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Title: Quantum computing with Majorana zero modes

Abstract:

Quantum information processing demands extraordinary control of a physical system for manipulation while still keeping it decoupled from the detrimental effects of environmental degrees of freedom. A very promising way to unite these antipodes is provided by topological quantum computing. The idea is to encode the quantum information nonlocally in order to protect it from the environment while still allowing for manipulation via braiding of the non-Abelian particles. One on the most promising systems, in this respect, are topological superconductors which host Majorana zero modes. I will give an introduction to the physics of Majorana zero modes with a special emphasis on charging effects in topological superconductors. With this, I will introduce the idea of parity-protected quantum computation that essentially offers all the advantages of topological quantum computation while being within experimental reach; I will present schemes for measurement and manipulation via braiding. I will end with recent ideas how to make the quantum information in a topological superconductor fault tolerant by performing tailor-made error correction in the Majorana toric code.