Contribution ID: **105** Type: **Contributed Oral**

Time-Reversal Symmetry Breaking Superconductivity in HfRhGe: A Noncentrosymmetric Weyl Semimetal

Tuesday, 22 July 2025 13:40 (20 minutes)

Unconventional superconductors offer pathways to novel technologies and deeper insights into electron correlations in condensed matter. Noncentrosymmetric superconductors, lacking inversion symmetry, exhibit mixed spin singlet/triplet pairing, making them candidates for time-reversal symmetry (TRS) breaking in their superconducting states.
We have identified HfRhGe, a new noncentrosymmetric Weyl semimetal with strong SOC, spontaneously breaks TRS in its superconducting state [1]. Magnetization and thermodynamics confirm bulk superconductivity. Zero-field μSR shows TRS breaking. Transverse-field μSR and specific heat indicate a fully gapped state. Calculations reveal Weyl nodes and Fermi arcs, confirming its Weyl semimetal nature. Ginzburg-Landau analysis suggests typical TRS-breaking states have nodes, contradicting our findings. We propose a loop supercurrent state with spontaneous Josephson loops to explain the fully gapped, TRS-breaking phase.
HfRhGe combination of noncentrosymmetry, Weyl topology, strong SOC, and TRS breaking makes it ideal for studying topology and unconventional superconductivity. Its properties suggest potential for the superconducting diode effect, promising quantum device and dissipationless electronics applications.

References:
1: Advanced Materials 37, 2415721 (2025)

Email

Funding Agency

Supervisors Name

Supervisors Email

Did you request an Invitation Letter for a Visitors Visa Application

No

Primary authors: HILLIER, Adrian (ISIS Neutron and Muon Facility); Dr SINGH, Deepak; Dr SAMANTA, Dibyendu; Dr SAJILESH, K.P.; Dr BISWAS, Pabitra (ISIS Neutron and Muon Facility); Dr MEENA, Pavan; Prof. SINGH, Ravi (IISER Bhopal); Dr KUSHWAHA, Roshan; Dr SRIVATAVA, Shashank; GHOSH, Sudeep; Dr TOLU, Tymoteusz; KANIGEL, Amit

Presenter: HILLIER, Adrian (ISIS Neutron and Muon Facility)

Session Classification: Oral Contributions

Track Classification: Superconductivity