Angle Dependent Magnetotransport in Cd_3As_2 Thin Films

I. A. Leahy[1], **A. D. Rice**[1], **H. Ness**[2], **J. N. Nelson**[1], **M. van Schilfgaarde**[1], **and K. Alberi**[1,3]

[1]*National Renewable Energy Laboratory, Golden, Colorado 80401, USA*

[2]*Department of Physics, King's College London, Strand, London WC2R 2LS, UK*

[3]*Renewable and Sustainable Energy Institute, National Renewable Energy Laboratory and University of Colorado, Boulder, 80301, CO, United States*

Measurements of the magnetic field angle dependence of magnetotransport have become very popular in the study of topological semimetals, potentially containing information about Fermi surface anisotropy, magnetocrystalline anisotropy, or mobility anisotropy[1-3]. Here, we report on a detailed analysis of angle dependent magnetotransport in (001) Cd_3As_2 thin films of varying carrier densities. We identify a range of possible behaviors depending on mobility and carrier density. Most strikingly, we find a large, positive magnetoresistance (MR) for both $H||I$ and $H \perp I$ (black trace in Fig. 1), contingent on the direction of the applied current and sample carrier density. In the $H \parallel I$ configuration, this large MR can evolve from negative longitudinal MR at low magnetic fields. Using an 8 x 8 $k \cdot p$ model in a magnetic field and linear response theory, we calculate the theoretical field angle and field magnitude dependence of the longitudinal and Hall resistivities, finding nontrivial dependence on the Fermi energy, which we compare to our experimental results.

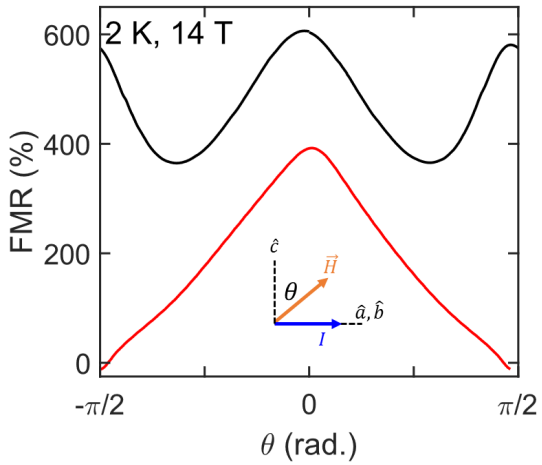

Figure 1: 2 K, 14 T Fractional magnetoresistance ($FMR = \rho_{xx} - \rho_0/\rho_0 * 100\%$) for two (001)-$Cd_3As_2$ samples with differing carrier densities and in-plane current directions.

References:

[1] A. Collaudin, B. FauquAngle, Y. Fuscya, W. Kang, and K. Behnia, *Angle Dependence of the Orbital Magnetoresistance in Bismuth*, Physical Review X, 5, 021022 (2015).

[2] J. Wang, H. Yang, L. Ding, W. You, C. Xi, J. Cheng, Z. Shi, C. Cao, Y. Luo, Z. Zhu, J. Dai, M. Tian, and Y. Li, *Angle-dependent MR and its implications for Lifshitz transition in W_2As_3*, npj quantum materials, 4, 58 (2019).

[3] S. Ghosh, A. Low, N. Devaraj, S. Changdar, A. Narayan, S. Thirupathaiah, *Extremely large and angle dependent MR in Kagome Dirac Semimetal RFe_6Sn_6 (R = Ho, Dy)*, Journal of Alloys and Compounds, 1040 183506 (2025).