Linear Magnetoresistance in Pyrochlore Iridates $Bi_2Ir_2O_7$

J.-H. Chu, J. Liu, C.R. Serero, D. Yi, M. Melissa, S.J. Suresha, A. Vishwanath, X. Marti, R. Ramesh (UC Berkeley); S.C. Riggs, M.C. Shapiro, I.R. Fisher (Stanford University); C. Frontera (ICMAB Spain)

Introduction

A linear in field magnetoresistance (MR) is generally unexpected. In some cases the linear MR might arise due to extrinsic effects such as sample inhomogeneity. However for a homogeneous clean system it is often an indication of the peculiarity of the underlying electronic structure, such as linear Dirac dispersion. We report the discovery of the linear MR in a promising candidate for Dirac material, pyrochlore iridate $Bi_2Ir_2O_7$. We note that the related family of rare earth pyrochlore iridates has been theoretically proposed to host a topological Weyl semi-metal phase [1]. In a Weyl semi-metal phase the bulk electronic structure is described by the Weyl equation, which has a linear dispersion in three dimensions.

Experimental

Single crystals of $Bi_2Ir_2O_7$ are grown from a binaryy melt of Bi_2O_3 and IrO_2. Epitaxial thin films of $Bi_2Ir_2O_7$ were grown on (111)-oriented yttria-stabilized zirconia (YSZ) substrates using pulsed laser deposition. Magnetotransport measurements were performed at cell 12 of the DC field facility of NHMFL in Tallahassee.

Results and Discussion

Fig. 1 summarizes the zero field resistance versus temperature and low temperature linear MR for the single crystal and the 30nm thick thin film. As shown in Fig. 1 (a), $Bi_2Ir_2O_7$ shows a weak metallic temperature dependence. As the temperature decreases the resistance of the thin film reaches a minimum at T = 14K and begins to increase linearly as a function of lnT, as shown in Fig. 1 (b). In contrast to the film, the resistance of the single crystal remains constant. The low temperature lnT divergence is most likely due to the disorder enhanced electron-electron interactions in two dimensions. The MR (ΔR/R) of the single crystal and the thin film measured at T = 1.6K is shown in fig.2 (c), which exhibits a linear field dependence and no sign of saturation up to 35T. The similarity of the MR for the single crystal and the thin film is rather striking, especially considering the presence of disorder inducted quantum interference in the thin film. Our observation is pointing towards an intrinsic origin of the linear MR in $Bi_2Ir_2O_7$.

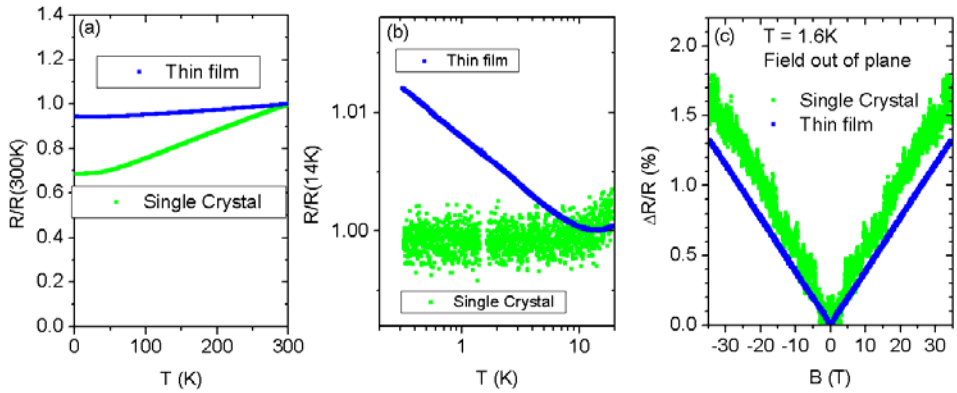

Fig. 1 Temperature dependence (a)(b) and magnetic field dependence (c) of the resistance of single crystal (green) and thin film (blue) of $Bi_2Ir_2O_7$.

Conclusions

In summary, we revealed the unusual quasi-particle behaivors of pyrochlore iridates $Bi_2Ir_2O_7$ by discovering a non-saturated linear MR in both single crystal and thin film samples.

Acknowledgements

We thank the experimental support by D. Graf. This work was supported by the DOE. Work at the NHMFL was done under NSF Cooperative Agreement No. DMR-1157490, the State of Florida, and the U.S. Department of Energy.

References

[1] X. Wan, et. al., *Phys. Rev. B* **83**, 205101 (2011)