Signatures of Dirac and Weyl physics in thermal transport properties

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Combined entropy and charge transport in Weyl semimetals reveal unique signatures of the topological features in their band structure and their surface states. Three such effects will be reviewed in this talk. First, the transverse Nernst thermopower of NbP in a magnetic field is over two orders of magnitude larger than the Seebeck effect and has a pronounced maximum in its temperature dependence. This will be shown to be a signature of Dirac dispersions. Second, its electronic thermal conductivity is theoretically enhanced in the presence of a longitudinal magnetic field. Indeed, the force the magnetic field exerts on the charge carriers in the surface states 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. Third, in Weyl semimetals with a non-zero net Berry curvature integrated over the Fermi surface, there is

a non-zero Nernst thermopower even at zero field because the Berry curvature itself acts like a magnetic field in k-space. Such effect is observed in $YbMnBi_2$.