Abstract Submitted
for the DAMOP15 Meeting of
The American Physical Society

Probing nuclear spin dynamics near solid-state atom-like systems via photon statistics SWATI SINGH, ITAMP, Y. CHU, A. PICK, Department of Physics, Harvard University, A. ASPECT, IOTA, Palaiseau, M. LUKIN, Department of Physics, Harvard University, S.F. YELIN, ITAMP and Department of Physics, University of Connecticut — Interaction between an electronic spin and its surrounding nuclear spin environment is a major source of decoherence in most solid-state spin qubits. Recently, optical pumping techniques were used to monitor and control the nuclear bath surrounding such solid state systems. We develop a detailed theoretical model for nuclear spin diffusion of ^{13}C spin bath near an individual Nitrogen Vacancy (NV^-) center in diamond subject to coherent population trapping (CPT) and explain suppression of bath dynamics due to the presence of an electronic dark state. We then develop a random walk model reminiscent of velocity selective coherent population trapping (VSCPT) to understand the anomalous diffusion of nuclear spins in the presence of an electronic dark state. Using this model, we propose a method for probing of non-equilibrium dynamics of the nuclear spin bath by analyzing photon statistics of NV fluorescence.

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Date submitted: 28 Jan 2015 Electronic form version 1.4