HQOC

HARVARD Quantum Optics Center

Special Seminar

Tuesday | Jan. 14 | 2:00 PM
Lyman 425

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"Artificial Gauge Fields in Driven Optical Lattices"

Quantum gases provide a controllable and isolated environment for the investigation of model Hamiltonians, reaching from the weakly-interacting to the strongly-correlated regime. However, as the constituent particles of these gases are typically neutral they do not respond to electromagnetic fields via the Lorentz force. This constitutes a central limitation towards the simulation of various solid state models involving external electromagnetic fields.

In recent years the creation of synthetic gauge fields for ultracold neutral atoms has developed to a promising field that allows overcoming this limitation. Recently, we have demonstrated that suitable periodic driving of atoms in an optical lattice can mimic the effects of a tunable gauge potential.

In this talk, we report on the experimental realization of a spin model with coupled continuous and discrete degrees of freedom on a periodically driven triangular lattice. As a result of the strong artificial gauge field, the bosonic atoms in the lattice show persistent circular currents in analogy to the cyclotron motion of electrons in magnetic fields. The direction of this mass flow provides the discrete Ising variable. By measuring the magnetization of the systems we observe a thermally driven Ising-type phase transition from an ordered, (anti-)ferromagnetic to an unordered, paramagnetic state.

Further, the superfluid ground state with well-defined phases on each lattice site provides continuous XY vector-spin variables. The interplay of these different degrees of freedom naturally raises the question of coupled order parameters and new universality classes of phase transitions.