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Magnetic field-induced breakdown of helical conduction in an InAs/GaSb bilayer DMITRY PIKULIN, Department of Physics and Astronomy, University of British Columbia, Vancouver, BC, Canada V6T 1Z1, TIMO HYART, Department of Physics and Nanoscience Center, University of Jyvaskyla, P.O. Box 35 (YFL), FI-40014 University of Jyvaskyla, Finland, SHUO MI, Instituut-Lorentz, Universiteit Leiden, P.O. Box 9506, 2300 RA Leiden, The Netherlands, JAKUB TWORZYDLO, Institute of Theoretical Physics, Faculty of Physics, University of Warsaw, Hoza 69, 00-681 Warsaw, Poland, MICHAEL WIMMER, Kavli Institute of Nanoscience, Delft University of Technology, P.O. Box 5046, 2600 GA Delft, The Netherlands, CARLO BEENAKKER, Instituut-Lorentz, Universiteit Leiden, P.O. Box 9506, 2300 RA Leiden, The Netherlands — We calculate the conductance of a two-dimensional bilayer with inverted electron-hole bands, to study the sensitivity of the quantum spin Hall insulator (with helical edge conduction) to the combination of the perpendicular magnetic field in presence of disorder. The characteristic breakdown field for helical edge conduction splits into two fields with increasing disorder, a field B_c for the transition into a quantum Hall insulator (supporting chiral edge conduction) and a smaller field B_c' for the transition to bulk conduction in a quasi-metallic regime. The spatial separation of the inverted bands, typical for broken-gap InAs/GaSb quantum wells, is essential for the magnetic-field induced bulk conduction – there is no such regime in HgTe quantum wells.

Dmitry Pikulin
Department of Physics and Astronomy, University of British Columbia,
Vancouver, BC, Canada V6T 1Z1

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