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All optical real-time measurement and preparation of nuclear spin states around an individual NV center in diamond EMRE TOGAN, YIWEN CHU, Harvard University, VINCENT JACQUES, ENS Cachan, ALP SIPAHIGIL, ALEXANDER KUBANEK, ADI PICK, MICHAEL GULLANS, Harvard University, ERIC KESSLER, GEZA GIEDKE, Max Planck Institute of Quantum Optics, SUSANNE YELIN, University of Connecticut, IGNACIO CIRAC, Max Plack Institute of Quantum Optics, ATAC IMAMOGLU, ETH Zurih, MIKHAIL LUKIN, Harvard University — Atomic coherence effects such as Coherent Population Trapping (CPT) have many important applications in AMO physics ranging from optical manipulation of atomic spin states, to slow and stopped light as well as sub-recoil laser cooling via Velocity Selective Coherent Population Trapping (VSCPT). In this work we demonstrate measurement and manipulation of electronic and nuclear spin states associated with an NV center in diamond using CPT. To this end we use the recently identified lambda-type two photon transitions in NV centers. The intrinsic magnetic field sensitivity of the CPT allows us to measure the instantaneous Overhauser field associated with the ^{13}C bath. We show that this quantum measurement technique can be used to prepare a state of the ^{13}C bath, which has much smaller uncertainty in the Overhauser field associated with it. Such preparation is verified by observing modification / narrowing of the transmission window. Potential applications include improved coherence properties of the electron spin qubits and all optical magnetic sensing with improved sensitivities.

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