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Stability of Majorana vortex bound states on the surface of superconducting topological insulators JUNYI ZHANG, Department of Physics, Princeton University, JENNIFER CANO, TITUS NEUPERT, PCTS, Princeton University — Fu and Kane showed that superconductivity induced on the surface of a 3D topological insulator results in isolated Majorana bound states that appear in the cores of vortices. Many efforts to realize this idea are based on proximity-induced superconducting order in a heterostructure. Recently, superconductivity has been observed in $PbTaSe_2$, which has the band topology of a topological insulator with Dirac cone surface states. Hence, it nourishes the vision of realizing the Fu and Kane proposal in a stoichiometric material without the need for doping or fabricating heterostructures. Motivated by this possibility, we give a comprehensive analysis of stability and localization properties of the vortex Majorana modes in such a topological superconducting material. In particular, we address the experimentally relevant questions regarding (i) the energy separation between the vortex bound and excited states, (ii) the dependence of the hybridization between Majorana modes from opposite surfaces on the thickness of a thin-film sample, (iii) the influence of the bulk superconducting pockets on the Majorana states.

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