Abstract Submitted
for the DAMOP07 Meeting of
The American Physical Society

Sideband cooling while preserving the nuclear spin state of alkaline-earth-like atoms IRIS REICHENBACH, IVAN DEUTSCH, University of New Mexico — Alkaline-earth-like atoms in the ground state have a total electron angular momentum of zero, and therefore no hyperfine interaction which couples the nuclear spin to the angular momentum of the electrons. By applying a magnetic field in the Paschen-Back regime, it is possible to also decouple the nuclear spin of higher-lying states from the electron angular momentum. We propose a scheme which uses these features to perform resolved sideband cooling without changing the state of the nuclear spin, thus preserving coherences which are usually destroyed due to optical pumping during laser cooling. This makes it possible for the first time to laser-cool neutral atom qubits without destroying the quantum information, if the quantum information is stored in the nuclear spin of the atom. The cooling scheme is explained on the example of ^{171}Yb and ^{87}Sr.

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Date submitted: 02 Feb 2007 Electronic form version 1.4