Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Anomalous thermal Hall effect in a disordered Weyl ferromagnet ATSUO SHITADE, RIKEN Center for Emergent Matter Science — Thermal Hall effect is a heat analog of the Hall effect, namely, the heat current flows perpendicular to a temperature gradient. According to the Wiedemann-Franz law, the Lorenz ratio $L^{ij} \equiv \kappa^{ij}/T\sigma^{ij}$ goes to the universal Lorenz number $L_0 \equiv \pi^2 k_B^2/3e^2$ as $T \to 0$, in which σ^{ij} and κ^{ij} are the electric and thermal (Hall) conductivities and T is temperature. At finite temperature, we can investigate effects of inelastic scattering by the breakdown of the Wiedemann-Franz law. In spite of its usefulness, it is theoretically difficult to calculate $T\kappa^{xy}$ because it is not expressed by the Kubo formula $T\tilde{\kappa}^{xy}$ alone but is corrected by the heat magnetization $2M_{Qz}$. Recently, I found a gravitational vector potential coupled to the energy current and established the Keldysh formalism to calculate $T\tilde{\kappa}^{xy}$ and $2M_{Qz}$ even in disordered or interacting systems [1]. Here I apply this formalism to a disordered Weyl ferromagnet which exhibits the anomalous (thermal) Hall effect. I first quantum-mechanically calculate σ^{ij} and $T\kappa^{ij}$ on an equal footing and reproduce the Wiedemann-Franz law. This is the first step towards a unified theory of the anomalous Hall effect at finite temperature, in which inelastic scattering by magnons is relevant. [1] A. Shitade, Prog. Theor. Exp. Phys. 2014, 123I01 (2014).

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Date submitted: 27 Sep 2016 Electronic form version 1.4