Abstract Submitted
for the DAMOP13 Meeting of
The American Physical Society

The Bichromatic Optical Force on the Atomic Life- time Scale[1]
CHRISTOPHER CORDER, BRIAN ARNOLD, HAROLD METCALF, Physics and Astronomy, Stony Brook University, 11794-3800 — Our experimental and theoretical studies of the bichromatic force (BF) have shown that its strength and velocity range are very much larger than those of the usual radiative force.[2] Since the BF relies on stimulated effects, the role of spontaneous emission in laser cooling has come into question.[3] We drive the $2^3S \rightarrow 3^3P$ transition of He at $\lambda = 389$ nm with laser frequencies $\omega_\ell = \omega_a \pm \delta$, where ω_a is the atomic transition frequency and $\delta \sim 30$ MHz. Thus the velocity range of the force is $\Delta v \sim \delta/2k = 6$ m/s. Because of the large and nearly constant strength of the BF, $F \sim \hbar k \delta/\pi$, all atoms can reach the velocity limit in a time $\leq M\Delta v/F = \pi/4\omega_r = 380$ ns, where ω_r is the atomic recoil frequency. In our experiment a beam of He atoms crosses perpendicular through the BF laser beams in 380 ns so the relatively long lifetime of the excited state ($\tau = 106$ ns) allows one or at most two spontaneous emission events, despite Δv of many tens of recoils. We will present our initial measurements of the BF in this new domain.

[1]Supported by ONR and Dept. of Ed. GAANN
[2]Phys. Rev. Lett. **93** 213004 (2004), Phys. Rev. A **70**, 063402 (2001)
[3]Phys. Rev. A **77**, 061401 (2008)

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Date submitted: 24 Jan 2013 Electronic form version 1.4