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Experimental realization of the topological Haldane model MICHAEL MESSER, GREGOR JOTZU, RÉMI DESBUQUOIS, MARTIN LEBRAT, THOMAS UEHLINGER, FREDERIK GÖRG, DANIEL GREIF, TILMAN ESSLINGER, ETH Zurich — The Haldane model is a fundamental example of a Hamiltonian exhibiting topologically distinct phases of matter and featuring a quantum Hall effect without a net magnetic field. We report on the experimental realization of the Haldane model and the characterization of its topological band-structure, using non-interacting ultracold fermionic atoms in a periodically modulated honeycomb lattice. Here the inertial force generated by circular modulation of the lattice position breaks time-reversal symmetry and leads to complex next-nearest-neighbor tunneling. We explore the resulting Berry-curvatures of the lowest band and map out topological phase transitions connecting distinct regimes. Furthermore we extend our method to create spin dependent effective Hamiltonians by periodic modulation of a magnetic field gradient. For each spin state, the differing band structure can be characterized either by measuring the expansion of an atomic cloud in the lattice, or by a measurement of the effective mass through dipole oscillations. Our method can be used to create systems where one state is pinned to the lattice, while the other remains itinerant.

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