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Majorana modes in a superconducting wire with quasiperiodic and WADE DEGOTTARDI, University of Illinois at Urbana-Champaign, MANISHA THAKURATHI, DIPTIMAN SEN, Centre for High Energy Physics, Indian Institute of Science, SMITHA VISHVESHWARA, University of Illinois at Urbana-Champaign — We present a systematic study of the role quasiperiodic and disordered potentials play in the topology of 1D p-wave superconducting systems based on a lattice model which we analyze using a transfer matrix approach. We employ a similarity transformation to demonstrate that the existence of Majorana modes is intimately connected to the band structure of the corresponding normal state system (i.e one which, though otherwise identical, lacks superconducting order). We illustrate this correspondence using the case of an electron moving in a quasiperiodic potential. The Hamiltonian of this system is the so-called "almost Mathieu operator" whose bulk spectrum (for a certain choice of parameters) is described by a fractal known as Hofstadter's butterfly. Specifically, we prove that states belonging to this spectrum host end Majoranas for arbitrarily weak superconductivity and that increasing the magnitude of the superconducting gap causes these topologically non-trivial regions of the phase diagram to expand and fill in the butterfly. We show that similar considerations give us excellent theoretical control over the topological phase diagram of systems with disordered potentials.

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