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The exchange-only singlet-only spin qubit JEROEN DANON, ARNAU SALA, Norwegian University of Science and Technology — In order to overcome the practical challenge of creating highly localized magnetic fields, the proposed implementations of spin qubits in semiconductor quantum dots have seen a gradual development from conceptually simple single-dot single-spin systems to more complicated triple-dot three-spin qubits that, due to the exchange interaction between the spins, can be fully operated by electric fields only. The main bottleneck for further improvement of such qubits in high-quality III-V materials is set by the fluctuating nuclear spins of the host material, resulting in slowly fluctuating random effective magnetic fields acting on the three spins. Since these fields couple into the qubit subspace, they contribute to qubit decoherence, typically yielding a T_2^* of tens of ns. We propose a simple solution to this problem: After adding one more spin to the setup, one can define the qubit in a four-spin singlet-only subspace which is to lowest order insensitive to the effective nuclear fields. We suggest a feasible quadruple-dot implementation of this idea and indicate how such a qubit could be initialized, manipulated, and read out using electric fields only.

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