Engineering new platforms for topological quantum computing

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Quantum computation requires controlled engineering of quantum states to perform tasks that go beyond those possible with classical computers. Topological quantum computation aims to achieve this task by using non-Abelian quantum phases of matter. Such phases allow for quantum information to be stored and manipulated in a non-local manner, which protects it from imperfections in the implemented protocols and from interactions with the environment. Despite progress in the field, experimentally controlling and manipulating non-Abelian quantum Hall states still proves to be a highly challenging task. We consider the possibility to engineer new non-Abelian systems by interfacing simpler, Abelian components. We show that this route leads to zero modes exhibiting a new type of non-Abelian statistics. Furthermore, judicially coupling these zero modes leads to new topological phases of matter, which can harbor excitations with computationally universal braid statistics.