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Laser Cooling Without Spontaneous Emission Using the Bichromatic Force[1] CHRISTOPHER CORDER, BRIAN ARNOLD, XIANG HUA, HAROLD METCALF, Physics Dept., Stony Brook University, Stony Brook NY 11794-3800 — We have demonstrated laser cooling without spontaneous emission using the bichromatic force (BF).[2,3] It works by restricting the atom-light interaction to a time short compared to a cycle of absorption followed by spontaneous emission. The BF exploits multiple absorption-stimulated emission cycles to cause many rapid momentum exchanges, with these cycles redistributing both energy and entropy between the atoms and light fields in the total atoms+light system. This momentum exchange is restricted to a well-defined velocity range, resulting from nonadiabatic transitions at a velocity that can be understood from simple energy conservation. The observed width of our one-dimensional velocity distribution is reduced by $\times 2$ thereby reducing the "temperature" by $\times 4$. Moreover, our results comprise a compression in phase space because the spatial expansion of the atomic sample is negligible. We have also done various simulations of the motion of atoms under the BF and they compare well with our data. This accomplishment is of interest to direct laser cooling of molecules or in experiments where working space or time is limited.

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[2]C. Corder et al., Phys. Rev. Lett. **114**, 043002 (2015).
[3]C. Corder et al., J. Opt. Soc. Am. B, submitted.

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