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Title:

Quantum Phase Transitions in an Optical Lattice

Abstract:

The Femi-Hubbard model is thought to be a useful model for understanding high-temperature superconductivity, but numerical solutions to such a model are prohibitively difficult to compute due to the existence of the so-called 'sign problem.' An alternative to numerical analysis of the Fermi-Hubbard model is to map the phase diagram explicitly via its direct experimental simulation in an optical lattice. Our experiment populates sites in an optical lattice with atoms of a fermionic isotope of potassium cooled to sub-microkelvin temperatures. In a manner similar to scanning-tunneling microscopy, we are working towards using optical microscopy to resolve the occupation numbers of sites in this lattice, which will reveal such phenomena as the superfluid to Mott-insulator quantum phase transition. The ability to tailor optical potentials and interaction strengths in the experiment will allow for scalability to more complex phase transitions in future work.