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Quantum Phases of Cesium Bose-Einstein Condensates in a two-dimensional Optical Lattice XIBO ZHANG, CHEN-LUNG HUNG, NATHAN GEMELKE, CHENG CHIN, Department of Physics and James Franck Institute, University of Chicago — The precise comparison between experiment and the Bose-Hubbard model in determining the phase boundaries of the superfluid to Mott-insulator transitions with ultracold atoms in an optical lattices serves as a first step towards a quantum simulator for many-body physics. Here we report experimental progress on probing phase boundaries using ^{133}Cs atoms in a thin layer of a two-dimensional optical lattice. A 2D geometry is chosen to remove the inhomogeneity along the imaging direction for a direct determination of the density profile. To load atoms into the 2D optical lattice, we prepare a high aspect ratio BEC of 10^4 ^{133}Cs atoms in a trap with weak horizontal and strong vertical confinement provided by a crossed 1064 nm dipole trap and a 10 μm light sheet, respectively. The BEC is then transferred into a single layer of 4 μm period vertical lattice, and a two-dimensional horizontal 2D lattice is formed by retroreflecting the crossed dipole trap beams. The on-site interaction is tuned by magnetic Feshbach resonance, and high resolution *in-situ* imaging is performed to probe the phase boundaries at given scattering length and lattice depth.

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