Contribution ID: **103** Type: **Contributed Oral**

To Be or Not To Be: Time-Reversal Symmetry Breaking Superconductivity in Sr2RuO4

Tuesday, 22 July 2025 14:00 (20 minutes)

After three decades of research, the symmetry of the superconducting state in Sr2RuO4 is still under strong debate (1). The long time favoured spin-triplet px + i py state is ruled out by NMR experiments (2). However, in general time-reversal-symmetry breaking (TRSB) superconductivity indicates complex two-component order parameters. Probing Sr2RuO4 under uniaxial pressure offers the possibility to lift the degeneracy between such components (2). We reported results of muon spin relaxation (μSR) measurements on Sr2RuO4 placed under uniaxial stress (3). We observed a large pressure-induced splitting between the onset temperatures of superconductivity (Tc) and TRSB (TTRSB). Moreover, at high stress beyond the van Hove singularity, a new spin density wave ordered phase is observed. To distinguish between a symmetry protected chiral state (d+id) and non-chiral accidentally degenerated order parameters (d+ig, f+ig) we reported SR studies under symmetry conserving hydrostatic pressure. In these experiment no splitting between Tc and TTRSB is observed (4). In this talk we want to discuss if and how these μSR specific observations can be consistent with proposals of single component sc order parameters deduced from recent thermodynamic observations.

(1) Y. Maeno et al., Nature Physics (20) 1712 (2024)
(2) A. Pustogow, et al., Nature 574, 72 (2019)
(3) V. Grinenko, S. Ghosh, et al., Nat. Phys. (2021)
(4) V. Grinenko, et al., Nat. Comm. (2021)

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Session Classification: Oral Contributions

Track Classification: Superconductivity