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High Speed Video Measurements of a Magneto-optical Trap[1]
LUKE HORSTMAN, CURTIS GRABER, SETH ERICKSON, ANNA SLATTERY, CHAD HOYT, Bethel University — We present a video method to observe the mechanical properties of a lithium magneto-optical trap. A sinusoidally amplitude-modulated laser beam perturbed a collection of trapped ^7Li atoms and the oscillatory response was recorded with a NAC Memrecam GX-8 high speed camera at 10,000 frames per second. We characterized the trap by modeling the oscillating cold atoms as a damped, driven, harmonic oscillator. Matlab scripts tracked the atomic cloud movement and relative phase directly from the captured high speed video frames. The trap spring constant, with magnetic field gradient $b_z = 36$ G/cm, was measured to be $4.5 \pm .5 \times 10^{-19}$ N/m, which implies a trap resonant frequency of 988 ± 55 Hz. Additionally, at $b_z = 27$ G/cm the spring constant was measured to be $2.3 \pm .2 \times 10^{-19}$ N/m, which corresponds to a resonant frequency of 707 ± 30 Hz. These properties at $b_z = 18$ G/cm were found to be $8.8 \pm .5 \times 10^{-20}$ N/m, and 438 ± 13 Hz.

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