Annual Report for Interplay of Magnetism and Topological Phases

Suzuki, T. (MIT, Physics); Devarakonda, A. (MIT, Physics); Checkelsky, J. G. (MIT, Physics)

Introduction

The interplay of symmetry breaking and topological phases is expected to give rise to exotic new states of matter that couple electronic and magnetic degrees of freedom in non-trivial ways. In topological insulators, magnetism and superconductivity are both expected to act as a symmetry breaking actors that allow for new topological states to form. Discovering systems which host this kind of symmetry breaking and understanding their Fermi surface are this important steps towards realizing new electronic states of matter. The family of half-Heusler compounds *Ln*PtBi (*Ln* is a Lanthanide) is predicted to be a possible host of this behavior [1-2]. Here we explore a candidate compound with *Ln* = Lu.

Experimental

Single crystals of LuPtBi were grown by the flux method. Transport measurements were performed at the NHMFL DC field facility in a He-3 cryostat with a rotation probe in Cell 9 and down to in a dilution refrigerator in SCM-1. Data taken in Cell 9 is shown here.

Results and Discussion

The magnetotransport response in LuPtBi is dominated by Shubnikov-de Haas oscillations (SdH). As shown for sample M1 in Fig. 1, a complex sets of oscillations in resistivity can be observed at low temperature (T = 0.5 K), some of which persist up to higher temperatures (T = 15 K). There is clear angular dependence to these SdH patterns (the angle is measured with B bending away from the 001 crystallographic direction). This indicates that the system has high electronic quality and that a mapping of the Fermi surface is possible. No signatures of magnetic ordering was observed, consistent with the full *f*-electron band for Lu. Beyond the clear SdH, we also observe a surprisingly large magnetoresistance, the origin of which is the subject of future study. There does not appear to be significant angular dependence to this large magnetoresistance.

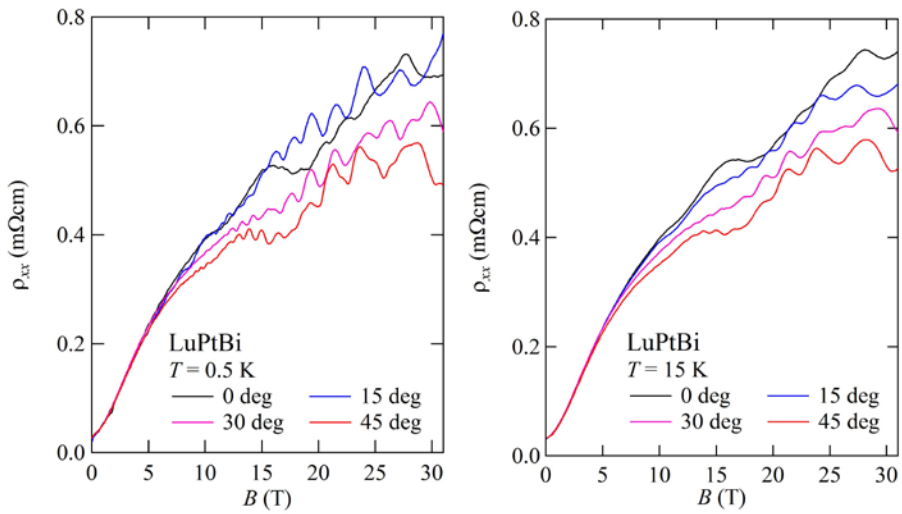

Fig.1 Magnetotransport of LuPtBi at temperature T = 0.5 K (left panel) and T = 15 K (right panel). A rich structure of SdH oscillations is observed.

Conclusions

We have measured the Fermi surface of single crystals of LuPtBi. Multiple oscillation frequencies likely corresponding to a number of different electronic bands are observed along with an overall large magnetoresistance.

Acknowledgements

A portion of this work was performed at the National High Magnetic Field Laboratory, which is supported by National Science Foundation Cooperative Agreement No. DMR-1157490, the State of Florida, and the U.S. Department of Energy. We also acknowledge support from the Gordon and Betty Moore Foundation EPiQS Initiative, Grant GBMF3848 to JGC.

References

[1] Chadov, S., *et al*., Nature Materials, **9**, 541-545 (2010).
[2] Lin, H., *et al*., Nature Materials, **9**, 546-549 (2010).