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Coherent control of a single atom in cavity QED T.E. NORTHUP, A.D. BOOZER, R. MILLER, A. BOCA, D. WILSON, H.J. KIMBLE, Caltech — In order to construct cavity QED-based quantum networks, we require both the coherent manipulation of trapped intracavity atoms as well as the ability to map quantum states between the atom and the cavity field. We have demonstrated the reversible transfer of a coherent state of light to and from the hyperfine states of an atom trapped within the mode of a high-finesse optical cavity. [1] Following preparation of an atom in a specific Zeeman state [2], we can also transfer population between hyperfine ground states via Raman transitions, where we make use of an efficient state detection scheme enabled by strong atom-cavity coupling. Here we discuss and quantify the decoherence mechanisms present in the system and present a mapping from a superposition of the atom's Zeeman states onto its hyperfine states, a prerequisite for detection of entanglement between atomic and photonic qubits.

[1]A. D. Boozer, A. Boca, R. Miller, T. E. Northup, and H. J. Kimble, Phys. Rev. Lett. 98, 193601 (2007).
[2]A. D. Boozer, R. Miller, T. E. Northup, A. Boca, and H. J. Kimble, Phys. Rev. A 76, 063401 (2007).

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