Quantum speed limit in producing atom-ion entanglement in Josephson junction

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Abstract

In this work, we have studied the tunneling of a single atom in a double-well. The atom is interacting with a single ion in a simple harmonic trap placed in the center of the double-well. The tunneling of the atom is controlled by the spin and/or motional state of the ion. Considering a model potential, we have shown that it is possible to generate an entangled state between the spatial state of the ion and the atomic wavefunction. By employing the optimal control method, the quantum speed limit of generating this entangled process has been explored. This system can be used as qubit in quantum computers.

Keywords: atom-ion entanglement, chopped random basis algorithm, optimal control, quantum speed limit

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