Chiral anomaly and electronic transition in Hexagonal - Mn_3Ge

Venus RAI[1], Shibabrata NANDI[1], Subhadip JANA[1], Jörg PERßON[1], Thomas BRÜCKEL[1]

[1] *Jülich Centre for Neutron Science (JCNS-2) and Peter Grünberg Institute (PGI-4), JARA-FIT, Forschungszentrum Jülich GmbH, D-52425 Jülich, Germany*

Topological quantum materials have attracted enormous attention since their discovery due to the observed anomalous transport properties, which originate due to the non-zero Berry curvature. Mn_3Ge has gained special attention because of its large anomalous Hall and Nernst effects that persist starting from Néel temperature (365 K) down to 2 K [1, 2]. Several experimental observations support the claim for Mn_3Ge as a Weyl semimetal [1 - 3]. However, the chiral anomaly in this sample has not been fully understood yet. We have performed angle, temperature, and magnetic field (*B*) dependent magnetoresistance (MR) and planar Hall effect (PHE) measurements with *B* and electric current (*I*) applied along the various combinations of the crystallographic axes of Mn_3Ge. We have observed negative longitudinal MR and PHE oscillations in certain magnetic field and temperature regimes, for various combinations of *I*, *B*, and crystallographic axes. These observations are the signature of chiral anomaly, but they can arise without chiral anomaly also. The detailed analysis of the temperature and magnetic field dependent behavior of MR and PHE strongly suggest that the chiral anomaly is most likely present in the Mn_3Ge. Also, we have observed that the slope of longitudinal MR and Hall resistivity at high field changes its sign in the temperature range of 165 - 230 K. The lattice thermal expansion coefficient has also shown a change in sign near 230 K. These observations suggests that the Mn_3Ge goes through electronic phase transition below 230 K, possibly driven by the lattice parameter of the sample.

E-mail for corresponding author: v.rai@fz-juelich.de

[1] A. K. Nayak, J. E. Fischer, Y. Sun, B. Yan, J. Karel, A. C. Komarek, C. Shekhar, N. Kumar, W. Schnelle, J. Kübler, et al., Sci. Adv. **2**, e1501870 (2016).

[2] C. Wuttke, F. Caglieris, S. Sykora, F. Scaravaggi, A. U. Wolter, K. Manna, V. Süss, C. Shekhar, C. Felser, B. Büchner, et al., Phys. Rev. B **100**, 085111 (2019).

[3] M.Wu, H. Isshiki, T. Chen, T. Higo, S. Nakatsuji, and Y. Otani, Appl. Phys. Lett. **116**, 132408 (2020).