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Robust optical delay lines via topological protection[1] MOHAMMAD HAFEZI, Joint Quantum Institute, University of Maryland, EUGENE DEMLER, MIKHAIL LUKIN, Harvard University, JACOB TAYLOR, Joint Quantum Institute, NIST — Phenomena associated with topological properties of physical systems are naturally robust against perturbations. This robustness is exemplified by quantized conductance and edge state transport in the quantum Hall and quantum spin Hall effects. Here we show how exploiting topological properties of optical systems can be profitably used in photonic devices. We demonstrate how quantum spin Hall Hamiltonians can be created with linear optical elements using a network of coupled resonator optical waveguides (CROW) in two dimensions. We find that key features of quantum Hall systems, including the characteristic Hofstadter butterfly and robust edge state transport, can be obtained in such systems. As a specific application, we show that the topological protection can be used to dramatically improve the performance of optical delay lines and to overcome limitations related to disorder in photonic technologies.

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