Invited talk

Correlations in homogeneous fermionic Hubbard gases: Coherence and Magnetism

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The fermionic Hubbard model (FHM), which describes electron motion in a lattice, is considered one of the key models for understanding high-temperature superconductors. Yet, resolving its low-temperature phase diagram remains difficult, both theoretically and numerically. Ultracold Fermi atoms in optical lattices provide a clean and highly controllable platform for simulating the FHM. In this talk, I will present our recent progress in quantum simulations of the FHM. We have constructed a homogeneous fermionic Hubbard system with approximately 800,000 lattice sites at temperatures below the Neel temperature. By observing and quantitatively characterizing the interference patterns of fermions, we have precisely measured non-local correlation functions of the system, offering new insights into the many-body physics of the FHM. Furthermore, we have employed spin-sensitive Bragg scattering to measure the spin structure factor of the system. When interaction strength, temperature, and doping concentration are finely tuned to their respective critical values, we have observed a sharp increase in the spin structure factor. These observations can be well described by a power-law divergence, providing conclusive evidence for the realization of the antiferromagnetic phase transition.