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Tunable spin filter and molecular hybridization in a quantum dot molecule F. MIRELES, E. COTA, F. ROJAS, CCMC-UNAM, Ensenada BC, Mexico, S.E. ULLOA, Dept. of Physics and Astronomy and NQPI, Ohio Univ., Athens OH — Spin filtering using few electron semiconductor quantum dots formed in two-dimensional electron gas systems has attracted much recent attention in spintronics. Spin filtering has been achieved in a quantum dot via universal conductance fluctuations and electron magnetic focusing [1]. A bipolar spin filter (**SF**) has been realized recently using a semiconductor quantum dot which can operate practically as a perfect SF, provided there is a large enough Zeeman splitting [2]. In this work we present calculations showing that the tunable (molecular) hybridization between two quantum dots with few electrons and connected "in parallel," produces a singlet-triplet transition in the ground state which can be used as a robust bipolar SF in both the linear and non-linear regimes of transport. The bipolar SF is found to be *fully tunable by only electrical gating* at low temperatures. We show that a singlet-triplet transition in the energy spectrum gives rise to the natural spin selectivity in the odd-to-even electron number transition in Coulomb blockade experiments. The competition between the Zeeman, Coulomb, and tunneling energies is studied in detail to determine the optimal conditions to achieve the singlet-triplet transition, so that it becomes broadly useful as a bipolar SF. [1] J. A. Folk et al., Science **299**, 679 (2003). [2] R. Hanson et al., cond-mat/0311414 (2003). *Supported by DGAPA-UNAM project 1N114403, CONACYT, projects J40521F and 143673F, and NSF-IMC.

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