Multiple Topologically non-Trivial Bands in non-Centrosymmetric YSn_2

Zhu, Y., Kidd, J., Mao, Z. (Tulane U., Physics); Zhang, T., Fang, Z., Weng, H. (Institute of Physics CAS); Hu, J. (Tulane U., Physics and University of Arkansas); Graf, D. (NHMFL, Tallahassee); Gui, X., Xie, W. (LSU, Physics); Zhu, M., Ke, X. (MSU, Physics); Huibo Cao (ORNL)

Introduction

Recently, there has been growing interest in relativistic fermions generated by 2D square lattices formed by group IV or V elements, since 2D square lattices might result in band-folding and non-symmorphic symmetric operation, which are closely related with band topology. A rich variety of topological phases have been observed or predicted in these materials [1–6]. We have recently studied a new layered topological semimetal YSn_2 with a non-centrosymmetric crystal structure and lightly distorted Sn square lattice. We find this material possesses multiple topologically non-trivial bands, one of which hosts a new type of tunable Weyl state induced by Rashba spin-orbit coupling (SOC) and tunable by magnetic field.

Experimental

We have synthesized YSn_2 single crystals using a flux method and carried out magneto-transport studies on this material using the NHMFL's 31T DC Field Facility in Tallahassee.

Results and Discussion

As shown in Figure 1(a), we observed strong dHvA quantum oscillations from high field torque measurements. The Fast Fourier transform (FFT) analyses show such dHvA oscillations consist four oscillation frequencies when the field is aligned alone the ac plane. Through the analysis of these dHvA data, we have revealed multiple bands hosting nearly massless relativistic fermions. Moreover, our principle calculations indicate one 3D band (i.e. the F_α band) hosts a new type of Weyl state caused by Rashba spin-orbital coupling. This band forms a point-like FS at Y point on the BZ boundary.

Conclusions

In this work, we performed quantum oscillation studies on a layered compound YSn_2 with non-symmorphic symmetry through magnetic torque measurements under high magnetic fields, from which we have demonstrated that it has multiple bands hosting relativistic fermions. Given that YSn_2 belongs to a large family of material $RESn_2$ (RE = rare earth), our results may motivate further studies on other isostructural $RESn_2$ compounds, which show magnetic orders. If they also harbor relativistic fermions, they may provide opportunities to study the interplay between relativistic fermions and magnetism. This work has been published in Physical Review B 98, 035117(117).

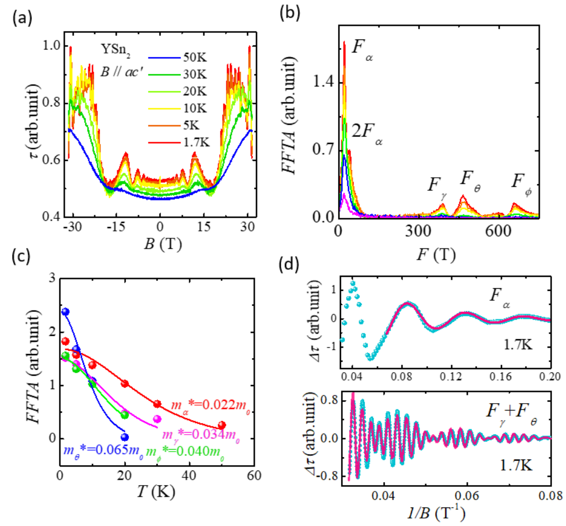

Figure.1 (a) The field dependence of magnetic torque τ at different temperatures from 1.7K to 80K. The magnetic field is applied nearly along the ac plane. (b) Shows the FFT spectra of the oscillatory magnetization $\Delta\tau$ for ac plane. (c) The fits of the FFT amplitudes to the temperature damping term RT of the LK formula. (d) Upper panel: the low frequency (F_α) dHvA oscillations probed in magnetic torque for *B*//ac plane. Bottom panel: the high frequency (F_γ and F_θ) oscillatory components of magnetic torque for *B*//*ac* plane.

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