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Scaling two-dimensional arrays of strontium atoms in optical tweezers for many-body physics and precision metrology WILLIAM ECKNER, AARON YOUNG, WILLIAM MILNER, MATTHEW NORCIA, NATHAN SCHINE, DHRUV KEDAR, JUN YE, ADAM KAUFMAN, JILA, CU Boulder and NIST — Ultracold atoms in optical lattices and tweezer arrays have independently provided flexible environments for studies of many-body quantum physics and optical-frequency metrology. Here we present on a new platform for creating two-dimensional optical potentials loaded with hundreds of strontium atoms, each in its three-dimensional ground-state. The building blocks for this platform are tweezers and lattices, between which atoms can be adiabatically transferred, and where each potential can independently address the diverse challenges posed by each step in an experimental sequence. We then leverage this new technology toward the development of a precise optical atomic clock with long-lived atom-atom coherence and high relative frequency stability. By 'Rydberg-dressing' the metastable clock state, we plan to introduce switchable, long-range interactions in a tunable two-dimensional array of 50-200 atoms. This would allow for studies of the metrological usefulness of highly-entangled 'squeezed-states,' as well as investigations into a broad class of interacting many-body spin systems, such as the transverse-field Ising model.

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