Abstract Submitted
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A new electrical readout mechanism for Si:P qubits DANE R. MCCAMEY, University of Utah, G.W. MORLEY, London Centre for Nanotechnology, S.-Y. PAIK, S.-Y. LEE, University of Utah, L.-C. BRUNEL, University of California, Santa Barbara, J. VAN TOL, National High Magnetic Field Laboratory, C. BOEHME, University of Utah — Phosphorus donor spins in silicon are a promising candidate for the implementation of quantum bits, and electrical detection is viewed as the most promising route towards the single donor readout required to further advance such concepts. We will discuss a major limitation to commonly used electrical detection schemes. The standard way to electrically detect Si:P spin states involves utilizing spin dependent recombination with nearby probe spins, usually of defects at the Si-SiO_2 interface. This process has a fast, fixed timescale, thereby limiting coherence times. We find that these times are of order 1μs, in agreement with other studies. By moving to high magnetic fields ($B > 8$ T) we enter a new regime - complete electron polarization. This allows us to utilize a different readout mechanism, namely, capture into the donor D^- state which causes a decrease in the photocurrent in the sample. We have developed a system which allows us to investigate the donor spin phase coherence times at these high magnetic fields; we find them to be over 100μs [1]. Additionally, the signal observed at these high fields is significantly larger ($\Delta I/I \sim 5$ %) than at low fields, providing a pathway towards single spin detection. [1] PRL **101**, 207602 (2008)

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