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Quantum dot dynamical Quantum dot dynamical nuclear spin polarization in the C.W. LAI, P. MALETINSKY, A. BADOLATO, A. IMAMOGLU, ETH Zurich — Hyperfine interaction in quantum dots (QD) is qualitatively different than in atoms: coupling of a single electron spin to the otherwise well isolated QD nuclear spins plays a key role in spin-based solid-state quantum information processing. Dynamical nuclear spin polarization (DNSP) is observed by resonant optical pumping of single self-assembled QDs in gated structures that allow deterministic charging with a single excess electron or hole. In the absence of external magnetic fields, the optically polarized electron spin induces an effective inhomogeneous magnetic (Knight) field which determines the direction along which the mesoscopic ensemble of nuclear spins could polarize and enables nuclear spin cooling by surpassing depolarization induced by nuclear dipolar interactions. Due to the effective magnetic (Overhauser) field induced by the polarized nuclei, photoluminescence of these charged trion transitions exhibit spin splitting $\approx 15\mu eV$ which can be determined by high-spectral-resolution ($< 1\mu eV$) spectroscopy based on a scanning Fabry-Perot interferometer. Our experiments constitute a first step towards a quantum measurement of the Overhauser field, which is in turn predicted to suppress electron spin decoherence in QDs.

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