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**Effects of Electromagnetically Induced Transparency on Laser Cooling of Three-Level Atoms**[1] JOSH W. DUNN, JILA and University of Colorado, FLAVIO C. CRUZ, JILA and Universidade Estadual de Campinas, J. W. THOMSEN, The Niels Bohr Institute, CHRIS H. GREENE, JILA and University of Colorado — We present a theoretical investigation of laser-cooling schemes involving three internal atomic levels and two lasers. Such configurations can occur for a variety of atomic systems, in the form of either ladder- ($\Xi$), lambda- ($\Lambda$), or V-type three-level systems, and are common in alkaline-earth-metal atoms. Experimental evidence for sub-Doppler temperatures in these configurations exists [1], although previous theoretical and experimental work is limited in extent. We utilize novel sparse-matrix numerical techniques to find exact solutions to the atom-laser master equation, including quantized center-of-mass atomic motion. Use of such fully quantum calculations allows quantitative estimates of expected experimental temperatures. We discuss the results of a thorough exploration of parameter space, including the various regimes of intensities for each of the lasers, and their detunings, independently. The effectiveness of cooling for different atomic species is also explored. Our analysis leads to an intuitive physical picture of how these cooling schemes work, and in particular we explain the important role played by electromagnetically induced transparency (EIT) effects. [1] N. Malossi et al., Phys. Rev. A **72**, 051403 (2005).

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