum discord [2, 3], as another kind of quantum correlation, can depict the quantumness of quantum state more deeply than the quantum entanglement in some quantum information processing, such as the DQC1 model [4] and is more robust against

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