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Three dimensional cooling of an optically trapped microsphere to millikelvin temperatueres SIMON KHEIFETS, TONGCANG LI, DAVID MEDELLIN, MARK RAIZEN, University of Texas at Austin — An optically trapped microsphere is appealing as a quantum opto-mechanical system for two reasons: in vacuum it is completely decoupled from thermal vibration, and the trap can be switched off to allow time-of-flight measurements analogous to those done in cold atom experiments. We have trapped glass microspheres in air and vacuum, and measured the position of a trapped bead in three dimensions with sufficient spatial and temporal resolution to observe the instantaneous velocity of the bead's Brownian motion in air. Knowledge of the bead's velocity allows us to actively apply a cold damping force, which we have used to successfully cool the center of mass motion of the bead from room temperature to millikelvin temperatures, in three dimensions. The coldest temperature we have achieved so far, for one of the modes of the optical trap, is 1.5mK.

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