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Direct probe of topological order for cold atoms[1] DONG-LING DENG, SHENG-TAO WANG, LU-MING DUAN, Department of Physics, University of Michigan, Ann Arbor, Michigan 48109, USA — Cold-atom experiments in optical lattices offer a versatile platform to realize various topological quantum phases. A key challenge in those experiments is to unambiguously probe the topological order. We propose a method to directly measure the characteristic topological invariants (order) based on the time-of-flight imaging of cold atoms. The method is generally applicable to detection of topological band insulators in one, two, or three dimensions characterized by integer topological invariants. Using detection of the Chern number for the two-dimensional anomalous quantum Hall states and the Chern-Simons term for the three-dimensional chiral topological insulators as examples, we show that the proposed detection method is practical, and robust to typical experimental imperfections such as limited imaging resolution, inhomogeneous trapping potential, and disorder in the system.

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