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Coherent optical manipulation of localized electron-nuclear spin systems in n-GaAs MAKSYM SLADKOV, ALOK U. CHAUBAL, MORTEN P. BAKKER, University of Groningen, The Netherlands, DIRK REUTER, ANDREAS D. WIECK, Ruhr University Bochum, Germany, CASPAR H. VAN DER WAL, University of Groningen, The Netherlands, UNIVERSITY OF GRONINGEN, THE NETHERLANDS TEAM, RUHR UNIVERSITY BOCHUM, GERMANY COLLABORATION — We present studies on ensembles of single-electron systems in GaAs, realized by Si doping at very low concentration. This yields a gas of donor-bound electrons in hydrogen-like orbitals. The Bohr radius is large and each electron spin has hyperfine interaction with around 10^5 nuclear spins. We address this system with a resonant Raman scheme: The electron spin states both have a transition to a common donor-bound trion state. With polarization maintaining fibers to a cryogenic confocal microscope we study spin selective excitations in this medium in transmission. This is used for extending earlier observations of coherent population trapping [PRL 95, 187405 (2005)] to a direct demonstration of electromagnetically induced transparency. However, this requires a long electron spin coherence time, which is hindered by nuclear spin fluctuations. We use the optical control to drive dynamic nuclear polarization effects, which result in stable configurations of the electron-nuclear spin system that are homogeneous over the electron ensemble.

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