Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

A Spin Qubit Coupled to a Photonic Crystal Cavity TIMOTHY SWEENEY, NRC postdoc at the Naval Research Lab, Washington, DC 20375, SAMUEL CARTER, NRL, MIJIN KIM, Sotera Defense Solutions, Annapolis Junction, MD 20701, CHUL SOO KIM, NRL, DMITRY SOLENOV, NRC postdoc at NRL, SOPHIA ECONOMOU, THOMAS REINEKE, NRL, LILY YANG, NRC postdoc at NRL, ALLAN BRACKER, DANIEL GAMMON, NRL — The development of a scalable light-matter quantum interface is an important goal of quantum information research. Photonic crystal (PC) membranes provide an architecture in which the interaction of photons with an optically active matter qubit can be controlled through the introduction of optical cavities and waveguides. Charge neutral quantum dots are commonly integrated into PC architectures and are useful for sources and switches, but do not demonstrate long-lived coherences. A charged quantum dot in a PC environment could lead to a spin-photon quantum interface, where it is the long-lived spin of the electron, not the exciton that serves as a qubit. We demonstrate optical spin initialization and coherent control of an electron in a quantum dot that is embedded in and coupled to a 2D PC membrane cavity. The PC membrane is incorporated into an asymmetric NIP diode that allows for charging of an InAs quantum dot via an applied bias. Resonant laser spectroscopy performed in a transverse magnetic field enables the optical measurement and initialization of the electron spin. Furthermore, with the introduction of detuned control pulses, we perform coherent rotations of the electron spin state. These studies demonstrate several essential accomplishments toward a spin-photon interface.

Timothy Sweeney
NRC postdoc at the Naval Research Lab, Washington, DC 20375

Date submitted: 13 Nov 2012 Electronic form version 1.4