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Multiple signatures of topological phase transitions in a finite superconducting nanowire with intrinsic interactions Y.-H. CHAN, Institute of Atomic and Molecular Sciences, Academia Sinica, Taipei 10617, Taiwan, CHING-KAI CHIU, Department of Physics and Astronomy, University of British Columbia, Vancouver, BC, Canada V6T 1Z1, KUEI SUN, Department of Physics, The University of Texas at Dallas, Richardson, Taxes 75080-3021, USA — We study a finite chain model with spinless fermions that describes a p-wave superconducting nanowire with proximity-induced pairing gap and intrinsic interactions. By systematically tracking various physical quantities such as ground state energy, compressibility, entanglement spectrum, Cooper pair size, and pair condensate density, we obtain multi-signature of topological phase transitions between strong and weak pairing states. Some of the signatures are stable against finite-size effects. In addition, we explore the possibility of the topological transition at fixed volume, number of particles, and number of condensed pairs. The results would help explore a fundamental question: whether or not must a topological phase transition accompany with the change of extensive thermodynamic quantities?

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