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Anomalous oscillations of the Josephson supercurrent in InSb nanowires ATTILA GERESDI, DÁNIEL B. SZOMBATI, LUDO J. CORNELISSEN, Kavli Institute of Nanoscience, Delft University of Technology, 2600 GA Delft, The Netherlands, DIANA CAR, SÉBASTIEN R. PLISSARD, ERIK P.A.M. BAKKERS, Department of Applied Physics, Eindhoven University of Technology, 5600 MB Eindhoven, The Netherlands, LEO P. KOUWENHOVEN, Kavli Institute of Nanoscience, Delft University of Technology, 2600 GA Delft, The Netherlands
— Semiconductor nanowires proximity coupled to superconducting leads provide an ideal experimental platform to investigate the Josephson effect in tunable ballistic channels in the presence of strong spin-orbit coupling and large Landé g-factor. The interplay of an external magnetic field perpendicular to the intrinsic spin-orbit field may lead to an anomalous supercurrent which is a proposed signature of the coupling between two Majorana modes through the channel. Here we present our experimental studies of the Josephson supercurrent in InSb nanowires. Ohmic contacts to bulk superconductor NbTiN leads enable us to trace supercurrents up to $B = 3\,\mathrm{T}$ magnetic field. The gate control over the channel allows us to investigate the amplitude of the critical current from the tunneling regime to a few transparent modes, where nonsinusoidal current-phase relationship (CPR) is expected, verified by the presence of fractional Shapiro steps under microwave irradiation. The evolution of the critical current with the external magnetic field is shown to exhibit non-monotonic behavior depending on the gate configuration, consistently with the theory of Josephson junctions hosting Majorana modes.

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