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Unconventional Superconductivity: Mechanisms for Time-Reversal Symmetry Breaking

Tuesday, 22 July 2025 13:10 (30 minutes)

Unconventional superconductivity is often referred to as originating from a pairing mechanism different from electron-phonon interactions and connected to an anisotropic superconducting order parameter with sign change of the Cooper pair wavefunction. A common microscopic mechanism discussed in view of high temperature superconductors is the spin-fluctuation mediated pairing where the formation of Cooper pairs is possible by avoiding the repulsive Coulomb interaction in space. This effective momentum-dependent pairing interaction gives rise to competing superconducting instabilities with sign-changing and momentum dependent electron pairing. Pinpointing the pairing state in real materials includes to determine of the spin structure of the Cooper pairs, identify possible sign changes of the gap function and detect possible time-reversal symmetry breaking (TRSB).
In this talk, I will review concepts for unconventional pairing, present considerations to investigate the sign of the superconducting order parameter and survey different theoretical mechanisms for the generation of TRSB in superconductors. In cases where a TRSB complex combination of two order parameter components is realized, defects, dislocations and sample edges may generate superflow patterns that can be picked up by magnetic probes. However, even single-component condensates that do not break time-reversal symmetry in their bulk phases can also support signatures of magnetism inside the superconducting state.

Email

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