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Strong potential impurities on the surface of a three-dimensional topological insulator ANNICA M. BLACK-SCHAFFER, Uppsala University, ALEXANDER V. BALATSKY, Los Alamos National Laboratory — Topological insulators (TIs) are said to be stable against non-magnetic impurity scattering due to suppressed backscattering in the Dirac surface states. We solve a lattice model of a three-dimensional TI in the presence of strong potential impurities on the surface and find that both the Dirac point and low-energy states are significantly modified: low-energy impurity resonances are formed that produce a peak in the density of states near the Dirac point, which is destroyed and split into two nodes that move off-center. The impurity-induced states penetrate up to 10 layers into the bulk of the TI. These findings demonstrate the importance of bulk states for the stability of TIs and how they can destroy the topological protection of the surface. Extensions to sub-surface and extended defects, as well as direct comparisons to recent experimental results are also made.

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