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Spectral diffusion of P donors in isotopically-enriched silicon with low ^{29}Si concentrations A.M. TYRYSHKIN, S.A. LYON, Princeton University, SHINICHI TOJO, K.M. ITOH, Keio University, J.J.L. MORTON, Oxford University, J.W. AGER, Lawrence Berkeley National Laboratory, M.L.W. THEWALT, Simon Fraser University, H. RIEMANN, N.V. ABROSIMOV, Institute for Crystal Growth (IKZ), P. BECKER, PTB Braunschweig, H.-J. POHL, VITCON Projectconsult GmbH — Spectral diffusion caused by fluctuating magnetic nuclei has been recognized as one of the most severe decohering processes for electrons spins in semiconductor devices. Aiming to answer how spectral diffusion scales with concentration of magnetic nuclei in the environment we report X-band pulsed ESR measurements of spectral diffusion for phosphorus donors in silicon at different ^{29}Si fractional concentrations from natural abundance 4.7% down to 50 ppm. At all (but 50 ppm) ^{29}Si concentrations we found a non-exponential Hahn echo decay which can be best fit using exp(-(t/T_{SD})^n); at 50 ppm the spectral diffusion was unmeasurably long. The spectral diffusion parameters, T_{SD} and n, both show a pronounced dependence on orientation of the magnetic field with respect to silicon crystal axes. T_{SD} changes from 0.6 ms at 4.7% ^{29}Si to 18 ms at 800 ppm, while n always stays in the range 2-3. We find our experimental results in good agreement with the existing theories. The work is funded by DOE and LPS.

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