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Study of the QPC Back-action to Electron Spin Based Qubits[1]
MING XIAO, HAIOU LI, GANG CAO, GUOPING GUO, GUANGCAN GUO, University of Science and Technology of China, HONGWEN JIANG, University of California at Los Angeles — The electron spin states in quantum dots (QD) are potential for implementing qubits. Quantum point contacts (QPC) are widely used to read-out these spin states. However, any read-out procedure inevitably causes back-action to the measured qubits. In this work we studied the back-action of a QPC to the electron spin states in a single GaAs QD. We found that the non-equilibrium effect in the QPC real-time charge counting statistics is a benchmark of the QPC back-action strength. The back-action driven excitations to higher energy levels contribute extra features which enabled us to study the QD's internal structures. The excitations between the two Zeeman states for odd number of electrons and between the spin singlet-triplet states for even number of electrons are respectively studied. This provides a way to quantitatively evaluate the influence of back-action on Zeeman or singlet-triplet based spin qubits. The dependence of the relaxation time of various spin excited states on the back-action strength was also studied.

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