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Topological photonic systems: from integer to fractional quantum Hall states[1] MOHAMMAD HAFEZI, Joint Quantum Institute, University of Maryland, MIKHAIL LUKIN, EUGENE DEMLER, Harvard University, JACOB TAYLOR, Joint Quantum Institute, NIST — Topological properties of systems lead to remarkable robustness against disorder. The hallmark of such behavior is the quantized quantum Hall effect, where the electronic transport in two-dimensional systems is protected against scattering from impurities and the quantized Hall conductance is the manifestation of a topological invariance. Here we suggest an analogous approach to quantum Hall physics to create robust photonic devices. Specifically, we show how quantum Hall and quantum spin Hall Hamiltonians can be implemented with linear optics using coupled resonator optical waveguides (CROW) in two dimensions. Key features of quantum Hall systems could be observed via reflection spectroscopy, including the characteristic Hofstadter "butterfly" and edge state transport. Furthermore, the addition of an optical non- linearity to our proposed system leads to the possibility of implementing a fractional quantum Hall state of photons, where phenomenon such as non-abelian statistics may be observable.

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