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**Ultracold atoms in strong synthetic magnetic fields**

WOLFGANG KETTERLE, MIT, Cambridge

The Harper Hofstadter Hamiltonian describes charged particles in the lowest band of a lattice at high magnetic fields. This Hamiltonian can be realized with ultracold atoms using laser assisted tunneling which imprints the same phase into the wavefunction of neutral atoms as a magnetic field does for electrons. I will describe our observation of a bosonic superfluid in a magnetic field with half a flux quantum per lattice unit cell, and discuss new possibilities for implementing spin-orbit coupling. Work done in collaboration with C.J. Kennedy, G.A. Siviloglou, H. Miyake, W.C. Burton, and Woo Chang Chung.