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Emergence of a Robust Dirac Cone from Rashba-Split Surface States on a Topological Semimetal[1]

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Topological materials (TMs) host protected surface states that emerge from strong spin orbit coupling in the bulk and on the surface. While their remarkable properties have generated much interest, previous studies have shown nanoscale variations in their surface state properties [1,2], prompting the development of a nanoscale band structure probe. Here we report the simultaneous observation and quantitative reconciliation of Landau quantization and quasiparticle interference phenomena on the topological semimetal Sb, which we employ to reconstruct its multi-component surface state band structure[3]. We thereby establish the technique of **band structure tunneling microscopy (BSTM)**, and utilize it to elucidate the relationship between bulk conductivity and surface state robustness, and to quantify essential metrics for spintronics applications. Meanwhile, our Landau quantization results help us visualize the evolution of quasiparticle behavior from massive Rashba to massless Dirac character, and determine the surface state g-factor.

[1] H. Beidenkopf *et al.*, Nature Physics 7, 939 (2011)
[2] Y. Okada *et al.*, Nature Communications 3, 1158 (2012)
[3] A. Soumyanarayanan *et al.*, arxiv:1311.1758 (2013)

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