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Ultracold atoms in strong synthetic magnetic fields

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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 dose for electrons. I will describe our observation of a bosonic superfluid in a magnetic field with half a flux quantum per lattice unit cell. Subsequently, we have used laser assisted tunneling to realize synthetic spin orbit coupling and to observe a supersolid. A supersolid is superfluid and breaks translational symmetry, i.e. it has shape.