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Microscopic control and detection of ultracold strontium for many-body physics and metrology

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Microscopic control and detection of ensembles of neutral atoms have transformed our ability to study complex many-body systems. Techniques like quantum gas microscopy and optical tweezers grant a new single-particle-resolved perspective on solid-state analogs and idealized quantum spin models, as well as altogether novel detection capabilities for fundamentally quantum quantities like entanglement. In this talk, I will describe our group's progress towards developing these tools for a new atomic species, strontium. In doing so, we establish new prospects for applying these microscopic control techniques to states of matter, like quantum spin liquids, that are enabled by alkaline-earth atoms, along with quantum-information-processing architectures that exploit the rich internal degrees-of-freedom of this species. Importantly, our work also demonstrates a new direction for these tools of microscopic control — neutral-atom optical clocks — a marriage which has a number of strengths for metrology. To this end, I will report also our recent results of Hz-scale coherence and repeated atomic interrogation, which are directed towards the development of a high-duty cycle tweezer-array clock.