V O R T R A G S E I N L A D U N G

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Interplay of charge and spin coherence in Landau-Zener interferometry in double quantum dots

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Landau-Zener-Stückelberg-Majorana (LZSM) physics has been exploited to coherently manipulate two-electron spin states in a GaAs double quantum dot (DQD) system at an anti-crossing between a singlet S and a triplet T_+ resulting from the hyperfine interaction with nuclear spins of the host material [1,2]. However, the fluctuations of the nuclear spin bath result in spin dephasing within $T_2^* \simeq 10-20$ ns. As a consequence, the sweep through the anti-crossing would have to be performed on a timescale comparable to T_2^* to achieve LZSM oscillations with 100% visibility. Moreover, the S-T_+ anti-crossing is located near the $(1,1)-(2,0)$ interdot charge transition, where (n_l, n_r) denotes the number of electrons in the left and right quantum dot. As a result the singlet state involved in the dynamics is a superpostion of $(1,1)$ and $(2,0)$ singlet states.

Here we demonstrate how to increase the oscillations visibility while keeping sweep times below the limit set by T_2^*. Our approach is based on a tailored pulse with a detuning dependent level velocity. The design includes a slow level velocity portion that is chosen to coincide with the passage through the S-T_+ anti-crossing and two fast level velocity portions. The latter minimizes the time spent in regions where spin and charge degrees of freedom are entangled, which renders the qubit susceptible to charge noise. The slow level velocity portion of the pulse results in an stronger effective coupling between the spins states, which increases the oscillations visibility [3,4].

[1] J. R. Petta, H. Lu, and A. C. Gossard, Science **327**, 669 (2010).
[2] H. Ribeiro, J. R. Petta, and G. Burkard, Phys. Rev. B **82**, 115445 (2010).
[3] H. Ribeiro, G. Burkard, J. R. Petta, H. Lu, and A. C. Gossard, Phys. Rev. Lett. **110**, 086804 (2013).
[4] H. Ribeiro, J. R. Petta, G. Burkard, Phys. Rev. B **87**, 235318 (2013).