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Optical Hyperpolarization of Donor Electron Spins in Silicon Using a Widely-Tunable DBR Laser BRENDON ROSE, Department of Electrical Engineering, Princeton University, GARY WOLFOWICZ, London Centre for Nanotechnology, University College London, ALEXEI TYRYSHKIN, Department of Electrical Engineering, Princeton University, MICHAEL THEWALT, Department of Physics, Simon Fraser University, KOHEI ITOH, School of Fundamental Science and Technology, Keio University, Japan, JOHN MORTON, London Centre for Nanotechnology, University College London, STEPHEN LYON, Department of Electrical Engineering, Princeton University — We report on measurements of isotopically enriched silicon samples (45 ppm Si-29) with very low donor densities (1e12-1e14 cm^{-3}). Pushing the donor density limit necessitates optimizing the experimental sensitivity and enhancing spin polarization. Donor spin polarization greater than Boltzmann (hyperpolarization) can be established by optically exciting the no-phonon bound exciton transitions followed by Auger recombination. We established significant donor spin hyperpolarization with a distributed Bragg reflector laser, tunable across all donors including P-31 and Bi-209. For phosphorus doped silicon we observed combined electron-nuclear spin polarizations of 100%-200% depending on donor density. For bismuth donors at a clock transition (B = 80.6 mT), we observed about 50% spin polarization, and 500% away from the clock transition. This increase in spin polarization allows for single shot measurement of low density samples (4e12 P/cm^3. and 1e14 Bi/cm^3).

Brendon Rose
Department of Electrical Engineering, Princeton University

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