Steve Winter

Title: Effective Hamiltonians and Thermal Hall Effect in Quantum Magnets

Abstract: Quantum materials represent a broad class of systems whose experimental response relies on uniquely quantum aspects such as entanglement, Berry phases, and electronic correlations. Modeling of such materials presents challenges related to a variety complex behaviours that manifest at different energy scales. In this field, first-principles approaches often provide a vital bridge between experiments and theoretical models. In this talk, I will introduce our numerical strategies for systematically building low-energy models with local spin, orbital, and lattice degrees of freedom of arbitrary complexity. I will discuss the insights that these methods have yielded for the phononic thermal Hall effect in the quantum magnet RuCl3. In particular, we have shown that essentially all experimental observations can be reproduced by careful consideration of the acoustic phonon Berry curvature induced by anisotropic spin-phonon coupling, which we completely parameterize using our first principles approach. This general approach represents a material-specific method for addressing the phenomenology of spin-phonon coupling effects on thermal transport, which can be easily applied to other materials.