CONDENSED MATTER SCIENCES SEMINAR

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Host

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Title

Josephson effects in Dirac semimetal Cd_3As_2

Friday, May 2nd, 2025

1st Floor – B101

15:00-16:00

Abstract

Josephson junctions (JJs) made of topological quantum materials have attracted a great deal of current interests due to their non-trivial band topology and the capability of realizing topological superconductivity. Here, I wish to report our recent observations of novel Josephson effects in topological JJs and superconducting quantum interference devices (SQUIDs) mediated by Cd_3As_2, a topological Dirac semimetal. First, in aluminum- Cd_3As_2-aluminum JJs, a π periodic supercurrents are observed. Our data analysis suggests that this π period could arise from interference between the induced bulk superconductivity and the induced Fermi-arc surface superconductivity. Moreover, we observe that in Cd_3As_2 SQUIDs this phase coupling between the surface-bulk superconducting channels is responsible for a surprising discovery of the Leggett modes, a collective quantum phenomenon predicted more than 50 years ago. Finally, we show that this phase coupling can further induce time-reversal symmetry breaking and, therefore, can give rise to a zero-field Josephson diode effect in asymmetric Cd_3As_2 SQUIDs.

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