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Theory and Testing of a Harmonic Trap for Atom Interferometry MATTHEW SQUIRES, JAMES STICKNEY, Air Force Research Laboratory, JOHN BURKE, Utah State University, EVAN CARLSON, STEFAN FAGAN-KELLY, STEPHEN MAKSIM, STEVEN MILLER, Air Force Research Laboratory — The coherence time of a cold/ultra-cold atom interferometer is dependent on multiple factors. For the purposes of atom interferometry the "mirrors" that form the arms of the atom interferometer are a source of decoherence. An atom interferometry mirror is commonly a well defined laser pulse or the classical turning points of the atoms oscillating in the trapping potential. In an ideal situation all of the atoms will experience the same phase change at the mirror. However, in practice there is a velocity dependent phase change for laser pulse mirrors and the classical turning points. In the classical turning point case, the velocity dependence can be eliminated by creating an ideal harmonic potential so the oscillation period is independent of the energy. We have analyzed and tested the conditions necessary to create a nearly ideal harmonic potential using a standard Ioffe-Prichard trapping configuration with a variable coil spacing. The optimal coil spacing that cancels the 4th order contribution to the trapping potential is $L/R \approx 1.2$ where $2L$ is the distance between the coils and R is the coil radius. The 6th order contribution to the potential may also be minimized by operating slightly from the point where the 4th order contribution is canceled.

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