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Establishing non-Abelian topological order in Gutzwiller projected Chern insulators via Entanglement Entropy and Modular S-matrix YI ZHANG, Stanford University, ASHVIN VISHWANATH, University of California, Berkeley — We use entanglement entropy signatures to establish non-Abelian topological order in a new class of ground states, the projected Chern-insulator wave functions. The simplest instance is obtained by Gutzwiller projecting a filled band with Chern number C=2 which may also be viewed as the square of the band insulator Slater determinant. We demonstrate that this wave function is captured by the $SU(2)_2$ Chern Simons theory coupled to fermions. In addition to the expected torus degeneracy and topological entanglement entropy, we also show that the modular S-matrix, extracted from entanglement entropy calculations, provides direct access to the peculiar non-Abelian braiding statistics of Majorana fermions in this state. We also provide microscopic evidence for the generalization (expected from the field theory), that the N^{th} power of a Chern number C Slater determinant realizes the topological order of the $SU(N)_C$ Chern Simons theory coupled to fermions, by studying the $SU(2)_3$ and the $SU(3)_2$ wave functions. An advantage of projected Chern insulator wave functions over lowest Landau level wave functions for the same phases is the relative ease with which physical properties, such as entanglement entropy, can be numerically calculated using Monte Carlo techniques.

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