**Reduction of the Low-Temperature Bulk Gap in Topological Kondo Insulator**

**Samarium Hexaboride Under High Magnetic Fields**

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**Introduction**

The recent quantum oscillation experiments by Tan *et. al.* [1] suggested that the physics of bulk SmB6 may be richer and much more complicated than anyone in the field had anticipated. There is great interest in trying to sort out the theoretical implications of these experiments as well as probing the bulk by new methods.

**Experimental**

A Corbino disk is fabricated on a single (001) crystallographic surface of single-crystal SmB6 grown via the aluminum flux method. The surface was prepared by lapping and polishing with Al2O3 slurry down to 0.3 µm grit size, and Corbino disks with inner diameter of 300 µm and outer diameter of 500 µm were fabricated using standard photolithography. The sample resistance was measured in one of the National High Magnetic Field Laboratory’s 65-T short pulse magnets using standard resistance bridge and AC (274.5 kHz) lock-in techniques.

**Results and Discussion**

It is critical to understand the bulk in correlated topological insulators. It is known that the size of the bulk gap is temperature-dependent, and one would expect that, associated with the changing gap, there must be changes in the surface conduction. The closure of the gap with magnetic fields was suggested by the earlier high field measurements by Cooley *et al*. [2]. We have recently studied the gap closure in one sample using magnetoresistance measurements in pulsed fields up to 60 T between 1.4 K and 4 K. For comparison, we show our normalized data together with the historic data in Fig 1. The data suggest that the magnetic response of the weakly *T*-dependent surface states is distinct from that of the activated bulk. From the analysis of the temperature dependence we are able to extract a transport gap as a function of magnetic field. The transport gap shrinks by 50% under fields up to 60 T as shown in Fig. 1. We are expecting to tease out some of the emerging theories that are aimed to understand bulk properties of SmB6 using such measurements.

**Fig 1.** **Left --** Traces of the Corbino disk 2-terminal normalized resistance at 1.39 K and 3.96 K, plotted together with Cooley *et al.*’s data (denoted by asterisks.) **Right --** Transport activation energy (black line) as a function of magnetic field (error bars correspond to fit residuals). **Inset** -- Example weighted fit (blue line) at 29 T of the calculated bulk resistance data (black dots with error bars) on an Arrhenius plot. The raw resistance is also plotted (green squares) for reference.

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**References**

[1] B. S. Tan, *et al*., Science 349, 287 (2015)

[2] J. C, Cooley. *et al*., Journal of Superconductivity 12, 171 (1999).