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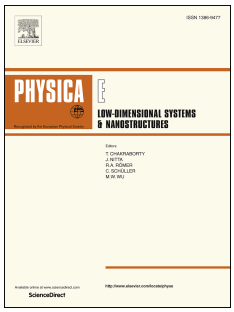

Fisher information of a single qubit interacts with a spin-qubit in the presence of a magnetic field

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Fisher information of a single qubit interacts with a spin-qubit in the presence of a magnetic field

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Abstract: In this contribution, quantum Fisher information is utilized to estimate the parameters of a central qubit interacting with a single- spin qubit. The effect of the longitudinal, transverse and the rotating strengths of the magnetic field on the estimation degree is discussed. It is shown that, in the resonance case, the number of peaks and consequently the size of the estimation regions increase as the rotating magnetic field strength increases. The precision estimation of the central qubit parameters depends on the initial state settings of the central and the spin- qubit, either encode classical or quantum information. It is displayed that, the upper bounds of the estimation degree are large if the two qubits encode classical information. In the non-resonance case, the estimation degree depends on which of the longitudinal/transverse strength is larger. The coupling constant between the central qubit and the spin- qubit has a different effect on the estimation degree of the weight and the phase parameters, where the possibility of estimating the weight parameter decreases as the coupling constant increases, while it increases for the phase parameter.

For large number of spin-particles, namely, we have a spin-bath particles, the upper bounds of the Fisher information with respect to the weight parameter of the central qubit decreases as the number of the spin particle increases. As the interaction time increases, the upper bounds appear at different initial values of the weight parameter.

1 Introduction

Fisher information plays an important role in the context of quantum metrology [1] and quantum information processing [2, 3, 4, 5, 6]. Quantum Fisher information (QIF) quantifies the information that can be elicited about a parameter. In other words, QFI is used as an estimation tool of parameters that contained in the quantum system during its evolution [7]. Due to its importance , there are some efforts that has been done to quantify QFI in different quantum systems.

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