Abstract Submitted
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A Bright Metastable Helium Beam for Neutral Atom Lithography[1] M. PARTLOW , (Now at Univ. Toronto), X. MIAO, J. BOCHMANN, (Now at MPI - Garching), M. EARDLEY , H. METCALF, Physics, Stony Brook Univ., Stony Brook, NY 11794-3800 — We have used non-monochromatic light to produce large optical forces over a wide range of atomic speeds, e.g., slowing a beam of metastable helium (He*)[2]. Our He* beam has now been brightened by active collimation[3] using large transverse bichromatic forces on the $2^3S_1 \rightarrow 2^3P_2$ transition at $\lambda = 1083$ nm. An LN_2 cooled discharge source yielding 10^{14} atoms/sr-s with $\overline{v} \approx 1000$ m/s forms the beam. We have captured atoms from a transverse velocity range of $\pm$ 87 m/s (175 mrad cone) in an interaction length of only 5 cm comprised of four interaction regions. The collimated beam has an integrated flux of 1.4×10^{11} atoms/s and thus contains $\sim 1/4$ of the total source output. Further collimation with a subsequent optical molasses yields an overall increase in brightness by a factor of 4100. Small improvements to the collimation will produce a flux density high enough to expose a resist for atomic nanolithography in less than one minute. The bichromatic detuning was $\delta = \pm 2\pi \times 60\,\mathrm{MHz}\,(\pm 37\gamma)$. For this δ, the bichromatic force is optimum for $I \sim 0.7$ W/cm^2 ($4100 \times I_{sat}$) for each of four frequencies. The light originates from a single, extended-cavity DBR diode laser and is injected into two fiber amplifiers.

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[2]M. Cashen and H. Metcalf, *J. Opt. Soc. Am. B* **20**, 915 (2003).
[3]M. Partlow et al., *Phys. Rev. Lett.* **93**, 213004 (2004).

Harold Metcalf
Stony Brook

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