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Three-qubit quantum register and quantum nondemolition detection using a single nitrogen-vacancy center LIANG JIANG, JONATHAN HODGES, JERO MAZE, MIKHAIL LUKIN, Harvard University — We experimentally demonstrate coherent control of a quantum register [1,2] consisting of three coupled spin qubits. In our experiments, the electronic spin of the nitrogen-vacancy (NV) center is the primary qubit that can be initialized/detected optically; the two proximal C-13 nuclear spins are ancillary qubits with long coherence times. We demonstrate the spin-exchange operation between the two C-13 nucleus, which enables the full control over three-qubit quantum register. In addition, we demonstrate repetitive quantum nondemolition detection (QND) of spin qubits. As an application, we discuss how such QND technique can improve the sensitivity of NV-based magnetometers [3,4]. [1] M. V. G. Dutt, et al., Science 316, 1312 (2007). [2] L. Jiang, et al., PRA 76, 062323 (2007). [3] J. R. Maze, et al., Nature 455, 644 (2008). [4] J. M. Taylor, et al., Nature Physics 4, 810 (2008).

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