Abstract Submitted
for the DAMOP10 Meeting of
The American Physical Society

Bichromatic force slowing of He* for ultracold atom production[1]

M.A. CHIEDA, E.E. EYLER, University of Connecticut Department of Physics — Magneto-optical traps (MOTs) for metastable helium are particularly difficult to load, usually requiring Zeeman slowers with a length of 2-3 meters and a high degree of engineering complexity. The bichromatic force offers an alternative approach to deceleration of a He* beam that should allow a significantly simpler and much more compact apparatus. Based on controlled phasing of absorption and stimulated emission from a pair of counterpropagating beams, it can be orders of magnitude stronger than the radiative force. Slowing of He* by as much as $\Delta v = 325$ m/s has been previously demonstrated, but in order to bring atoms to near-rest, the technique must be extended to $\Delta v \approx 900$ m/s. We are conducting computer modeling and experimental studies of two approaches to this challenge. The first is a two-stage slower, each with a bichromatic detuning of about ± 375 MHz from the appropriate center velocity. The second is a frequency-chirped single-stage slower in which the frequencies of a pair of lasers are swept to compensate the Doppler shift of the decelerating atoms.

[1]This work was supported by the University of Connecticut and the NSF.

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Date submitted: 26 Jan 2010 Electronic form version 1.4