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Title of the Presentation: Field-tunable toroidal moment and anomalous Hall effect in noncollinear antiferromagnetic Weyl semimetal $Co_{1/3}TaS_2$

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Short Biography:

Pyeongjae Park received his BS degree in Physics from Yonsei University (2016). Supervised by Prof. Je-Geun Park, he is currently a Ph.D. student at Seoul National University. His research interest includes magnetism in metallic and noncollinear antiferromagnets, and band topology in magnetic materials.

Abstract:

Combining magnetism with band topology provides various novel phenomena that are otherwise impossible. While anomalous Hall effect (AHE) in metallic ferromagnets is the representative example, the large potential may lie in antiferromagnets; they provide several interesting situations and could, in principle, offer unseen properties arising simply from the enormous number of possible spin configurations [1]. However, due to the lack of suitable materials, only a few studies have successfully materialized the untapped potential of antiferromagnetic metallic systems, especially with triangular lattice antiferromagnets.

This work reports that metallic triangular antiferromagnet $Co_{1/3}TaS_2$ exhibits a substantial AHE related to its noncollinear magnetic order. Our first-principles calculations found that hourglass Weyl fermions from the non-symmorphic symmetry trigger AHE. We further show that AHE in $Co_{1/3}TaS_2$ can be characterized by a field-tunable *toroidal dipole moment*, a vortex-like multipole component distinct to magnetic multipoles. Combined with the possibility of mechanical exfoliation, $Co_{1/3}TaS_2$ is a rare metallic magnet offering a chance of studying noncollinear antiferromagnetism and relevant topological properties in both three and two-dimension.

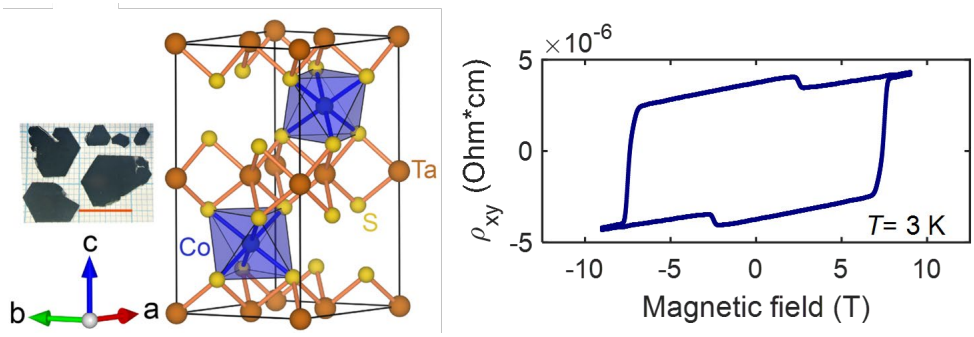

Fig. 1. (Left) A crystallographic unit cell of $Co_{1/3}TaS_2$ and its single crystal. (Right) Field dependence of Hall resistivity ρ_{xy} in $Co_{1/3}TaS_2$ at 3 K.

[1] L. Šmejkal *et. al.*, arXiv:2107.03321 (2021)