Abstract Submitted
for the DAMOP08 Meeting of
The American Physical Society

Using Spin Echo Techniques to Measure and Null Background Magnetic Fields in Cold Atom Experiments AARON SMITH, University of Arizona — Quantum control of atomic spins requires precise control of the total magnetic field acting on the spins. This makes accurate nulling of the (generally time dependent) background magnetic field one of the most important limiting factors of a real-world control experiment. We have devised a convenient method to use the atoms themselves as an in situ probe, combining spin-echo techniques and polarization spectroscopy to generate a highly sensitive signature of a desired component of the field. This allows us to quickly and independently measure three orthogonal components of the total field with a resolution of a few tens of μG in a bandwidth of $\sim$1kHz, and to apply the inverse of the measured field with three sets of Helmholtz coils driven by arbitrary waveform generators. The resulting background field is typically less than $\sim 50\mu$G rms averaged over a 10 ms window, an overall reduction of about one order of magnitude compared to the uncompensated AC field in our laboratory.

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Date submitted: 31 Jan 2008 Electronic form version 1.4