Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Axion field theory, chiral anomaly and anomalous non-dissipative transport properties of (3+1)-dimensional Weyl semi-metals and superconductors[1] PALLAB GOSWAMI, National High Magnetic Field Laboratory and Florida State University, SUMANTA TEWARI, Department of Physics and Astronomy, Clemson University — From a direct calculation of the anomalous Hall conductivity and an effective electromagnetic action obtained via Fujikawa's chiral rotation technique, we conclude that an axionic field theory with a non-quantized coefficient describes the electromagnetic response of the (3+1)-dimensional Weyl semi-metal. The coefficient is proportional to the momentum space separation of the Weyl nodes. Akin to the Chern-Simons field theory of quantum Hall effect, the axion field theory violates gauge invariance in the presence of the boundary, which is cured by the chiral anomaly of the surface states via the Callan-Harvey mechanism. A direct linear response calculation also establishes an anomalous thermal Hall effect and a Wiedemann-Franz law. But, thermal Hall conductivity does not directly follow from the well known formula for the (3+1)-dimensional gravitational chiral anomaly. By calculating the gravitational chiral anomaly at finite temperature we show the existence of a new term, which correctly accounts for the thermal Hall effect in (3+1)-dimensional Weyl materials, topological insulators and topological superconductors.

[1]NSF

Pallab Goswami
National High Magnetic Field Laboratory and Florida State University

Date submitted: 09 Nov 2012 Electronic form version 1.4