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Role of Spatial Inhomogeneity in the Experimental Determination of the Two Dimensional Bose-Hubbard Model Critical Point KHAN W. MAHMUD, University of California, Davis, VALERY G. ROUSSEAU, Instituut-Lorentz, LION, Universiteit Leiden, Postbus 9504, 2300 RA Leiden, The Netherlands, MARCOS RIGOL, Georgetown University, GEORGE G. BATROUNI, University of Nice, RICHARD T. SCALETTAR, University of California, Davis — Recent experiments at NIST on confined Rb atoms in two dimensions, combined with high precision Quantum Monte Carlo (QMC) values for the homogeneous Bose-Hubbard model critical point, represented important progress toward testing the concept of optical lattice emulator. The experimentally determined critical coupling for the superfluid-Mott transition is in quite good agreement with the QMC results $(U/t)_c = 16.74$ for the homogeneous case. We present an analysis of these results which takes into account the spatial inhomogeneity arising from the confining potential. We perform a detailed QMC calculation of the density profile, local density fluctuations, and condensate fraction along the trajectory followed experimentally. We demonstrate that for the number of atoms, optical lattice depth, curvature of the confining potential, and temperature in the NIST experiment, the critical value for the formation of Mott domains is rather close to that of the homogeneous system.

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