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Enhancement of electron spin coherence by optical preparation of nuclear spins DIMITRIJE STEPANENKO, GUIDO BURKARD, University of Basel, GEZA GIEDKE, Max Planck Institute for Quantum Optics, Garching, ATAC IMAMOGLU, ETH Zurich — We study a large ensemble of nuclear spins interacting with a single electron spin in a quantum dot under optical excitation and photon detection. When a pair of applied laser fields satisfy two-photon resonance between the two ground electronic spin states, detection of light scattering from the intermediate exciton state acts as a weak quantum measurement of the effective magnetic (Overhauser) field due to the nuclear spins. If the spin were driven into a coherent population trapping state where no light scattering takes place, then the nuclear state would be projected into an eigenstate of the Overhauser field operator and electron decoherence due to nuclear spins would be suppressed: we show that this limit can be approached by adapting the laser frequencies when a photon is detected. We use a Lindblad equation to describe the time evolution of the driven system under photon emission and detection. Numerically, we find an increase of the electron coherence time from 5 ns to 500 ns after a preparation time of 10 microseconds.

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