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Progress towards tweezer-based assembly of many-body states of strontium in an optical lattice AARON YOUNG, MATTHEW NORCIA, WILLIAM ECKNER, BENJAMIN JOHNSTON, ADAM KAUFMAN, JILA, CU Boulder and NIST — Microscopy of ultracold atoms trapped in optical potentials has proven to be a powerful platform for studying quantum many-body systems, with applications ranging from metrology to quantum information and simulation. So far, much of this work has centered on alkali atoms, whose internal degrees of freedom grant ease of control and detection. Here, I present tools for high-fidelity single-particle-resolved detection of the alkaline-earth atom strontium (Sr), and full quantum state control of its motional and internal degrees of freedom. These capabilities are enabled by our use of the diverse optical transitions present in Sr and other alkaline-earth atoms, key for ground-state cooling, rapid detection, and the generation of long-lived atom-optical coherence. These tools enable a variety of future directions; in this talk I will focus on our progress towards optical tweezer-based rearrangement of Sr in an optical lattice. By combining the flexible motional control and state preparation afforded by Sr in optical tweezers with the very stable potential provided by an optical lattice, we aim to study 1D and 2D Hubbard model physics in a lattice, with arbitrary initial state preparation and site- and particle-resolved readout.

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