MAR16-2015-000273

Abstract for an Invited Paper
for the MAR16 Meeting of
the American Physical Society

Double sweet-spot operation of the resonant exchange qubit in three-electron quantum dots[1]

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The resonant exchange (RX) qubit is a promising variant of the exchange-only spin qubit in a triple quantum dot which responds to a narrow-band resonant frequency. But the advantage of a permanently applied exchange splitting for spin control generally entails an increased susceptibility to charge noise. We have investigated the influence of electrical charge noise on a resonant exchange (RX) qubit by taking into account uncorrelated noise in each quantum dot, giving rise to two independent noisy bias parameters ε and Δ [1]. Calculating the energy splitting of the two qubit states as a function of these two bias detuning parameters, we have identified sweet spots, where the qubit is least susceptible to noise. Our investigation shows that the sweet spots exist within the low-bias regime, in which the bias detuning parameters have the same magnitude as the hopping parameters between the dots. By calculating and comparing the charge dephasing rates at the various operating points of the RX qubit, we identify a new favorable operating regime for the RX qubit in the case of weak noise, based on these double sweet spots. In contrast, spin noise can be mitigated using exchange-based dynamical decoupling sequences that have been optimized using two different strategies, Uhrig dynamical decoupling (UDD) and optimized filter function dynamical decoupling (OFDD) [2]. Finally, we give a brief outlook towards the possibility of long-distance coupling between resonant exchange qubits mediated by a microwave cavity [3].

[1] M. Russ and G. Burkard, Phys. Rev. B 91, 235411 (2015).
[2] N. Rohling and G. Burkard, arXiv:1510.04098.
[3] M. Russ and G. Burkard, Phys. Rev. B (accepted) [arXiv:1508.07122].

[1]Supported by DFG through SFB 767 and ARO through grant No. W911NF-15-1-0149.