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Anomalous transverse thermal and thermoelectric response in topological magnets

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报告摘要：We present our recent results on electric, thermal and thermoelectric response in noncollinear antiferromagnets Mn3X (X= Sn, Ge), which hosts a large anomalous Hall effect (AHE) Berry curvature generates off-diagonal thermal (Righi-Leduc) and thermoelectric (Nernst) signals, which are detectable at room temperature and invertible with a small magnetic field. In Mn3Sn, the thermal and electrical Hall conductivities respect the Wiedemann-Franz law, implying that the transverse currents induced by the Berry curvature are carried by Fermi surface quasiparticles. We also show the finite-temperature violation of the Wiedemann-Franz correlation in Mn3Ge, contrast to the case of Mn3Sn, is caused by a mismatch between the thermal and electrical summations of the Berry curvature. Our results demonstrate a new route to violating the Wiedemann-Franz law in the topological transport. Then we show that the domain walls of Mn3Sn system generate an additional contribution to the Hall conductivity tensor and a transverse magnetization. The former is an electric field lying in the same plane with the magnetic field and electric current and therefore a planar Hall effect. We demonstrate that in-plane rotation of spins inside the domain wall would explain both observations and the clockwise or anticlockwise chirality of the walls depends on the history of the field orientation and can be controlled. By studying Co3Sn2S2, another topological half-metallic semimetal hosting sizable and recognizable ordinary and anomalous Nernst responses, we demonstrate an anti-correlation between the amplitude of ANE and carrier mobility. We argue that the observation, paradoxically, establishes the intrinsic origin of the ANE in this system. We conclude that various intrinsic off-diagonal coefficients are set by the way the Berry curvature is averaged on a grid involving the mean-free-path, the Fermi wavelength and the de Broglie thermal length.

报告人简介：朱增伟，国家第十批青年千人计划入选者，教授，博士生导师。2003年本科毕业于浙江师范大学，2009年博士毕业于浙江大学，其中2008年9月到2009年8月在法国巴黎市立高等工业物理化学院（ESPCI）联合培养一年。2010年2月到2012年7月于ESPCI做博士后，从事半金属中的热、电输运研究工作。2012年10月到2014年6月在美国洛斯阿拉莫斯国家实验（LANL）、美国国家强磁场实验室脉冲强磁场设施(NHMFL)开展半金属在脉冲强磁场下的特殊物性研究。2014年6月加入华中科技大学国家脉冲强磁场科学中心。研究领域——凝聚态物理：极低温和脉冲强磁场等极端条件下的材料物性研究。

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Photograph by Xiaodong Hu