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Three-dimensional topological insulators, superconductors and defects in the Dirac limit[1] PAVAN HOSUR, University of California at Berkeley, SHINSEI RYU, ASHVIN VISHWANATH — If the electronic energy dispersion in a system is Dirac-like at low energies, a number of proximate phases can be accessed by perturbations that open a gap in the spectrum. Using this approach in three-dimensions, we find, besides several well-known phases, what we call a ıChiral Topological Insulatorȷ (cTI) and a ıSinglet Topological Superconductorȷ (sTS). We construct explicit microscopic models on a simple cubic lattice for these phases. Also, a physical picture of constructing the cubic lattice by stacking weakly coupled layers makes the topological nature of the cTI and the sTS apparent. An analogous picture leads us to a model of the time-reversal-invariant Z_2 topological insulators on a simple cubic lattice. The Dirac model also allows a facile calculation of the quantum numbers of topological defects to reveal dualities between order parameters, and we find that a hedgehog in Neel order has quantum numbers corresponding to the cTI and sTS, and one in the cTI and the sTS carries spin 1/2.

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