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Coherent manipulation of a Si/SiGe-based singlet-triplet qubit[1]

MARK GYURE, HRL Laboratories, LLC

Electrically defined silicon-based qubits are expected to show improved quantum memory characteristics in comparison to GaAs-based devices due to reduced hyperfine interactions with nuclear spins. Silicon-based qubit devices have proved more challenging to build than their GaAs-based counterparts, but recently several groups have reported substantial progress in single-qubit initialization, measurement, and coherent operation. We report [1] coherent control of electron spins in two coupled quantum dots in an undoped Si/SiGe heterostructure, forming two levels of a singlet-triplet qubit. We measure a nuclei-induced T_2^* of 360 ns, an increase over similar measurements in GaAs-based quantum dots by nearly two orders of magnitude. We also describe the results from detailed modeling of our materials and devices that show this value for T_2^* is consistent with theoretical expectations for our estimated dot sizes and a natural abundance of ^{29}Si. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the official policies, either expressly or implied, of the United States Department of Defense or the U.S. Government. Approved for public release, distribution unlimited.

[1] B. M. Maune et al., "Coherent Singlet-Triplet Oscillations in a Silicon-based Double Quantum Dot," accepted by Nature.

[1]Sponsored by United States Department of Defense.