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The effects of interactions on the topological classification of free fermion systems LUKASZ FIDKOWSKI, ALEXEI KITAEV, Caltech — We describe in detail a counterexample to the topological classification of free fermion systems. We deal with a one dimensional chain of Majorana fermions with an unusual T symmetry. The topological invariant for the free fermion classification is an integer, but with the introduction of interactions it becomes well defined only modulo 8. We illustrate this in the microscopic model of the Majorana chain by constructing an explicit path between two distinct free phases whose topological invariants are equal modulo 8, along which the system remains gapped. The path goes through a strongly interacting region. We also find the field theory interpretation of this phenomenon. There is a second order phase transition between the two phases in the free theory which can be avoided by going through the strongly interacting region. We show that this transition is in the 2D Ising universality class, where a first order phase transition line, terminating at a second order transition, can be avoided by going through the analogue of a high temperature paramagnetic phase. In fact, we construct the full phase diagram of the system as a function of the thermal operator (i.e. the mass term that tunes between the two phases in the free theory) and two quartic operators, obtaining a first order Peierls transition region, a second order transition region, and a region with no transition.

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