Contribution ID: **23** Type: **Poster Presentation**

Competing Quantum Orders in 6R-TaS_2: Unconventional Superconductivity, Charge Order, and an Anomalous Hall Effect Phase

The bulk heterostructure 6R-TaS_2 offers a unique platform to study the interplay of charge density waves, superconductivity, and electronic transport anomalies. Notably, nematic Ising superconductivity has been recently proposed, and a hidden order accompanied by a large anomalous Hall effect at $T^* \simeq 35$ K has been identified, raising fundamental questions about the nature of superconducting pairing and its connection to CDW order and the AHE. Using μSR, magnetotransport, and pressure techniques, we identify a nodal superconducting state with low superfluid density at ambient pressure, with no spontaneous magnetic order detected below T^* [1]. This indicates that the AHE originates from the band structure rather than magnetism. Under pressures up to 2 GPa, the superfluid density rises markedly in correlation with the superconducting transition temperature, the nodal pairing shifts to a nodeless state, and the CDW onset is reduced by half. Notably, AHE is fully suppressed and magnetoresistance drops by 50% within just 0.2 GPa, highlighting the fragility of the hidden order. These results reveal an unconventional superconducting pairing in 6R-TaS_2, competing with both CDW and hidden orders. With a multifaceted approach, we establish a comprehensive phase diagram that reveals the intricate interplay and competition between the intertwined quantum orders in 6R-TaS_2.

[1] V. Sazgari et. al. and Z. Guguchia, arXiv:2503.13944 (2025).

Email

zurab.guguchia@psi.ch

Funding Agency

Supervisors Name

Supervisors Email

Did you request an Invitation Letter for a Visitors Visa Application

Yes

Primary author: GUGUCHIA, Zurab (PSI Center for Neutron and Muon Sciences, Switzerland)

Co-authors: Dr SAZGARI, Vahid (PSI Center for Neutron and Muon Sciences CNM, Villigen PSI, Switzerland); Dr GRAHAM, Jennifer (PSI Center for Neutron and Muon Sciences CNM, Villigen PSI, Switzerland); Dr ISLAM, Sohel (PSI Center for Neutron and Muon Sciences CNM, Villigen PSI, Switzerland); Dr KRÁL, Petr (PSI Center for Neutron and Muon Sciences CNM, Villigen PSI, Switzerland); Mr GERGURI, Orion (PSI Center for Neutron and Muon Sciences CNM, Villigen PSI, Switzerland); Dr ACHARI, Amit (The University of Manchester); Mr TANGERMANN, Janek (University of Geneva); Dr SIMUTIS, Gediminas (PSI Center for Neutron and Muon Sciences CNM, Villigen PSI, Switzerland); Prof. JANOSCHEK, Marc (University of Zürich); Dr BARTKOWIAK, Marek (PSI Center for Neutron and Muon Sciences CNM, Villigen PSI, Switzerland); KHASANOV, Rustem (PSI Center for Neutron and Muon Sciences CNM, Villigen PSI, Switzerland); Dr LUETKENS, Hubertus (PSI Center for Neutron and Muon Sciences CNM, Villigen PSI, Switzerland); Prof. ROHR, Fabian von (University of Geneva); Prof. NAIR, Raul R (University of Manchester)

Presenter: Dr GRAHAM, Jennifer (PSI Center for Neutron and Muon Sciences CNM, Villigen PSI, Switzerland)

Session Classification: Poster Session 1

Track Classification: Superconductivity