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Quantum gates for the singlet-triplet T_+ qubit HUGO RIBEIRO, University of Konstanz, J.R. PETTA, Princeton University, GUIDO BURKARD, University of Konstanz — We theoretically show that hyperfine interactions can be harnessed for quantum gate operations in GaAs semiconductor quantum dots [1]. In the presence of an external magnetic field B, which splits the triplet states, the hyperfine interaction results in an avoided crossing between the spin singlet S and spin triplet T_+, which form the basis of a new type of spin qubit. Coherent quantum control for this qubit is achieved through Landau-Zener-Stückelberg transitions at the S-T_+ avoided crossing [2]. A set of suitable transitions allows to build any single qubit gates on timescales shorter than the decoherence time $T_2^* \sim 16$ns [1]. We also show how to build a conditional two-qubit gate by capacitively coupling two S-T_+ qubits.

[1] H. Ribeiro, J. R. Petta, and G. Burkard, Phys. Rev. B 82, 115445 (2010).
[2] H. Ribeiro and G. Burkard, Phys. Rev. Lett. 102, 216802 (2009).

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