Condensed Matter Physics Seminar Series

Search for topological superconductivity in UTe_2

Sean Thomas

Los Alamos National Laboratory

Topological superconductivity is a long-sought state of matter in bulk materials, and odd-parity superconductor UTe_2 is a prime candidate. UTe_2 possesses unusual phase diagrams for both applied pressure and magnetic field with both tuning parameters inducing additional superconducting phases. Further, several prior experiments provide evidence that the superconducting order parameter in UTe_2 is multicomponent and breaks time-reversal symmetry. Because UTe_2 has orthorhombic symmetry, proposals for its superconducting order parameter involve two nearly-degenerate irreducible representations (e.g., $B_{2u} + iB_{3u}$). Here, I will provide an overview of our efforts on improving UTe_2 crystal quality and the experimental search for topological superconductivity in this fascinating system. By applying symmetry-breaking uniaxial strain, we probe multicomponent superconductivity by looking for a splitting of the transition temperatures. We complement these efforts by performing measurements capable of probing whether the superconducting state breaks time-reversal symmetry on several UTe_2 samples - grown via two different techniques. Our results show no evidence for a spontaneous Kerr signal in zero field measurements. Although our results demonstrate that the superconducting state of UTe_2 does not intrinsically break time-reversal symmetry at zero pressure and field, future experiments will probe whether this occurs in other parts of the phase diagram.

Sean Thomas received his Ph.D. in Physics from the University of California at Irvine, in 2016. During his PhD he studied the topological Kondo insulator candidate SmB_6 and other strongly correlated systems. He later joined Los Alamos National Laboratory, in 2017. His main research interest is the characterization of strongly correlated quantum materials using a variety of techniques including electrical transport, thermal expansion, and torque magnetometry. Recently he has focused on using symmetry breaking uniaxial strain to understand emergent material properties.

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