Electronic transport in ferromagnetic single-electron transistor with non-collinear magnetizations in the cotunneling regime

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Spin-dependent electronic transport in a ferromagnetic single-electron transistor (FM SET) is studied theoretically in the Coulomb blockade regime [1]. Two external electrodes and the central part (island) of the device are assumed to be ferromagnetic, with the corresponding magnetizations being non-collinear in a general case. First order (sequential) transport is suppressed in the Coulomb blockade regime, so only the second order (cotunneling) processes contribute to the current. The cotunneling processes take part via four intermediate (virtual) states of the island: two of them are with one extra electron (spin majority or spin minority) on the central electrode of the device, whereas the other two virtual states are with a hole (in the spin majority or spin minority subbands) in the central electrode. The cotunneling processes not only transfer the charge, but also create electron-hole excitation of the central electrode. In a general case they also can create spin excitation of the island. However, we assume relatively fast spin relaxation in the island, so the spin accumulation is neglected. Basic transport characteristics, like tunneling current, differential conductance and tunnel magnetoresistance, are calculated for an arbitrary magnetic configuration of the system and for different values of the bias and gate voltages.

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[1] *Single Charge Tunneling*, Vol. 294 of NATO Advanced Study Institute, Series B, edited by H. Grabert and M. H. Devoret, Plenum Press, New York 1992.

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