MAR17-2016-009712

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Coupling of three-spin qubits to microwave cavities[1]

MAXIMILIAN RUSS, Department of Physics, University of Konstanz, D-78457 Konstanz, Germany

Qubit cavity coupling and hybrid quantum systems are recently under intense investigation due to its application in long-distance entanglement protocols and fast quantum-state read-out schemes. We investigate the behavior of qubits consisting of three electron spins in triple quantum dots (TQDs) which are coupled to a microwave cavity via their electric dipole moment[2]. Our model includes two different geometries of the hybrid where the qubit is embedded longitudinally or transversally inside the cavity which yield a qubit-cavity coupling to independent TQD detuning parameters, ε and ε_M. These parameters can be controlled in experiments by gate voltages applied to the quantum dot structures. By varying the detuning parameters, one can switch the qubit type from the resonant exchange qubit to other three-spin qubit encodings by shifting the energies in the single quantum dots thus changing the electron occupancy in each. In a semi-microscopic approach we calculate the transition dipole matrix elements of the qubit-cavity interaction that determine the qubit-cavity coupling strength needed for two-qubit gates and dispersive read-out[3]. We investigate both geometries and compare the two with and without the influence of charge noise. As a final result, the requirements for the vacuum coupling strength and quality factor of the cavity are presented.

[1]Funded by ARO through grant No. W911NF-15-1-0149

[2]M. Russ, F. Ginzel, and G. Burkard, Phys. Rev. B 94, 165411 (2016)

[3]G. Burkard and J. Petta, arXiv:1607.08801 (accepted in Phys. Rev. B, 2016)