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Multiple quantum dot spin qubits

SEIGO TARUCHA, The University of Tokyo Riken Center for Emergent Matter Science

To date various techniques of implementing spin qubits and entangling gates have been developed with quantum dos (QDs). The necessary step for further scaling up the qubit system is to increase the number of QDs with a well-controlled charge state to prepare multiple qubits and improve the fidelity of the qubit gates as well. I will first review spin-1/2 qubit gates with triple QDs for operating three qubits, local and non-local entangling gates, and SWAP gates. I show that the fidelity of these spin manipulations is significantly increased by decreasing the data acquisition time. Secondly I will refer to quadruple and quintuple QDs to implement multiple spin qubits. For the triple QD we use two sets of two coupled dots in the spin blockade regime to demonstrate operation of three individual spin qubits. We use an exchange coupling between the neighboring dots to make two sets of SWAPs and an inhomogeneous Zeeman field difference between the neighboring dots (between the remote dots) to make local (non-local) control of S-T_0 oscillations. We apply the same technique for the quadruple QD to coherently manipulate individual four spins. We finally discuss a way to further scale up the qubit system using multiple QDs.