Bi-based Topological Josephson Junctions

A. Brinkman

University of Twente, Enschede, The Netherlands

***Abstract*— $Bi_{1-x}Sb_x$ is an accidental three-dimensional Dirac semimetal at a doping level of x = 3% for which band inversion occurs. When a magnetic field is applied parallel to the current in Hall bar devices the degenerate Dirac cone splits into two Weyl cones and we observe a negative magnetoresistance as an indication of the chiral anomaly. The accidental three-dimensional Dirac semimetal is ideally suited for realizing Majorana bound states in superconducting hybrids since chirality prevents the 4pi-periodic current-phase relation from opening a gap at zero energy for Andreev bound states at perpendicular incidence. We observe a strong contribution of 4pi-periodic Majorana bound states to the supercurrent in Nb-$Bi_{1-x}Sb_x$-Nb devices. The 4pi-modes are revealed by studying the junction under GHz microwave irradiation. The large g-factor of the Zeeman effect from a magnetic field applied in the plane of the junction, allows tuning of the junctions from 0 to pi regimes.**

***Keywords (Index Terms)* — Topological Josephson junctions, Majorana bound states, current-phase relation.**

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