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Optical hyperpolarization of the nuclear and electronic spins of ^{31}P in ^{28}Si A. YANG, M. STEGER, T. SEKIGUCHI, M. L. W. THEWALT, Dept. of Physics, Simon Fraser University, Burnaby, BC, Canada, T. D. LADD, E. L. Ginzton Laboratory, Stanford University, Stanford, CA, USA, K. M. ITOH, Keio University and CREST-JST, Yokohama, Japan, H. RIEMANN, N. V. ABROSIMOV, Institute for Crystal Growth (IKZ), Berlin, Germany, P. BECKER, PTB Braunschweig, Braunschweig, Germany, H.-J. POHL, VITCON Projectconsult GmbH, Jena, Germany, J. W. AGER III, E. E. HALLER, UC Berkeley and LBNL, Berkeley, CA, USA — We have recently shown that the donor hyperfine splitting can be resolved for the ^{31}P donor bound exciton transition in highly enriched ^{28}Si, enabling either optical or optical-electrical readout of the electronic and nuclear spin state of this promising qubit candidate.[1] Here we show that these same optical transitions can be used to quickly achieve large nuclear and electronic hyperpolarizations of the ^{31}P donor in ^{28}Si. This may provide a viable solution to the problem of initializing the nuclear spins, a roadblock for quantum computing schemes involving nuclear spins in Si. We also report on the remarkably narrow homogeneous linewidth of this bound exciton transition, measured by hole burning spectroscopy. This suggests that even higher spin selectivity and hyperpolarization may be achievable in more highly enriched ^{28}Si, or when dealing with individual ^{31}P donors. [1] A. Yang et al., Phys. Rev. Lett. 97, 227401 (2006).

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