Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Coherence time of the nuclear spin of ionized phosphorus donors in ^{28}Si at liquid He and room temperature MICHAEL L.W. THEWALT, KAMYAR SAEEDI, Dept. of Physics, Simon Fraser University, Burnaby BC V5A 1S6 Canada, STEPHANIE SIMMONS, Dept. of Materials, Oxford University, Oxford OX1 3PH, UK, JOHN J.L. MORTON, London Centre for Nanotechnology, University College London, London WC1H 0AH, UK — Remarkable coherence times have recently been reported for the nuclear spin of dilute neutral ^{31}P in highly enriched ^{28}Si [1]. For ionized ^{31}P, the removal of the hyperfine-coupled electron should result in a nuclear spin even more decoupled from the environment, and hence even longer coherence times at cryogenic temperatures. The coherence time of ionized ^{31}P was recently observed in natural Si, and while the nuclear coherence time was indeed much longer than the electron coherence time measured in the same device, it was limited to 18 ms due to both the presence of ^{29}Si as well as the readout mechanism being employed [2]. Here we report on coherence time measurements for ionized ^{31}P in the same ^{28}Si samples used for the previous [1] neutral donor study. In addition to the promise of longer cryogenic coherence times, the removal of the hyperfine-coupled electron should result in a profound change in the temperature dependence of T_2. For the neutral donor, the electron T_1 decreases very rapidly with increasing temperature, and even at 4.2 K the nuclear T_2 is limited by the electron T_1 [1]. This mechanism is absent for the ionized donor, and we will report on nuclear coherence time measurements for ionized ^{31}P at room temperature.

[1] M. Steger et al., Science 336, 1280 (2012).
[2] L. Dreher et al., Phys. Rev. Lett. 108, 027602 (2012).

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Date submitted: 19 Nov 2012 Electronic form version 1.4