Confirmation of Dirac Semimetal in CaAgBi by magnetostriction measurements

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Introduction

The exploration of new materials with topological Fermi surface states is important in both physics and materials science[1,2]. In particular, topological semimetals have been attracting tremendous interest in current research, partly because they offer a convenient platform to explore the intriguing physics of high-energy elementary particles.
In the last two magnet time rounds, we developed a promising new high-resolution method for measuring magnetostriction in pulsed magnetic fields at cryogenic temperatures that we term a magnetoelectric voltage sensor (MEVS). The new method works by gluing the sample to a piezoelectric material. The variation in voltage of the piezoelectric material is proportional to the strain generated by the magnetostrictive sample in the magnetic field. We have demonstrated its high sensitivity and accuracy by measuring the angle-dependent magnetostriction of a Ca3Co1.03Mn0.97O6 (CCMO) single crystal in pulsed magnetic fields, which is in agreement with previous FBG results and other relevant experiments[3]. Here we propose that the magnetostriction is a bulk-only property and it can be applied to probe the bulk Fermi surface of DSM by measuring the angle dependent high field quantum oscillation. In particular, when the Fermi surface is very close to the Dirac point, the area of the Fermi pocket must be very small, leading to a small oscillation frequency and pushing the observable oscillation signal to very high magnetic field.

Experimental

We measured the magnetostriction of CaAgBi as a function of *H* at selected temperatures down to 1.5 K. All the measurements were performed in 65T Multi shot (25 mS) magnet.

Results and Discussion

In our magnetostriction measurements, we did not see any sign of quantum oscillation up to 60 T and down to 1.5 K. Therefore, the sample we measured probably do not have Dirac point or its quality is not high enough to show observable quantum oscillation.

Conclusions

High quality sample or other Dirac semimetal samples should be tried next time with our MEVS technique.

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