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Are noncentrosymmetric superconductors necessarily unconventional?

Daniel Tay,[1] Tian Shang,[2] Toni Shiroka,[1,3] and Hans-Rudolf Ott[1,3]

[1] *Laboratorium für Festkörperphysik, ETH Zürich, CH-8093 Zürich, Switzerland*
[2] *Key Laboratory of Polar Materials and Devices (MOE), School of Physics and Electronic Science, East China Normal University, Shanghai 200241, China*
[3] *Laboratory for Muon-Spin Spectroscopy, Paul Scherrer Institut, Villigen PSI, Switzerland*

Superconductors whose crystal structures lack an inversion center, known as noncentrosymmetric superconductors (NCSCs), represent an attractive platform for investigating unconventional- and topological superconductivity (SC). As such they are intensively studied, since the lack of an inversion center sets the scene for a variety of exotic properties, e.g., nodes in the superconducting gap, multigap SC, upper critical fields beyond the Pauli limit, and breaking of time-reversal symmetry (TRS) in the superconducting state.

However, results of extensive NMR-, μSR, and specific-heat measurements in selected noncentrosymmetric superconductors, including W_3Al_2C [1], NbReSi [2] and ThIrSi [3], provide ample evidence for exhibiting conventional BCS-type s-wave superconductivity. Our results imply that the broken inversion symmetry, in combination with considerable spin-orbit coupling, does not necessarily lead to unconventional superconductivity. We put our findings in a broader context and argue that only in certain cases a noncentrosymmetric structure results in the formation of an unconventional superconducting state.

[1] Journal of Physics: Condensed Matter, 34(19), 194005.
[2] Physical Review B, 105(14), 144506.
[3] Paper in progress.