Quantum-Gas Microscopes - Quantum-Simulation with Single-Particle Access

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Ultracold atoms in well-controlled engineered environments in optical lattices are a versatile tool for quantum-simulation of strongly correlated quantum systems. The most recent developments in this field include quantum-gas microscopes [1], enabling single-lattice-site resolution and single-atom control [2]. I will present how we achieved single-atom-resolved fluorescence imaging of fermionic potassium-40 atoms using electromagnetically-induced-transparency (EIT) [3] and Raman sideband cooling. We also developed a method for preparing a single two-dimensional sample of a two-spin mixture of fermionic potassium in a single antinode of an optical lattice, in a quantum-gas microscope apparatus, using spatially selective adiabatic microwave pulses in a magnetic field gradient [5]. I will also report on our progress towards study of strongly correlated fermionic quantum systems and their out-of-equilibrium dynamics.

References

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