Topological order and semions in a strongly correlated quantum spin Hall insulator ANDREAS RUEGG, GREGORY A. FIETE, University of Texas at Austin — We provide a self-consistent mean-field framework to study the effect of strong interactions in a quantum spin Hall insulator on the honeycomb lattice. We identify an exotic phase for large spin-orbit coupling and intermediate Hubbard interaction. This phase is gapped and does not break any symmetry. Instead, we find a four-fold topological degeneracy of the ground state on the torus and fractionalized excitations with semionic mutual braiding statistics. Moreover, we argue that it has gapless edge modes protected by time-reversal symmetry but a trivial Z_2 topological invariant. Finally, we discuss the experimental signatures of this exotic phase. Our work highlights the important theme that interesting phases arise in the regime of strong spin-orbit coupling and interactions.

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