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Majorana fermions in 1D superconducting wires subject to disorder and other spatial inhomogeneities WADE DEGOTTARDI, Argonne National Laboratory, DIPTIMAN SEN, Indian Institute of Science, SMITHA VISHVESHWARA, University of Illinois at Urbana-Champaign — We present a systematic study of the role that disordered and quasiperiodic potentials play in the topology of 1D p-wave superconducting systems characterized by boundary Majorana modes. We forge a connection between Majorana wave functions and the localization properties of the corresponding normal state system (i.e, one which, though otherwise identical, lacks superconducting order). This enables the leveraging of the vast body of literature on Anderson localization to extensively map the topological phase diagram in superconducting wires. We find that the phase boundary is extremely sensitive to the detailed form of the potential. Our analysis provides a mapping between the limits of weak and strong disorder; in some cases, we are able to find the full phase boundary analytically. A noteworthy discovery is a tell-tale singularity in the phase boundary at the point corresponding to the quantum Ising model, a feature which offers a window into the physics of Majorana fermions. Our results can be directly applied to a spin-1/2 XY chain in a transverse magnetic field which is quasiperiodic or disordered.

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