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Unexpected edge conduction in HgTe quantum wells under broken time reversal symmetry ERIC YUE MA, M. REYES CALVO, JING WANG, BIAO LIAN, Stanford University, MATTHIAS MUEHLBAUER, CHRISTOPH BRÜNE, Universität Würzburg, YONGTAO CUI, Stanford University, KEJI LAI, UT Austin, WORASOM KUNDHIKANJANA, YONGLIANG YANG, MATTHIAS BAENNINGER, MARKUS KÖNIG, Stanford University, CHRISTOPHER AMES, HARTMUT BUHMANN, PHILIPP LEUBNER, LAURENS MOLENKAMP, Universität Würzburg, SHOU-CHENG ZHANG, DAVID GOLDHABER-GORDON, MICHAEL KELLY, ZHI-XUN SHEN, Stanford University — A key prediction of quantum spin Hall (QSH) theory that remains to be experimentally verified is the breakdown of the edge conduction under broken TRS by a magnetic field. Here we use a unique cryogenic microwave impedance microscopy (MIM) on two HgTe QW devices, corresponding to a trivial (5.5 nm) and an inverted (7.5 nm) band structure, to find unexpectedly robust edge conduction under broken TRS. At zero field and low carrier densities, clear edge conduction is observed only in the local conductivity profile of the 7.5 nm device, consistent with QSH theory. Surprisingly, the edge conduction persists up to 9 T with little effect from the magnetic field, as confirmed by both transport and real space MIM images. This indicates physics beyond current simple QSH models, possibly associated with material-specific properties, other symmetry protection and/or electron-electron interactions.

Eric Yue Ma
Stanford University

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