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Title: Time Reversal Symmetry Breaking and Multi-Component Order Parameter in Complex Superconductors

Abstract:

The search for a material platform for topological quantum computation has recently focused on unconventional superconductors, particularly those that exhibit time reversal symmetry breaking (TRSB) and thus are capable of hosting novel phenomena, including emergent Majorana quasiparticles. A natural place to search for chiral superconductors is among superconductors in which the pair wavefunction possesses internal degrees of freedom. Where two- (or higher) dimensional representations are allowed, the order parameter may be composed of more than one component, which can be in phase or out-of-phase with each other, hence acquiring an imaginary component that is responsible for the TRSB superconducting state. In some cases, two symmetry-distinct ordering tendencies, instead of competing, will appear together as parts of a multi-component composite order parameter. While such a scenario may be attributed to "accidental" near-degeneracy, specific examples may indicate a secondary ordering field that couples to the superconducting order parameters in a way that stabilizes the multi-component composite state. We will focus our discussion on the nearly ferromagnetic compound UTe2, where TRSB was inferred from observations of a spontaneous Kerr response in the superconducting state after cooling in zero magnetic field, while a finite c-axis magnetic field training was further used to determine the nature of the non-unitary composite order-parameter of this material.