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Sub-Doppler Cooling of Neutral Atoms in a Grating Magneto-Optical Trap[1] J.A. GROVER, J. LEE, L.A. OROZCO, S.L. ROLSTON, Joint Quantum Institute, Dept. of Physics, UMD and NIST, College Park, MD 20742, USA — The recent demonstration of a grating magneto-optical trap (GMOT) for ^{87}Rb presents an advancement in the field of atom traps [1]. The system requires only a single beam and three planar diffraction gratings to form an accessible cloud of cold atoms above the plane of the diffractors. Here we demonstrate further sub-Doppler cooling of the atoms to a temperature of 7.6(0.6) μK through a multi-stage, far-detuned MOT in conjunction with optical molasses. A decomposition of the electric field into polarization components for this geometry does not yield a mapping onto standard sub-Doppler cooling configurations. With numerical simulations, we find that the polarization composition of the GMOT optical field, which includes both σ- and π-polarized light, does indeed produce sub-Doppler temperatures. We also discuss the integrability of the GMOT with an optical nanofiber trap as a step towards creating a hybrid quantum system that couples atoms to superconducting circuits.

[1] M. Vangeleyn *et al.*, Opt. Lett. **35**, 3453 (2010).

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