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All-optical coherent control and spin-echo of electron spins bound to neutral donors in GaAs SUSAN CLARK, Stanford University, KAI-MEI FU, Hewlett-Packard Laboratories, QIANG ZHANG, Stanford University, THADDEUS LADD, Stanford University and National Institute of Informatics, Toyko Japan, COLIN STANLEY, H.C. HOLLAND, University of Glasgow, YOSHIHISA YAMAMOTO, Stanford University and National Institute of Informatics, Toyko Japan — Electron spins bound to neutral donors in GaAs are promising systems for quantum information processes. These electron spins form three-level Lambda-type systems that can be manipulated quickly by ultrafast light pulses and have potentially long storage times, making them natural candidates for quantum information manipulation and storage. Unlike quantum dots, they are extremely homogenous, making multi-qubit interactions and entanglement more accessible. Here, we report on our efforts to coherently control these electron spins using fast pulses and an all-optical spin-echo technique. Using three, off-resonant, small-angle (pi/3), ultrafast (2 ps) pulses, we have demonstrated that the spins exhibit an echo signal indicating T2 coherence times much longer than the previously measured 1 ns T2* bulk dephasing time. The visibility of the echo signal for different pulse delays gives us insights into the T2 decoherence time and decoherence processes in this system. Currently, we are measuring coherences as long as 4 microseconds.

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