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Majorana fermions in 3DTI with superconductivity PEDRO LOPES, Unicamp/UIUC, POUYAN GHAEMI, SHINSEI RYU, UIUC — We study the problem of a strong 3D topological insulator (TI) with intrinsic superconductivity (SC). Particularly we present microscopic calculations using a low energy model of bulk massive Dirac fermions with mean field s-wave SC pairing. Introducing a kink in the mass in one spatial direction we can verify the appearance of localized (around the kink) states which correspond to the TI surface states and, with the further introduction of a vortex in the SC pairing, we are able to bind Majorana zero-modes (MZM's). The MZM's are known to be elusive particles in the sense that they are hard to detect. We then introduce a Majorana representation to the system Hamiltonian described above and propose an artificial doubling of this system which gives rise to a O(2) symmetry and allows us to define a conserved charge that can be used to probe for the presence of the MZM's. This doubled Majorana system then becomes an interesting playground, allowing us to search for masses which mix the different Hilbert spaces and study the behavior of this charge. We finish with a path-integral formulation of the problem through which we can integrate out the fermions and find an effective action for both, the electromagnetic as well as the corresponding to the O(2) conserved charge, gauge fields.

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