Entropy transport in Weyl semimetals with topologically protected charge carriers

J. P. Heremans

Department of Mechanical & Aerospace Engineering, Ohio State University, Columbus, OH 43210, USA

Weyl semimetals are solids with bulk Dirac bands and topologically protected surface states. By combining charge with entropy transport, their thermal and thermoelectric transport properties carry unique signatures of these topological properties. In this talk, we show how the electronic thermal conductivity is theoretically enhanced in the presence of a longitudinal magnetic field. This effect is due to the force the magnetic field exerts on the charge carriers in the surface states under the proper alignment: this force creates a circulating topologically protected current of electrons and holes through the sample that results in zero charge current. Yet, because the entropy is not dependent on the polarity of the carrier, the same force is predicted to greatly enhance heat transport. A second effect is a transverse Nernst thermopower over two orders of magnitude larger than the regular Seebeck effect. This is demonstrated experimentally on NbP and explained by a theoretical model devoid of adjustable parameters, which relies solely on the charge neutrality in te sample and again the perfect compensation between the electron and hole parts of the Dirac dispersion.