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Fidelity of Majorana-based quantum operations MOSTAFA TANHAYI AHARI, GERARDO ORTIZ, BABAK SERADJEH, Indiana Univ - Bloomington — It is well known that one-dimensional p-wave superconductor, the so-called Kitaev model, has topologically distinct phases that are distinguished by the presence of Majorana fermions. Owing to their topological protection, these Majorana fermions have emerged as candidates for fault-tolerant quantum computation. They furnish the operation of such a computation via processes that produce, braid, and annihilate them in pairs. In this work we study some of these processes from the dynamical perspective. In particular, we determine the fidelity of the Majorana fermions when they are produced or annihilated by tuning the system through the corresponding topological phase transition. For a simple linear protocol, we derive analytical expressions for fidelity and test various perturbative schemes. For more general protocols, we present exact numerics. Our results are relevant for the operation of Majorana-based quantum gates and quantum memories.

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