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Quantum Spin Hall Insulator Made of InAs/GaSb

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Quantum Spin Hall Insulator (QSHI) is a two-dimensional variant of a novel class of materials characterized by topological order, whose unique properties have recently triggered much interest and excitement in the condensed matter community. Most notably, topological properties of these systems hold a great promise in mitigating the difficult problem of decoherence in implementations of quantum computers. Although QSHI has been theoretically predicted in a few different materials, so far only the semiconductor systems of HgTe/CdTe and, more recently, inverted InAs/GaSb, have shown direct evidence for the existence of this phase. Ideally insulating in the bulk, QSHI is characterized by one-dimensional channels at the sample perimeter, which have helical property, with carrier spin tied to the carrier direction of motion, and protected from back-scattering by time-reversal symmetry. Here we present low temperature transport measurements of inverted InAs/GaSb quantum wells, showing strong evidence for the existence of proposed helical edge channels. Edge modes persist in spite of conductive bulk, which is of non-trivial origin but highly tunable via electrostatic gates, and show only a weak magnetic field dependence. This is a direct consequence of a gap opening away from the zone center leading to effective decoupling of edge to bulk states due to the Fermi velocity mismatch. Low Schottky barrier of this material system and good interface to superconductors allows us to further probe topological properties of helical channels in Andreev reflection measurements and opens a promising route in realization of exotic Majorana modes.