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Current-phase relationship of planar Josephson junctions mediated by the surface states of a topological insulator C. KURTER, A.D.K. FINCK, C.D. ENGLISH, University of Illinois at Urbana Champaign, Y.S. HOR, Missouri University of Science and Technology, D.J. VAN HARLINGEN, University of Illinois at Urbana Champaign — It is predicted that the presence of Majorana fermions manifests itself with a 4π periodic current-phase relation (CPR) in planar Josephson junctions formed with topological weak links. To test this proposal, we have fabricated planar junctions by depositing Nb leads on exfoliated Bi_2Se_3 single crystals. The temperature and magnetic field dependence of the proximity-induced supercurrent have been examined in various doping regimes accessed via top gating. The critical current modulation with magnetic field deviates from the usual Fraunhofer diffraction pattern, suggesting modifications to a sinusoidal CPR consistent with a $sin(2\phi)$ component. We are corroborating those results with direct measurements of the CPR using a phase-sensitive SQUID interferometry technique.

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