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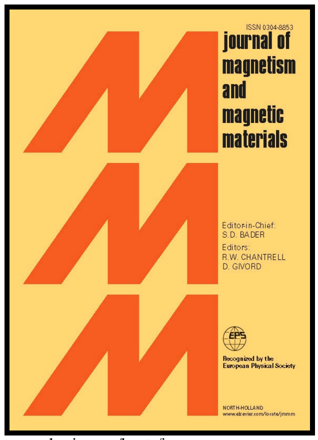

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Edris Faizabadi

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Spin-polarization and spin-flip in a triple-quantum-dot ring by using tunable lateral bias voltage and Rashba Spin-Obit interaction

Dr Edris Faizabadi

IUST, Narmak, Tehran 16844, Iran

Phone: +982122741366. E-mail: edris@iust.ac.ir

Abstract: By using the Green's function formalism, we investigate the effects of single particle energy levels of a quantum dot on the spin-dependent transmission properties through a triple-quantum-dot ring structure. In this structure, one of the quantum dots has been regarded to be non- magnetic and the Rashba spin-orbit interaction is imposed locally on this dot while the two others can be magnetic. The on-site energy of dots, manipulates the interference of the electron spinors that are transmitted to output leads. Our results show that the effects of magnetic dots on spin-dependent transmission properties are the same as the difference of on-site energies of the various dots, which is applicable by a controllable lateral bias voltage externally. Besides, by tuning the parameters such as Rashba spin-orbit interaction, and on-site energy of dots and magnetic flux inside the ring, the structure can be indicated the spin-flip effect and behave as a full spin polarizer or splitter.

Keywords: Quantum dot; Onsite energy; Magnetic dot; Rashba spin-orbit interaction; Green's function.

I. Introduction

Recently, the craft of manipulation and control of the electron spin, which is referred to as spintronics, has been the subject of many studies. The concept of spintronics concerns to interaction between the spin of particles and its surrounded solid-state ambience, to develop practical devices [1]. The most important aspects of spintronics in the applied sciences are quantum information and quantum computing. Due to these topics, the electron spin as a qubit has achieved a central role in recent papers [2-6]. The fundamental part of a quantum computer's memory is called "qubit" that is corresponded to two possible spin directions, i.e. spin-up and spin-down. In order to have such spin-polarized electrons in application, control, and manipulation the spin degrees of freedom play a key role in spin-dependent structures. Therefore polarizing and splitting the electron beams have been remarked as the most important aims of many recent studies [1]. In this regard, some theoretical and experimental investigations have been directed on quantum confinement systems, e.g. quantum dots (QDs), quantum wires, quantum rings, and so on [7-11]. In an Aharnov-Bohm (AB) quantum ring (i.e. ring shaped structures), the quantum interference has become one of the dominant phenomena, which can affect the physical properties of these structures, e.g. spin transport properties. This is partially due to the geometry of these structures, as the incoming electrons have two different spatial paths that interfere at the