Universal state diagrams for harmonically trapped bosons in optical lattices MARCOS RIGOL, Georgetown University, GEORGE G. BATROUNI, INLN, Universite de Nice-Sophia Antipolis, VALERY G. ROUSSEAU, Instituut-Lorentz, Universiteit Leiden, RICHARD T. SCALETTAR, University of California, Davis — We use quantum Monte-Carlo simulations to obtain universal zero temperature state diagrams for strongly correlated lattice bosons in one and two dimensions under the influence of a harmonic confining potential. Since harmonic traps generate a coexistence of superfluid and Mott insulating domains, we use local quantities like the quantum fluctuations of the density and a local compressibility to identify the phases present in the inhomogeneous density profiles. We emphasize the use of the 'characteristic density' to produce a universal state diagram which is relevant to experimental optical lattice systems, regardless of the number of bosons or trap curvature. We show that the critical value of U/t at which Mott insulating domains appear in the trap depends on the filling in the system, and it is in general greater than the value in the homogeneous system. Recent experimental results by Spielman et al. [Phys. Rev. Lett. 100, 120402 (2008)] are analyzed in the context of our two-dimensional state diagram, and shown to exhibit a value for the critical point in good agreement with simulations.

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