TITLE: Measurement of Phonon Angular Momentum via the Einstein-de Haas Effect, Fiber-Optic Interferometry, and a High-Q Oscillator

<everyone on project>

Abstract:

We report initial design and use of capacitive and fiber-optic-interferometer systems to measure the predicted[1] macroscopic phonon angular momentum. An oscillating magnetic field is applied to an insulating ferromagnet attached to our single-crystal high-Q double torsional oscillator. By the Einstein-de Haas effect, oscillator displacement measurements compared between liquid-nitrogen-temperatures and those closer to the Debye temperature allow extraction of the phonon angular momentum. We predict a force change of 5 x 10­^(-7) N for a 1mm^3 MgZn sample, which is easily measurable via a capacitive force sensitivity of 6.6 x 10^14 N and an interferometer force sensitivity of 2.3 x 10^10 N at a resonance of 2.252 Hz. Competing effects are being minimized; for example, induced eddy current momentum can overwhelm the phonon effect for metallic ferromagnets.