北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Seminar

Unconventional anomalous Hall effect in transition metal compounds

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Venue: Room W563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

Abstract

Anomalous Hall effect (AHE) reflects rich physics related to the quantum nature of electrons, such as Berry phase, quantum-phase interference, and spin-orbit interaction; it also attracts attention from an application point of view, in particular, related to spintronics. The mechanism of AHE is often classified into two groups: intrinsic mechanism related to the Berry curvature of electronic bands, and extrinsic mechanism related to the impurity scattering. In addition to these two mechanisms, it was recently discovered that non-trivial magnetic textures also give rise to AHE, so-called topological Hall effect. These mechanisms or combinations thereof well explains the observed AHE in low temperatures. On the other hand, in a finite temperature, many materials sometimes show unusual behavior, such as enhancement of AHE, the sign change of anomalous Hall conductance, and unconventional scaling behavior. As these phenomena often take place in a high temperature comparable to the critical temperature, it is likely to be related to fluctuation effects. However, unlike the temperature effect in extrinsic mechanisms, the temperature effect in the topological Hall effect is less understood.

In this talk, we theoretically study the effect of fluctuations in the topological Hall effect, and show that the fluctuating spins give rise to another mechanism for the Hall effect [1]. The competition of the topological Hall effect and this mechanism may explain the observed sign change of topological Hall resistivity in MnGe. A similar physics may also appear when the impurities locally break the inversion symmetry [2,3]. This mechanism may contribute to AHE in centrosymmetric compounds, where the topological Hall effect by skyrmions is absent.

[1] H. Ishizuka and N. Nagaosa, Sci. Adv. **4**, eaap9962 (2018).
[2] D. Zhang, *et al*, Phys. Rev. B **97**, 184433 (2018).
[3] H. Ishizuka and N. Nagaosa, preprint (arXiv:1806.06833).

About the speaker

Prof. Dr. Hiroaki Ishizuka obtained his PhD from Department of Applied Physics in University of Tokyo in 2013 under a supervise of Yukitoshi Motome. Then, he did a postdoc research in UCSB under a supervise of Leon Balents (2013-2015). Since December of 2015, he has been an assistant professor in Naoto Nagaosa's group in University of Tokyo.