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Superconductivity on the surface of topological insulators and in two-dimensional noncentrosymmetric materials TITUS NEUPERT, LUIZ SANTOS, CLAUDIO CHAMON, CHRISTOPHER MUDRY — We study the superconducting instabilities of a single species of two-dimensional Rashba-Dirac fermions, as it pertains to the surface of a three-dimensional time-reversal symmetric topological band insulator. We also discuss the similarities as well as the differences between this problem and that of superconductivity in two-dimensional time-reversal symmetric noncentrosymmetric materials with spin-orbit interactions. The superconducting order parameter has both s-wave and p-wave components. We identify one single superconducting regime in the case of superconductivity in the topological surface states (Rashba-Dirac limit), irrespective of the relative strength between singlet and triplet pair potentials. In contrast, in the Fermi limit relevant to the noncentrosymmetric materials we find two regimes depending on the value of the chemical potential and the relative strength between singlet and triplet potentials. We construct explicitly the Majorana bound states in these regimes. In the single regime for the case of the Rashba-Dirac limit, there exist one and only one Majorana fermion bound to the core of an isolated vortex. In the Fermi limit, there are always an even number (0 or 2) of Majorana fermions bound to the core of an isolated vortex.

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