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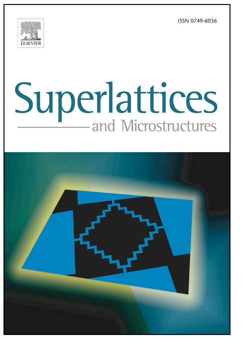

Weak coupling polaron and Landau-Zener scenario: Qubits modeling

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Weak coupling polaron and Landau-Zener scenario: qubits modeling

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Abstract

The paper presents a weak coupling polaron in a spherical dot with magnetic impurities and investigates conditions for which the system mimics a qubit. Particularly, the work focuses on the Landau-Zener (LZ) scenario undergone by the polaron and derives transition coefficients (transition probabilities) as well as selection rules for polaron's transitions. It is proven that, the magnetic impurities drive the polaron to a two-state superposition leading to a qubit structure. We also showed that the symmetry deficiency induced by the magnetic impurities (strong magnetic field) yields to the banishment of transition coefficients with non-stacking states. However, the transition coefficients revived for large confinement frequency (or weak magnetic field) with the orbital quantum numbers escorting transitions. The polaron is then shown to map a qubit independently of the number of relevant states with the transition coefficients lifted as LZ probabilities and given as a function of the electron-phonon coupling constant (Fröhlich constant).

Key words: polaron, magnetic field,qubits, driving time

1 Introduction

LZ tunneling is a basic process of quantum mechanics and a vast amount of literature has been devoted to its application for a numerous physical systems such as current driven Josephson junctions [1] , atoms in accelerating optical lattices [2] and field-driven super-lattices [3] .

Generally, such quantum mechanical system undergoes either diabatic or adiabatic process. Adiabatic evolution has been used as a standard driving tool for quantum system's evolutions. The adiabatic theorem guarantees that a