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Lattice model for the surface states of a topological insulator MARCEL FRANZ, DOMINIC MARCHAND, University of British Columbia — A surface of a strong topological insulator (STI) is characterized by an odd number of linearly dispersing gapless electronic surface states. It is well known that such a surface cannot be described by an effective two-dimensional lattice model (without breaking the time-reversal symmetry), which often hampers theoretical efforts to quantitatively understand some of the properties of such surfaces, including the effect of strong disorder, interactions and various symmetry-breaking instabilities. Here we describe a lattice model that can be used to describe a pair of STI surfaces and has an odd number of Dirac fermion states with wavefunctions localized on each surface. The Hamiltonian consists of two planar tight-binding models with spin-orbit coupling, representing the two surfaces, weakly coupled to each other by terms that remove the redundant Dirac points from the low-energy spectrum. The utility of this model is illustrated by studying the magnetic and exciton instabilities of the STI surface state driven by short-range repulsive interactions.

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