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Robustness of Majorana modes and minigaps in a spin-orbit-coupled semiconductor-superconductor heterostructure LI MAO, CHUANWEI ZHANG, Department of Physics and Astronomy, Washington State University — We study the robustness of Majorana zero energy modes and minigaps of quasiparticle excitations in a vortex by numerically solving Bogoliubov-deGennes equations in a heterostructure composed of an s -wave superconductor, a spin-orbit-coupled semiconductor thin film, and a magnetic insulator. This heterostructure was proposed recently as a platform for observing non-Abelian statistics and performing topological quantum computation. The dependence of the Majorana zero energy states and the minigaps on various physics parameters (Zeeman field, chemical potential, spin-orbit coupling strength) is characterized. We find the minigaps depend strongly on the spin-orbit coupling strength. In certain parameter region, the minigaps are linearly proportional to the s -wave superconducting pairing gap Δ_s , which is very different from the Δ_s^2 dependence in a regular s - or p -wave superconductor. We characterize the zero energy chiral edge state at the boundary and calculate the STM signal in the vortex core that shows a pronounced zero energy peak. We show that the Majorana zero energy states are robust in the presence of various types of impurities. We find the existence of impurity potential may increase the minigaps and thus benefit topological quantum computation.

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