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Simulations and characterization of arrays of Josephson junctions on the surface of a topological insulator[1] ERIK HUEMILLER, CIHAN KURTER, AARON FINCK, DALE VAN HARLINGEN, University of Illinos at Urbana Champaign — Topological insulators (TI) have drawn a great deal of interest due to their unique surface states protected by time-reversal symmetry and strong spin-orbit coupling. Josephson junctions made by proximity coupling of s-wave superconductors (S) through the surface states of 3D TI have been predicted to produce excitations of Majorana fermions, which modify the usual current-phase relationship (CPR). In this talk, we present simulations of arrays of superconducting islands connected by Josephson junctions with a CPR of the form of $I_1 \sin\phi + I_2 \sin\phi/2$. We calculate the energy of the metastable states of the array and the resistance in dynamical states as a function of external magnetic field, and junction critical current for different array sizes and geometries. The 4π-periodic component of the CPR lifts the degeneracy to create additional metastable states and a modulation of the energy and resistance that depends on whether the number of vortices per cell is even or odd. We discuss experimental progress towards the fabrication of superconducting islands connected by S/TI/S junctions and their characterization by transport and imaging.

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