Atomic Spin Entanglement and Anyonic Statistics in Optical Lattices

Thursday, 14 September 2023 11:15 (35 minutes)

In this talk, I will report our recent research progress with ultracold atoms trapped in optical lattices. Ultracold atoms in optical lattices hold promise for the creation of entangled states for quantum simulation and quantum computation.

In our experiment, we developed a novel setup of spin-dependent optical superlattices. We were able to generate, manipulate and detect the atomic spin entanglement in this lattice. Moreover, based on the techniques of precisely manipulating atomic spins, we built a minimum version of the toric code Hamiltonian with four atomic spins in optical plaquettes. We observed four-body ring-exchange interactions, existing in many-body systems while never observed before in experiment, and the topological properties of anyonic excitations within this ultracold atom system. This work represents an essential step towards studying topological matter with ultracold atoms and offers new perspectives on topological quantum simulation.

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