Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Complete quantum control of a single quantum dot spin using ultrafast optical pulses DAVID PRESS, Stanford University, THADDEUS LADD, Stanford University, National Institute of Informatics, BINGYANG ZHANG, Stanford University, YOSHIHISA YAMAMOTO, Stanford University, National Institute of Informatics — We demonstrate a complete set of ultrafast all-optical single-qubit operations on a single electron spin in a quantum dot [*Nature* **456**, 218 (2008)]. First, the spin is initialized by optical pumping into a pure spin-state with 92% fidelity. Next, a single-qubit gate is implemented by rotating the spin about any arbitrary axis using a sequence of two ultrafast optical pulses separated by a time delay. Finally, the spin is measured by detecting single-photon photoluminescence. As a manifestation of controlling the spin with optical pulses, we demonstrate six complete Rabi oscillations between the two spin states, and a complete set of Ramsey interference fringes. The fidelity of our $\pi/2$- and π-rotations exceed 90%. The single-qubit gate is completed in 38 ps, potentially allowing for approximately 10^5 operations within the qubit's expected microsecond coherence time, and quantum information processing with clock speeds exceeding 10 GHz.

David Press
Stanford University

Date submitted: 15 Nov 2008 Electronic form version 1.4