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Measurement of a topological edge invariant in a microwave network JASON C. PILLAY, WENCHAO HU, Nanyang Technological University, KAN WU, Shanghai Jiao Tong University, MICHAEL PASEK, PERRY PING SHUM, YIDONG CHONG, Nanyang Technological University — We report on the experimental measurement of topological edge invariants in an electromagnetic analog of a topological insulator, realized by a classical microwave network. This experiment serves as a classical electromagnetic realization of Laughlin's "topological pumping" thought experiment for the quantum Hall effect. The experiment consists of determining the electromagnetic scattering matrix, based on the input and output wave amplitudes measured at the edges of the network via a network analyzer. The winding on the scattering matrix eigenvalues, resulting from a tunable phase shift built into the network, forms a topological invariant. We demonstrate the existence of a topologically trivial phase, where the winding is zero (no edge states), as well as a topologically nontrivial phase, where the winding is non-zero (topological edge states present). Unlike most other systems used to study topological insulator physics, the full complex scattering parameters can be measured in this setup. As in most microwave experiments, however, our system is susceptible to losses. We show that topological behavior can be meaningfully defined in the experiment despite the effects of loss.

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