Chez Pierre

Presents ...

Friday, November 14, 2025
12:00 pm - 1:00 pm
Duboc Room – 4-331

Special Chez Pierre Seminar

Brad Ramshaw, Cornell University

"Phonons with a Twist: Measuring the Phonon Hall Viscosity in a Proposed Quantum Spin Liquid"

The thermal Hall effect - where a temperature gradient develops perpendicular to both a heat current and an applied magnetic field - has emerged unexpectedly in a wide range of insulating materials. These include the Mott-insulating parent compounds of cuprate superconductors, several proposed spin-liquid candidates, strontium titanate, and, more recently, almost everything. This raises fundamental questions: Are these thermal Hall effects driven by intrinsic coupling between heat carriers and magnetic fields? What are the heat carriers? And can we trust the data?

RuCl3 has been at the center of this debate, initially proposed to host chiral Majorana edge modes that produce a quantized thermal Hall effect. Competing explanations invoke phonon skew scattering off magnetic impurities - an extrinsic mechanism.

I will introduce the concept of phonon Berry curvature and show how it gives rise to phonon Hall viscosity - a dissipationless viscosity that rotates phonon polarizations and bends their trajectories, generating a thermal Hall effect. I will then show how we use ultrasonic measurements of the acoustic Faraday effect to directly probe phonon Hall viscosity. Our results reveal that phonons in RuCl3 exhibit a Hall viscosity that both qualitatively and quantitatively accounts for the observed thermal Hall effect. This finding overturns both prevailing views: the thermal Hall effect in RuCl3 is neither extrinsic nor is it due to Majorana edge modes. Instead, it arises from intrinsic coupling between lattice and spin degrees of freedom.

More broadly, I will argue that the acoustic Faraday effect is a powerful tool for detecting phonon Hall viscosity and the associated Berry curvature in gapped topological states of matter. I will also comment on the current state of thermal transport experiments and give a possible explanation for the unexpected abundance of insulators with thermal Hall effects.