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M2Or2F-02: [Invited] Josephson diode effect in Dirac semimetal Cd3As2

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In general, the critical current (Ic) in a conventional Josephson junction (JJ) is independent of the current sweeping directions, when either time reversal symmetry (TRS) or inversion symmetry is presented. However, when both symmetries are broken, Ic can display different values, thus the Josephson diode effect (JDE), depending on the direction of current being swept. Like the diode effect in p-n junctions for microelectronics, JDE is expected to find important applications such as passive on-chip gyrators, radio-frequency circulators, etc.

Non-centrosymmetric superconducting systems are usually utilized to break inversion symmetry. TRS, however, is hard to break, and magnetic JJs or finite magnetic fields are generally needed. In this regard, it is surprising that in recent experiments magnetic-field free JDE was observed in non-magnetic materials, thus calling for more investigations. In this talk, I will present our recent progress in exploring magnetic-field free JDE in asymmetric superconducting quantum interference devices (SQUIDs) in Dirac semimetals. We will show that the coupling of the superconducting phases between the surface and bulk states in Dirac semimetal SQUIDs can lead to TRS broken and enable a zero-magnetic-field JDE.

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