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Time Reversal Invariant Topologically Insulating Circuit

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Univ of Chicago — With the discovery of the quantum hall effect and topological insulators, there has been an outpouring of ideas to harness topologically knotted band-structures in the design of state-of-the art, disorder-insensitive materials. From studies of exotic quantum many- body phenomena to applications in spintronics and quantum information processing, topological materials are poised to revolutionize the condensed matter frontier. Here we demonstrate, for the first time, a circuit that behaves as a time-reversal invariant topological insulator for RF photons. In this meta-material, composed of capacitively coupled high-Q inductors, we observe a gapped density of states consistent with a modified Hofstadter spectrum at a flux per plaquette of $\phi=\pi/2$. In-situ probes further reveal time-resolved, spin-dependent edge-transport. We leverage the unique flexibility of our materials to investigate, for the first time, features of topological insulators on manifolds such as the Mobius strip. This new approach elucidates the fundamental ingredients essential to topologically active materials, whilst providing a powerful laboratory to study topological physics and a promising route to topological quantum science.

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