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Observation of band gap closing in a synthetic Hall tube of neutral fermions.[1] JEONG HO HAN, JIN HYOUN KANG, YONG-IL SHIN, Seoul National University — The Harper-Hofstadter Hamiltonian is the essential model for studying the quantum Hall physics of lattice systems. Recently, many types of Hall systems have been realized in the optical lattice experiments. In this talk, we present our experimental realization of a synthetic Hall lattice system with three-leg tube geometry for ultracold fermionic ytterbium atoms in a 1D optical lattice. The legs of the synthetic tube are composed of three atomic hyperfine spin states, and the cyclic inter-leg links are generated by two-photon Raman transitions between the spin states, resulting in a uniform gauge flux ϕ penetrating each side plaquette of the tube. Using quench dynamics, we investigate the band structure of the Hall system for a commensurate flux $\phi = 2\pi/3$. The momentum-resolved analysis of the quench dynamics reveals the band gap closing behavior at the critical point of a topological phase transition for the Hall tube system as its boundary condition evolves from periodic to open by varying the one of the inter-leg coupling strengths. We also investigate the emergent topological features of the Hall tube system for the case of incommensurate gauge flux.

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