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Realization and Detection of Three Dimensional Chiral Topological Insulators in Optical Lattices[1] SHENGTAO WANG, DONG-LING DENG, LUMING DUAN, Univ of Michigan - Ann Arbor — Chiral topological insulators are protected by the chiral symmetry, which does not occur naturally in condensed matter systems. Here, we propose an experimental scheme to realize and detect chiral topological insulators in three dimensions (3D) with cold atoms in optical lattices. Three nearly degenerate internal states are used and all terms in the Hamiltonian are realized by two-photon Raman transitions. Unlike time-reversal-invariant Z_2 topological insulators, these chiral topological insulators are characterized by a Z index. A notable feature of the model Hamiltonian is the presence of an exactly zero-energy flat band with nontrivial topology. The macroscopic degeneracy may provide an excellent testing ground for fractional topological physics in 3D, as it occurred in 2D fractional quantum Hall states. We show that Lifshitz transitions and the symmetry-protected Dirac cones can be probed through time-of-flight measurements and momentum-resolved interband transitions. The flat band can be detected via atomic density measurements in the trap.

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