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Interaction-enabled chiral trajectories in a ladder governed by the Harper-Hofstadter Model MATTHEW RISPOLI, M. ERIC TAI, ALEX LUKIN, ROBERT SCHITTKO, TIM MENKE, DANIEL BORGNIA, Harvard University, PHILIPP PREISS, Universitaet Heidelberg, FABIAN GRUSDT, ADAM KAUFMAN, MARKUS GREINER, Harvard University — The combination of interacting charged particles and magnetic fields can to lead to exotic phases of matter that exhibit high degrees of spatial entanglement and topological order. Ultracold atoms and optically engineered artificial gauge fields have been used to study a number of single particle effects, such as edge states, topological band structures, and the quantum hall effect. However, these experiments have not yet incorporated inter-particle interactions. I will describe recent experimental results in which we combine microscopy, interacting atoms, and the presence of a synthetic magnetic field in a 2xN real-space ladder. In particular, we observe the chiral dynamics of both single-particle and two-particle systems with strong, finite interactions. We show the interactions for the two-particle system enable these chiral dynamics where they would otherwise be absent. Additionally, the observed correlations distinguish the presence of states with bound and free-particle character and their contributions to the chirality. Our observation of a novel form of interaction-enabled chirality illustrates the rich physics that can emerge with these ingredients even in the few particle limit. Realizing this combination of elements is essential to advance into the regime of fractional quantum hall physics, as well as to drive explorations for new phenomena with the microscopic tools of AMO systems.

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