Abstract Submitted
for the DAMOP09 Meeting of
The American Physical Society

Atomic quantum superposition state generation via optical probing ANNE E. B. NIELSEN, Lundbeck Foundation Theoretical Center for Quantum System Research, Department of Physics and Astronomy, Aarhus University, DK-8000 Aarhus C, Denmark, UFFE V. POULSEN, ANTONIO NEGRETTI, KLAUS MØLMER — Light is a useful tool to probe the state of matter. Performing measurements on a light field, which has interacted with a system, changes the density operator of the system, and this back action has, e.g., been utilized to spin squeeze atoms. Here, we demonstrate that a similar measurement scheme allows preparation of N spin-1/2 atoms in a superposition of a state with most of the atoms in the spin up state and a state with most of the atoms in the spin down state [1]. The protocol exploits the strong coupling regime of cavity QED, achieved experimentally in [2], to reduce the decoherence effects of light field losses, and we use the stochastic master equation derived in [3] to analyze the performance of the setup. In addition to a continuous coherent state probe, we also investigate probing with a continuous beam of squeezed light. Probing with a slightly squeezed vacuum can improve the protocol. [1] A. E. B. Nielsen et al, arXiv:0812.4048. [2] F. Brennecke et al, Nature **450**, 268 (2007); Y. Colombe et al, Nature **450**, 272 (2007). [3] A. E. B. Nielsen et al, Phys. Rev. A **77**, 052111 (2008).

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Date submitted: 23 Jan 2009 Electronic form version 1.4