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Measurement of 2D topological invariants from anomalous edge spectral flow SRIRAM GANESHAN, Simons center of geometry and physics, Stony Brook University, SUNIL MITTAL, JINGYUN FAN, Joint Quantum Institute, NIST/University of Maryland, College Park, ABOLHASSAN VAEZI, Stanford University, MOHAMMAD HAFEZI, Joint Quantum Institute, NIST/University of Maryland, College Park MD — A hallmark example of a TQFT is the 2+1 D Chern-Simons (CS) theory, which describes topological properties of both integer and fractional quantum Hall effects. The gauge invariant form of the CS theory with boundaries, encompassing both edge and bulk terms, provides an unambiguous way to relate bulk topological invariants to the edge dynamics. This bulk-edge correspondence is manifested as a gauge anomaly in the bulk and chiral anomaly at the edge, and provides a direct insight into the bulk topological order. In this work, we experimentally implement the integer quantum Hall model in a photonic system where the edge modes are described by the anomalous chiral conformal field theory. By selectively manipulating and probing the edge, we exploit the chiral anomaly of the edge theory, for the first time. The associated spectral edge flow associated to the chiral anomaly allows us to unambiguously measure topological invariants, i.e., the winding number of the edge states. This experiment provides a new approach for direct measurement of topological invariants, independent of the microscopic details, and thus could be extended to probe strongly-correlated topological orders.

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