ID de Contribution: **29** Type: **Oral presentation**

SQUID interferometry, higher order topology and mesoscopic transport.

mercredi 2 novembre 2022 15:15 (15 minutes)

WTe2, a transition metal dichalcogenide, is predicted to have striking topological properties that combine the characters of type II Weyl semimetal and second-order 3D topological insulator (SOTI). SOTIs are characterized by topologically protected helical 1D states at their hinges. 1D states located at certain edges of multilayer WTe2 have indeed been demonstrated in Josephson interferometry experiments. However, more experimental evidence confirming their ballistic nature is needed.
We have design a WTe2-based Superconducting Quantum Interference Device (SQUID) in which the supercurrent through one edge of the crystal interferes with the supercurrent far from the edge. The critical current of this asymmetric SQUID yields the supercurrent-versus-phase relation of the edge states. Its sawtooth shape is a tell-tale sign that the supercurrent through the edge flows ballistically over 600 nm (which is ten times the estimated normal state mean free path). Combining behaviours of the supercurrent at various temperatures and magnetic fields, we identify the existence of a highly ballistic hinge channel which further supports the SOTI properties of WTe2.

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Classification de Session: Oral Presentations (first in the afternoon)