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Ultracold atoms in an optical lattice one millimeter from air DYLAN JERVIS, GRAHAM EDGE, STEFAN TROTZKY, DAVID MCKAY, JOSEPH THYWISSEN, University of Toronto — Over the past decade, ultracold atoms in optical lattices have shown to be versatile systems able to realize canonical Hamiltonians of condensed matter. High-resolution in-situ imaging of ultracold clouds has furthermore enabled thermometry, equation of state measurements, direct measurement of fluctuations, and unprecedented control. We report on microscopy of ultracold bosons and fermions in a novel configuration where the atoms are harmonically trapped 800 microns away from a 200 micron-thick vacuum window. This window also serves as a retro-reflecting mirror for an optical lattice, into which the atoms can be loaded. Two additional transverse standing waves complete the three-dimensional lattice setup. In free space, we have shown that laser cooling with 405 nm light, on the open $4S_{1/2}$-$5P_{3/2}$ transition, allows for temperatures below the Doppler temperature of the $4S_{1/2}$-$4P_{3/2}$ cycling transition at 767 nm. Microscopy with 405 nm light furthermore reduces the diffraction limit of in-situ imaging.

Joseph Thywissen
University of Toronto

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