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(3 + 1)-dimensional BF theory from a tight-binding model of interacting spinless fermions MAURO CIRIO, Macquarie University, GIANDOMENICO PALUMBO, JIANNIS K. PACHOS, University of Leeds — Currently, there is much interest in discovering analytically tractable (3 + 1)-dimensional models that describe interacting fermions with emerging topological properties. Towards that end we present a three-dimensional tight-binding model of spinless interacting fermions that reproduces, in the low energy limit, the (3 + 1)-dimensional Abelian BF topological theory. We first consider the non- interacting case. By employing a mechanism equivalent to the Haldane's Chern insulator we can turn the model into a (3 + 1)-dimensional chiral topological insulator. We then isolate energetically one of the two Fermi points of the lattice model. In the presence of fermionic interactions we can map the system to a generalised version of the (3 + 1)-dimensional Thirring model with low energy behaviour that is faithfully described by the BF theory. This approach directly establishes the presence of (2 + 1)-dimensional BF theory at the boundary of the lattice and it provides an observable for the topological order of the model through fermionic density measurements.

Mauro Cirio
Macquarie University

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