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Magnetic Torque Anomaly in the Quantum Limit of Weyl and Dirac Semimetals NITYAN L. NAIR, PHILIP J.W. MOLL, ANDREW C. POTTER, Univ of California - Berkeley, BRAD RAMSHAW, KIMBERLY MODIC, National High Magnetic Field Laboratory, Los Alamos, SCOTT RIGGS, BIN ZENG, National High Magnetic Field Laboratory, Tallahassee, NIRMAL GHIMIRE, ERIC BAUER, Los Alamos National Laboratory, ROBERT KEALHOFER, ZHENGLU LI, STEVEN LOUIE, Univ of California - Berkeley, FILIP RONNING, Los Alamos National Laboratory, JAMES G. ANALYTIS, Univ of California - Berkeley — Three dimensional Dirac and Weyl semimetals, characterized by bulk quasiparticles that behave as massless, linearly dispersing Dirac or Weyl fermions, have excited physicists with their unique topological properties and potential for applications. The experimental signatures of Weyl or Dirac fermions, however, are often subtle and indirect, especially in systems where they coexist with trivial electrons. Here, we report a novel method by which these topological systems can be unambiguously experimentally identified. Magnetic torque measurements were performed on the Weyl semimetal NbAs in high magnetic field, showing a large anomaly upon entering the quantum limit. The torque exhibits a striking sign reversal, corresponding to a change in the magnetic anisotropy that is a direct result of the topological properties of the charge carriers. This result can be generalized to other Dirac and Weyl semimetal systems and establishes quantum limit torque measurements as a simple and direct experimental method of distinguishing topologically non-trivial Weyl and Dirac systems from trivial semiconductors.

Nityan Nair
Univ of California - Berkeley

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