SINGLET-TRIPLET SWITCHING INDUCED BY ELECTRIC FIELD IN TRIPLE QUANTUM DOTS

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9.7 cm

We present theoretical studies on an artificial molecule which is constructed from three coherently coupled quantum dots (TQD). The system of TQD can be closed ($\triangle$) or open ($\wedge$) and contains four electrons, with the total spin $S = 0$ (singlet) and $S = 1$ (triplet state). In calculations we use the Hubbard model with a single orbital level at each quantum dot, taking into account Coulomb interactions. We also add a term describing influence of electric field on the system, which leads to splitting of energy levels (linear and quadratic Stark effect) and to a transition between the singlet and triplet ground state. In order to understand a nature of the transition, we analyze influence of the electric field on competition between a direct and super-exchange process. We calculate also current in the TQD system connected to electrodes and show, that Pauli spin blockade can give information about the singlet-triplet transition. A similar singlet-triplet switching effect in electric field was recently considered by Baadji et al [1] in magnetic molecules. Our studies are motivated by search for new devices in spintronics and quantum computing.

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[1] N. Baadji, M. Piacenza, T. Tugsuz, F. D. Sala, G. Maruccio and S. Sanvito, Nature Materials 8, 813 (2009).

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