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Weyl Wiggles: exotic quantum oscillatory phenomena in Weyl and Dirac semi-metals

JAMES ANALYTIS, UC Berkeley

Dirac semi-metals show a linear electronic dispersion in three dimensions described by two copies of the Weyl equation, a theoretical description of massless relativistic fermions. At the surface of a crystal, the breakdown of fermion chirality is expected to produce topological surface states without any counterparts in high-energy physics nor conventional condensed matter systems, the so-called "Fermi Arcs". Here we present Shubnikov-de Haas oscillations in Focused Ion Beam prepared microstructures of Cd3As2 that share characteristics of surface and bulk states as expected for "Weyl orbits", the theoretically predicted cyclotron path that weaves together Fermi arc and chiral bulk states. In contrast to conventional cyclotron orbits, these are governed by the chiral bulk dynamics rather than the common momentum transfer due to the Lorentz force. Our observations provide evidence for direct access to the topological properties of charge in a transport experiment, a first step towards their potential application.