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Towards Quantum Simulation of Light-Matter Interfaces with Strontium Atoms in Optical Lattices NEVEN SANTIC, ANDRE HEINZ, ANNIE JIHYUN PARK, JAN TRAUTMANN, EVA CASOTTI, FLORIAN WALLNER, IMMANUEL BLOCH[1], SEBASTIAN BLATT, Max Planck Institute of Quantum Optics — In the last two decades, quantum simulators based on ultracold atoms in optical lattices have successfully emulated strongly correlated condensed matter systems. With the recent development of quantum gas microscopes, these quantum simulators can now control such systems with single-site resolution. Within the same time period, atomic clocks have also started to take advantage of optical lattices by trapping alkaline-earth-metal atoms such as Sr, and interrogating them with precision and accuracy at the 10^{-18} level. Here, we report on progress towards a new quantum simulator that combines quantum gas microscopy with optical lattice clock technology. We have developed in-vacuum buildup cavities with large mode volumes that will be used to overcome the limits to system sizes in quantum gas microscopes. We measure the spatial overlap of two orthogonal cavity modes of the in-vacuum buildup cavity by loading ultracold strontium atoms in a lattice created by those modes. By using optical lattices created in this buildup cavity that are state-dependent for the clock states, we aim to emulate strongly-coupled light-matter-interfaces in parameter regimes that are unattainable in real photonic systems.

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