Supplementary Information

Topological quantum phase transition in the magnetic semimetal HoSb

J. -M. Zhang[a,*], F. Tang[b,c], Y. -R. Ruan[a,d], Y. Chen[b], R. -W. Zhang[e], W. -T. Guo[a,d], S. -Y. Chen[a,d], J. -P. Li[f], W. Zhao[g], W. Zhou[b], L. Zhang[b], Z. -D. Han[b], B. Qian[b], X. -F. Jiang[b], Z. -G. Huang[a,d], D. Qian[h], and Y. Fang[b,*]

[a]Fujian Provincial Key Laboratory of Quantum Manipulation and New Energy Materials, College of Physics and Energy, Fujian Normal University, Fuzhou 350117, China

[b]Jiangsu Laboratory of Advanced Functional Materials, Department of Physics, Changshu Institute of Technology, Changshu 215500, China

[c]Jiangsu Key Laboratory of Thin Films, School of Physical Science and Technology, Soochow University, Suzhou 215006, China

[d]Fujian Provincial Collaborative Innovation Center for Advanced High-Field Superconducting Materials and Engineering, Fuzhou, 350117, China

[e]Key Lab of advanced optoelectronic quantum architecture and measurement (MOE), Beijing Key Lab of Nanopho tonics &
Ultrafine Optoelectronic Systems, and School of Physics, Beijing Institute of Technology, Beijing 100081, China

[f]Automotive & Transportation Engineering, Shenzhen Polytechnic, Shenzhen 518055, Guangdong, China

[g]ISEM, Innovation Campus, University of Wollongong, Wollongong, New South Wales 2500, Australia

[h]Key Laboratory of Artificial Structures and Quantum Control (Ministry of Education), Shenyang National Laboratory for Materials Science, School of Physics and Astronomy and Tsung-Dao Lee Institute, Shanghai Jiao Tong University, Shanghai 200240, China

[*)]Author to whom correspondence should be addressed. Electronic mail: jmzhang@fjnu.edu.cn, and fangyong@cslg.edu.cn.

Figure S1 shows the angular magnetoresistance for HoSb at two representative temperatures 2 and 10 K where this compound is in the paramagnetic and antiferromagnetic states respectively. As displayed in Fig. S1(a), the angular magnetoresistance at 10 K simply follows a $B|\cos\theta|$ function (not shown), which is widely observed in GdSb and ErBi[1,2]. In Fig. S1(b), a more complicated angle-dependent magnetoresistance is observed at 2 K. Thus, the spin orderings have significant effect on the angular magnetoresistance of HoSb.

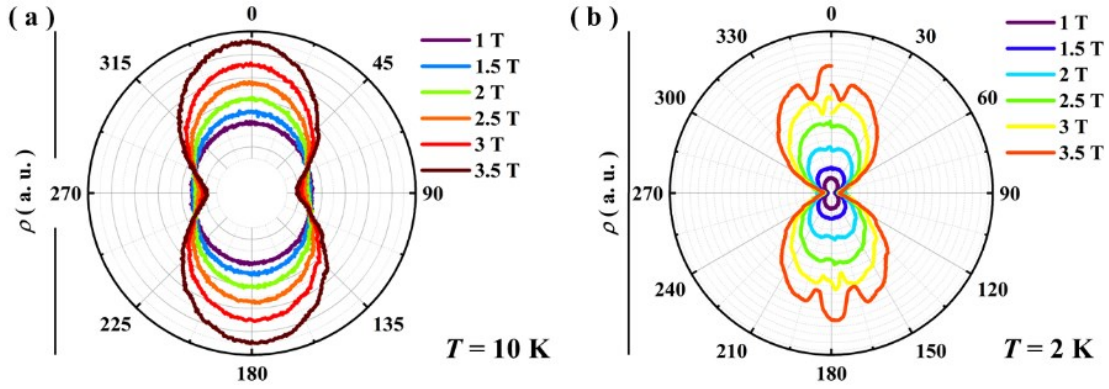

Figure S1 (a)-(b) The angular magnetoresistance of HoSb single crystal at 10 and 2 K.

To clearly show the topological nature of the electronic properties for NM HoSb in Fig. 5(a), the Wilson loop (Wannier Charge Center) in the $k_z = 0$ plane is calculated by GGA method, from which a nonzero topological invariant can be obtained.

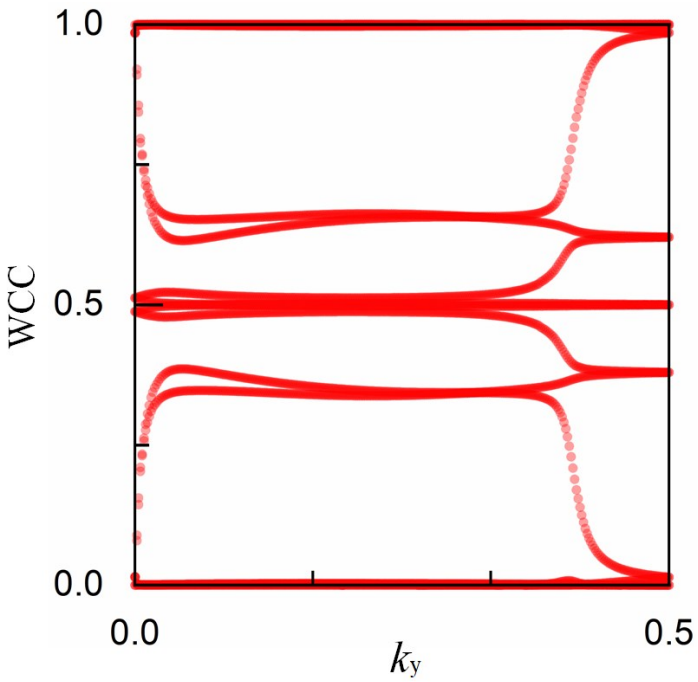

Figure S2 Wannier charge centers for nonmagnetic HoSb.

Reference

[1] J. J. Song, F. Tang, W. Zhou, Y. Fang, H. L. Yu, Z. D. Han, B. Qian, X. F. Jiang, D. H. Wang and Y. W. Du, Extremely large magnetoresistance in the antiferromagnetic semimetal GdSb, *J. Mater. Chem. C*, 2018, **6**, 3026.

[2] L. Y. Fan, F. Tang, W. Z. Meng, W. Zhao, L. Zhang, Z. D. Han, B. Qian, X. F. Jiang, X. M. Zhang and Y. Fang, Anisotropic and extreme magnetoresistance in the magnetic semimetal candidate erbium monobismuthide, *Phys. Rev. B*, 2020, **102**, 104417.