Lattice Hall effects

Dominik Juraschek

Eindhoven University of Technology

The thermal Hall effect describes the generation of a transverse heat current arising from a longitudinal thermal gradient, which in semiconductors and insulators is primarily carried by collective excitations, such as phonons and magnons. In recent years, the phonon Hall effect has been shown to be ubiquitous in crystalline solids, including materials ranging from simple semiconductors to ferroelectrics and high-temperature superconductors. Here, we generalize the phonon Hall effect to different types of lattice excitations, including chiral phonons and ferrons. Specifically, I will present three recent predictions of novel Hall responses of the crystal lattice: First, the phonon angular momentum Hall effect, in which a transverse angular momentum current is generated similar to the conventional spin Hall effect [1]. Second, the ferron Hall effect, in which a transverse polarization current is generated by a magnetic field [2]. Third, the phonon polariton Hall effect, in which light is deflected by a magnetic field when traveling through a dielectric material [3].

[1] Bustamante Lopez, Brehm, and Juraschek, arXiv:2604.01899.

[2] Bustamante Lopez and Juraschek, in preparation.

[3] Yaniv and Juraschek, arXiv:2509.16100.