Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Decoherence-protected nuclear spin quantum register in diamond VIATCHESLAV DOBROVITSKI, WAN JUNG KUO, Ames Laboratory US DOE, Iowa State University, Ames, IA, 50011, USA, RONALD HANSON, TIM H. TAMINIAU, Delft University of Technology, 2600 GA Delft, the Netherlands — We analyze the decoherence-protected operation of a quantum register based on the nuclear spins surrounding a nitrogen-vacancy (NV) center in diamond. Combination of the decoherence protection with the quantum gates is achieved by applying the decoupling pulses to the NV center's electronic spin in resonance with the motion of one of the nuclear spins [1,2]. In this way, many weakly coupled (tens of kHz) nuclei located far from the NV center can be combined in a quantum register. We study the limits, set by realistic experimental parameters, on the size of such a register and on the duration of the quantum gates needed for its operation. We also consider the ways of accelerating the quantum gate operation, and integration of the decoherence-protected gates with the decoupling of the nuclear spins themselves. We conclude that creation of such registers is feasible with current experimental capabilities. Work at the Ames Laboratory was supported by the Department of Energy - Basic Energy Sciences under Contract No. DE-AC02-07CH11358. [1] T. van der Sar et al., Nature 484, 82 (2012). [2] T. H. Taminiau et al., Phys. Rev. Lett. 109, 137602 (2012).

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Date submitted: 08 Nov 2012 Electronic form version 1.4