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Decoherence of Neutral ³¹P Donor Nuclear Spins by ²⁹Si¹ E.S. PE-TERSEN, A.M. TYRYSHKIN, S.A. LYON, Princeton University, J.J.L. MORTON, University College London, K.M. ITOH, Keio University, M.L.W. THEWALT, Simon Fraser University — NMR data from degenerately doped Si:P has suggested that the coherence of ³¹P nuclear spins can be limited to a few ms in natural Si by spectral diffusion from ²⁹Si [1]. Here we report measurements of the nuclear spin coherence of neutral isolated ³¹P donors in lightly-doped ($\sim 10^{15}$ /cm³) Si with ²⁹Si concentrations from 1% to 50%. Pulsed ENDOR at X-band microwave frequency and a magnetic field of 0.35 T was used to measure the nuclear spins. The light doping and measurement temperature of 1.7K ensured that neither electron spin flips nor flip-flops limited the nuclear T₂. We find that the resulting echo intensity decays are nonexponential, and the time to reach 1/e is inversely proportional to the ²⁹Si density. The nuclear decoherence time for natural silicon is found to be approximately 1 second, about 2000 times longer than donor electron spins in natural Si.

[1] G.P. Carver et al., Phys. Rev. B 3, 4285 (1971).

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Evan S. Petersen Princeton University

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