Evidence Supporting BiPd as a Topological Superconductor

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Topological materials are scientifically fascinating and technologically appealing due to their unique electronic properties and behavior. *The superconductor, BiPd, has the possibility of being a topological superconductor by virtue of its crystal structure being noncentrosymmetric*, which means its crystal structure lacks a center of inversion symmetry. Its large spin-orbit coupling is therefore antisymmetric, making it a likely candidate material to host a topological superconducting state.

One method of determining if topological states are present is by measuring the Fermi surface of a material. This was accomplished via torque magnetometry, a technique that is highly sensitive to changes in the magnetization and allows a measurement of the angular dependence of the de Haas-van Alphen effect. The measurements were performed in a 35T resistive magnet coupled to a cryostat with a base temperature of 350 mK. Data from sweeping the magnetic field (a) are combined to produce (b) a map of the Fermi surface as a function of angle, which are compared to (c) calculations of the Fermi surface. *Analysis of these data revealed that a nontrivial Berry phase is associated with the α frequency, strongly suggesting the presence of topological states in bulk BiPd.*

Facilities used: DC Field Facility, 35-Tesla resistive magnet (Cell 12).
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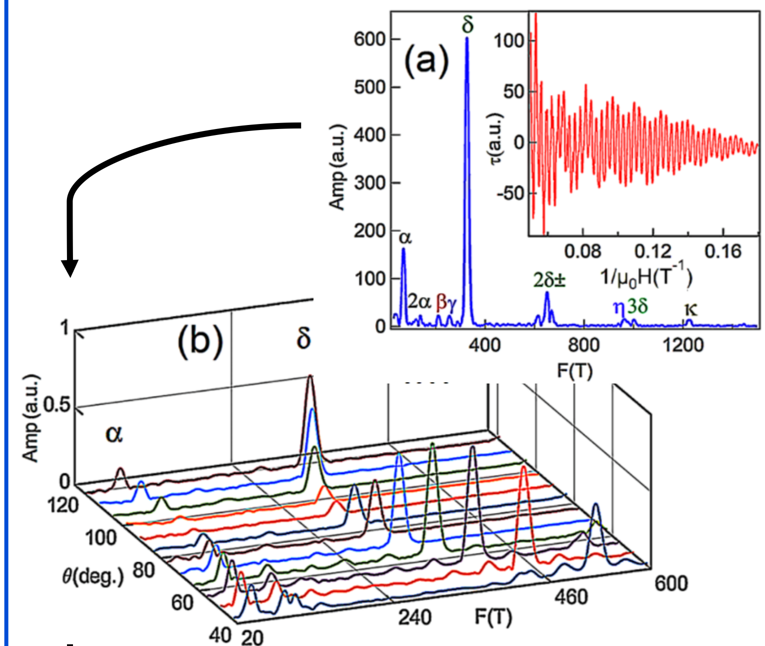

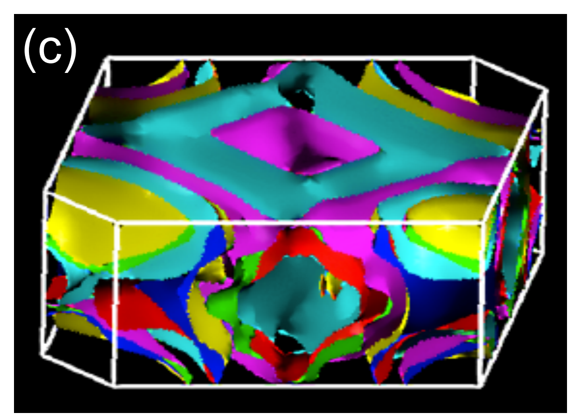

(a) Inset: Quantum oscillations in the sample's magnetization, measured by a torque cantilever magnetometer. Main panel: Fourier transform of these quantum oscillations between 5 and 20 T. The primary frequencies and their higher harmonics are labeled in the figure. These frequencies are inversely proportional to the extremal areas of the Fermi surface. (b) Frequency vs. angle map arising from shapes of the Fermi surface. (c) The calculated Fermi surface of BiPd projected into the first Brillouin zone. It is complex, 3-dimensional, and composed of multiple sheets.