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Effects of Interactions on a Topological Phase Exhibiting Majorana Fermions in Quantum Wires MILES STOUDENMIRE, JASON ALICEA, UC Irvine — The ability to create and manipulate Majorana fermions in condensed matter systems is not only of fundamental interest for understanding topological phases but also provides a realistic route toward quantum computation. Recently, a series of devices have been proposed that could realize exotic Majorana physics in relatively conventional settings; among the most promising is a superconducting wire system with strong spin-orbit coupling. Because superconducitivity is induced in this system by proximity effect, the system remains superconducting even with net repulsive interactions. The effects of such interactions on this system have until now remained unexplored. Using the Density Matrix Renormalization Group method, we explore the fate of the topological phase in the presence of interactions. Obtaining a matrix product state representation of the degenerate ground states is especially helpful as it allows us to determine detailed properties of the Majorana edge states. Furthermore, we find that interactions significantly expand the topological region of the phase diagram, a result which strengthens proposals to realize Majorana fermions in such wire systems experimentally.

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