TCSUH Bi-Weekly Seminar

Superconductor vortices in Weyl semimetals

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In Person – Room 102, Houston Science Center, 12:00 p.m. – 1:00 p.m.

Sandwiches will be provided on a first-come, first-served basis.

ABSTRACT: Vortices in type-II superconductors carry critical information about the parent metal. For example, ordinary metals produce equally spaced levels with finite zero-point energy, whereas massless Dirac metals yield exotic Majorana fermions at precisely zero energy. Weyl semimetals are gapless topological materials defined by accidental band intersections or Weyl nodes in the bulk and a bizarre surface metal composed of open Fermi arcs instead of closed Fermi surfaces. We ask, "what is the spectrum of superconductor vortices in Weyl semimetals?" Restricting to non-magnetic Weyl semimetals and superconductivity that is gapped when uniform, we show that the spectrum is generically gapped and follows from semiclassical quantization of closed orbits consisting of Fermi arcs on opposite surfaces connected by one-way bulk conduits. It is expected to produce a slew of exotic behaviors such as (i) periodic oscillations in the specific heat and tunneling conductance as the vortex is tilted (ii) transmutation between bosonic, fermionic, and supersymmetric statistics (iii) and "magic angles" where the spectrum becomes independent of the slab thickness. Moreover, if the semiclassical orbits are shorted by quantum tunneling in the bulk, surface Majorana modes appear under simple conditions based on the Fermi arc connectivity and bulk Weyl node positions. We propose well-studied materials NbP, TaP, LifeCoAs and FeSeTe for realizing different parts of our proposals.

BIO: Dr. Pavan Hosur received his Ph.D. in Physics in 2012 from the University of California Berkeley. After spending four years as a postdoc at Stanford University, Dr. Hosur joined the Department of Physics at the University of Houston as an Assistant Professor in 2016 and was promoted to Associate Professor in 2022. Dr. Hosur's research interests are in theoretical condensed matter physics and quantum statistical mechanics. Within condensed matter theory, he is currently excited about topological phases of matter, especially gapless ones such as Dirac and Weyl semimetals. He is also interested in exploring unusual broken symmetry phases and devising ways to detect them in experiments. Questions in quantum statistical mechanics that he is thinking about revolve around quantum ergodicity, quantum chaos, and, generally, how ideas from classical statistical mechanics apply to quantum systems.

Persons with disabilities who require special accommodations to attend this lecture should call (713) 743-8212.