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Microscopy of the interacting Harper-Hofstadter model in the few-body limit M. ERIC TAI, ALEXANDER LUKIN, MATTHEW RISPOLI, ROBERT SCHITTKO, TIM MENKE, DAN BORGNIA, Harvard University, PHILIPP PREISS, Universität Heidelberg, FABIAN GRUSDT, ADAM KAUFMAN, MARKUS GREINER, Harvard University — The interplay of magnetic fields and interacting particles can lead to exotic phases of matter exhibiting topological order and high degrees of spatial entanglement. While these phases were discovered in a solid-state setting, recent techniques have enabled the realization of gauge fields in systems of ultracold neutral atoms, offering a new experimental paradigm for studying these novel states of matter. This complementary platform holds promise for exploring exotic physics in fractional quantum Hall systems due to the microscopic manipulation and precision possible in cold atom systems. However, these experiments thus far have mostly explored the regime of weak interactions. Here, we show how strong interactions can modify the propagation of particles in a $2 \times N$, real-space ladder governed by the Harper-Hofstadter model. We observe inter-particle interactions affect the populating of chiral bands, giving rise to chiral dynamics whose multiparticle correlations indicate both bound and free-particle character. The novel form of interaction-induced chirality observed in these experiments demonstrates the essential ingredients for future investigations of highly entangled topological phases of many-body systems.

M. Eric Tai
Harvard University

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