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**Stability of the quantum spin Hall effect with disorder and interactions** CENKE XU, JOEL MOORE, University of California Berkeley — The stability to interactions and disorder of the quantum spin Hall effect (QSHE) proposed for time-reversal-invariant 2D systems is discussed. The QSHE requires an energy gap in the bulk and gapless edge modes that conduct spin-up and spin-down excitations in opposite directions. When the number of Kramers pairs of edge modes is odd, certain one-particle scattering processes are forbidden due to a topological $Z_2$ index. However, two particle scattering processes can localize the edge modes and destroy the QSHE: the region of stability for both classes of models (even or odd number of Kramers pairs) is obtained explicitly. For a single Kramers pair the QSHE is stable to weak interactions and disorder, while for two Kramers pairs it is not; however, the two-pair case can be stabilized by *either* finite attractive or repulsive interactions. We also discuss a mechanism to generate 1D localized states in magnetic semiconductors. These states are localized by the domain wall between two opposite ferromagnetic orderings. The total number of these localized states can be expressed in terms of a real space topological number. The existence of these localized states can result in a quantum spin Hall effect as well as a quantum charge Hall effect.

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