CMD30 FisMat2023 - Submission - View

Abstract title: Josephson Diode Effect in High-Mobility InSb Nanoflags

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Abstract

High-quality III–V narrow bandgap semiconductor materials with strong spin–orbit coupling and large Landé g-factor provide a promising platform for next-generation applications in the field of high-speed electronics, spintronics, and quantum computing. InSb offers a narrow bandgap, high carrier mobility, and small effective mass and, thus, is very appealing in this context. In fact, this material has attracted tremendous attention in recent years for the implementation of topological superconducting states supporting Majorana zero modes. An attractive pathway to obtain two-dimensional InSb layers is the growth of freestanding InSb nanoflags (NF). We have demonstrated the fabrication of ballistic Josephson-junction devices based on InSb NFs with Ti/Nb contacts that show a gate-tunable proximity-induced supercurrent and a sizable excess current.In this talk, I will report on the observation of the Josephson diode effect in these Josephson junctions. Indeed, when an in–plane magnetic field is applied, the devices are driven into a non-reciprocal transport regime, where we observe an asymmetry between the positive and negative critical current. The asymmetry is modulated by the angle between the in-plane field and the current direction, and strongly depends on temperature. Our experimental evidence demonstrates that these devices can work as Josephson diodes, with dissipation–less current flowing in only one direction. Our results place InSb nanoflags in the spotlight as a versatile and convenient 2D platform for advanced quantum technologies and as a playground for investigating unconventional superconductivity.