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Stability of surface Majorana modes in superconducting doped topological insulators ASHVIN VISHWANATH, PAVAN HOSUR, POUYAN GHAEMI, ROGER MONG, University of California at Berkeley — In recent years, several model condensed matter systems have been predicted to harbor Majorana fermion zero modes. One such system is the surface of a strong topological insulator with proximity-induced superconductivity. A vortex in this surface superconductor was shown to host a topologically protected Majorana mode. Since then, bulk superconductivity has been induced in several strong topological insulators via doping or application of pressure. Here, we address the question of whether a vortex in these superconductors will trap Majorana zero modes at the surface. Viewed as a 1D system, the vortex can be characterized by a Z_2 topological invariant which denotes the presence or absence of a Majorana mode at its end. For weak pairing, we find that, the transition point between the two topological phases is determined by a Fermi surface property in the normal state. Hence, the phase transition can be achieved by simply varying the Fermi level. At the transition, the vortex supports gapless Majorana excitations along its length. Using this criterion, we discuss whether surface Majorana modes exist in the experimentally established superconductors $Cu_xBi_2Se_3$, p-doped $TlBiTe_2$ and $Pd_xBi_2Te_3$. Interestingly, the Fermi surface criterion also allows superconducting vortices in systems with non-topological band structures to be associated with surface Majorana modes.

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