A Bright Metastable Helium Beam for Neutral Atom Lithography\textsuperscript{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-monomochromatic light to produce large optical forces over a wide range of atomic speeds, e.g., slowing a beam of metastable helium (He\textsuperscript{*})\textsuperscript{2}. Our He\textsuperscript{*} beam has now been brightened by active collimation\textsuperscript{3} using large transverse bichromatic forces on the 2\textsuperscript{3}S\textsubscript{1} \rightarrow 2\textsuperscript{3}P\textsubscript{2} transition at $\lambda = 1083$ nm. An LN\textsubscript{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 $1.4 \times 10^{11}$ 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 $\delta = \pm 2\pi \times 60$ MHz ($\pm 37\gamma$). For this $\delta$, 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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