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Construction of a Quantum Matter Synthesizer MICKEY MCDONALD, JONATHAN TRISNADI, MINGJIAMEI ZHANG, CHENG CHIN, Department of Physics, University of Chicago — We report progress on the construction of a "Quantum Matter Synthesizer," a new experimental platform which will have the capability to deterministically prepare two-dimensional arrays of ultracold atoms with single site addressability. Pre-cooled cesium atoms are first transferred into a science cell via a moving lattice, and then loaded into a magic-wavelength, far-detuned 2D optical lattice. The cell is centered between two microscope objectives. The upper objective projects an array of optical tweezers created via a digital micromirror device (DMD) onto the atom plane. The tweezers will arrange atoms into a desired configuration. The lower objective performs in situ imaging of atoms in the lattice. To extend conventional quantum gas microscopes, we highlight results from our development of a technique for super-resolution microscopy of cold atoms, enabling sub-wavelength imaging of atomic density distributions far below the diffraction limit. Such an imaging scheme will be integrated into our quantum matter synthesizer.

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