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 1 mm^3 MgZn ferrite sample, which should be easily measurable: our oscillator, with a resonance at 2.25 kHz, has a thermal noise limit of ~6 x 10^-14 N/\sqrt{Hz}. With capacitive detection, we currently achieve a force noise of ~10^-8 N/\sqrt{Hz}, and interferometer detection will improve our force sensitivity to about 2 x 10^-11 N/\sqrt{Hz}. Competing effects are being minimized; for example, induced eddy current momentum can overwhelm the phonon effect for metallic ferromagnets.

[1] Niu---add reference