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Magnetic Control of Majorana Edge Modes in Topological Insulator-Ferromagnet-Superconductor Heterostructures XIAOTING ZHOU, CHEN FANG, Purdue University, WEI-FENG TSAI, National Sun Yat-sen University, JIANGPING HU, Purdue University — A surface of a strong 3D topological insulator (TI) doped with ferromagnetic atoms can be spin-polarized and similar to a 2D quantum anomalous Hall state. If an s-wave superconductivity can be induced by proximity effect on such a surface, a 2D topological superconducting phase is obtained. If we consider a TI-ferromagnet(FM)-superconductor(SC) heterostructure, a 2D time-reversal symmetry breaking topological superconducting (TSC) phases with Majorana edge mode(s) will be realized. We demonstrate that the existence of the edge modes critically depend on the combination of the directions and magnitudes of spin polarization on all surfaces, and that a model describing the states on only one surface is insufficient. We find that the number, the positions and the chirality of these edge modes corresponding to various TSC phases can be engineered by controlling the ferromagnetism on different surfaces. Our results are obtained by self-consistently solving for the edge modes in a 3D lattice model for topological insulator in contact with an s-wave BCS superconductor. We also offer an analysis to illustrate the underlying physics, using an effective 2D theory for the surface states.

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