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Stability of Z_2 topological order in the presence of vacancy-induced impurity band[1] CHUNG-YU MOU, SHI-TING LEE, National Tsing Hua University, SHIN-MING HUANG, Natinal Tsing Hua University — Although topological insulators (TIs) are known to be robust against non-magnetic perturbations and exhibit edge or surface states as their distinct feature, experimentally it is known that vacancies often occur in these materials and impose strong perturbations. Here we investigate effects of vacancies on the stability of Z_2 topological order using the Kane-Mele (KM) model as a prototype of topological insulator. It is shown that even though a vacancy is not classified as a topological defect in KM model, it generally induces a pair of degenerate midgap states only in the TI phase. We show that these midgap states results from edge states that fit into vacancies and are characterized by the same Z_2 topological order. Furthermore, in the presence of many vacancies, an impurity band that is degenerate with edge states in energy is induced and mixes directly with edge states. However, the Z_2 topological order persists and edge states exist between the impurity band and perturbed bulk bands until a phase transition occurs when Dirac cones near Dirac points are depleted. Our analyses indicate that the same scenario holds for point vacancies or line of vacancies in 3D TIs as well.

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