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Induced Superconductivity in the Quantum Spin Hall Edge[1]
HECHEN REN, SEAN HART[2], TIMO WAGNER, Harvard University, PHILIPP LEUBNER, MATHIAS MUEHLBAUER, CHRISTOPH BRUENE, HARTMUT BUHMANN, LAURENS MOLENKAMP, Wuerzburg University, AMIR YACOBY, Harvard University — Two-dimensional topological insulators have a gapped bulk and helical edge states, making it a quantum spin Hall insulator. Combining such edge states with superconductivity can be an excellent platform for observing and manipulating localized Majorana fermions. In the context of condensed matter, these are emergent electronic states that obey non-Abelian statistics and hence support fault-tolerant quantum computing. To realize such theoretical constructions, an essential step is to show these edge channels are capable of carrying coherent supercurrent. In our experiment, we fabricate Josephson junctions with HgTe/HgCdTe quantum wells, a two-dimensional material that becomes a quantum spin Hall insulator when the quantum well is thicker than 6.3 nm and the bulk density is depleted. In this regime, we observe supercurrents whose densities are confined to the edges of the junctions, with edge widths ranging from 180 nm to 408 nm. To verify the topological nature of these edges, we measure identical junctions with HgTe/HgCdTe quantum wells thinner than 6.3 nm and observe only uniform supercurrent density across the junctions.

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