

Quantum Simulation with Ultracold Atoms

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Manipulating quantum phenomena of microscopic particles to emulate novel states of matter and establish high-precision time standards promises to greatly advance future technological developments. Techniques involving ultracold atoms have formed a nexus between disciplines such as quantum information science, condensed matter physics, and quantum precision measurement, positioning them at the forefront of hot research areas in physics. In quantum simulation, systems comprising hundreds up to millions of atoms can be artificially created and controlled to mimic complex systems found in condensed matter physics and quantum field theory. This facilitates the validation or prediction of novel quantum phenomena, exploration of the underlying microscopic mechanisms, and fosters the next generation of technological and industrial revolutions. Utilizing small-scale and manageable ultracold fermionic systems, important unsolved models in condensed matter physics like the Fermi-Hubbard model can be simulated, aiming to acquire phase diagrams of strongly correlated fermionic systems at low temperatures. In this talk, I will introduce the latest developments in quantum simulation based on ultracold fermionic systems in USTC.