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Quantum gas microscopy of the interacting Harper-Hofstadter system M. ERIC TAI, ALEX LUKIN, PHILIPP PREISS, MATTHEW RISPOLI, ROBERT SCHITTKO, ADAM KAUFMAN, MARKUS GREINER, Harvard University — At the heart of many topological states is the underlying gauge field. One example of a gauge field is the magnetic field which causes the deflection of a moving charged particle. This behavior can be understood through the Aharonov-Bohm phase that a particle acquires upon traversing a closed path. Gauge fields give rise to novel states of matter that cannot be described with symmetry breaking. Instead, these states, e.g. fractional quantum Hall (FQH) states, are characterized by topological invariants, such as the Chern number. In this talk, we report on experimental results upon introducing a gauge field in a system of strongly-interacting ultracold Rb87 atoms confined to a 2D optical lattice. With single-site resolution afforded by a quantum gas microscope, we can prepare a fixed atom number and project hard walls. With an artificial gauge field, this quantum simulator realizes the Harper-Hofstadter Hamiltonian. We can independently control the two tunneling strengths as well as dynamically change the flux. This flexibility enables studies of topological phenomena from many perspectives, e.g. site-resolved images of edge currents. With the strong on-site interactions possible in our system, these experiments will pave the way to observing FQH-like states in a lattice.

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