Abstract Submitted
for the DAMOP05 Meeting of
The American Physical Society

Coherence time of a cold atomic ensemble as a quantum memory

C. W. CHOU, Department of Physics, Caltech, D. FELINTO, H. DE RIEDMATTEN, S. POLYAKOV, H. J. KIMBLE — In the quantum communication scheme proposed by Duan, Lukin, Cirac, and Zoller (DLCZ)[1], two distant ensembles of atoms can be entangled through the concepts of quantum repeaters. Since the scheme is probabilistic, long coherence time is essential for a scalable quantum network. However, in all experiments reported so far that employ cold atomic ensembles for the DLCZ protocol [2], the coherence times were short (of the order of 100 ns). The major cause of decoherence is identified as the inhomogeneous broadening of the atomic ground states due to the quadrupole magnetic field of the magneto-optical trap (MOT). We have developed a theory to describe this decoherence and made comparisions to the observed rate of decay of field correlations. We have also developed a technique to probe the effect of the magnetic field on the coherence time by way of in situ Raman spectroscopy between hyperfine ground states. By fast switching of the quadrupole magnetic field and nulling the residual magnetic field, we improved the coherence time to a few microseconds. Other solutions that we are investigating include utilizing a field-insensitive set of states for the DLCZ protocol.
[1] Duan, L.-M., et. al, Nature 414, 413 (2001) [2] A. Kuzmich, et, al, Nature 423 726-729 (2003), C. W. Chou et. al, Phys. Rev. Lett. 92, 213601 (2004), S. Polyakov et al, Phys. Rev. Lett. 93, 263601 (2004), D. N. Matsukevich and A. Kuzmich, Science 306, 663(2004)

Chin-wen Chou
Caltech

Date submitted: 28 Jan 2005 Electronic form version 1.4