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Josephson supercurrent through a topological insulator surface state MENNO VELDHORST, MARIEKE SNELDER, MARCEL HOEK, TIAN GANG, MESA+ Institute for Nanotechnology,University of Twente, The Netherlands, XIAO-LIN WANG, Institute for Superconducting and Electronic Materials,University of Wollongong, Australia, VEERENDRA GUDURU, ULI ZEITLER, High Field Magnet Laboratory, Radboud University Nijmegen,The Netherlands, WILFRED WIEL, MESA+ Institute for Nanotechnology,University of Twente, The Netherlands, ALEXANDER GOLUBOV, HANS HILGENKAMP, ALEXANDER BRINKMAN, MESA+ Institute for Nanotechnology, University of Twente, The Netherlands — The long-sought yet elusive Majorana fermion is predicted to arise from a combination of a superconductor and a topological insulator. An essential step in the hunt for this emergent particle is the unequivocal observation of supercurrent in a topological phase. Here, we present direct evidence for a Josephson supercurrent in superconductor (Nb) - topological insulator (Bi_2Te_3) - superconductor e-beam fabricated junctions by the observation of clear Shapiro steps under microwave irradiation, and a Fraunhofer-type dependence of the critical current on magnetic field. The dependence of the critical current on temperature and electrode spacing shows that the junctions are in the ballistic limit. Shubnikov-de Haas oscillations in magnetic fields up to 30 T reveal a topologically non-trivial two-dimensional surface state. We argue that the ballistic Josephson current is hosted by this surface state despite the fact that the normal state transport is dominated by diffusive bulk conductivity. The lateral Nb-Bi_2Te_3-Nb junctions hence provide prospects for the realization of devices supporting Majorana fermions.

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