Inhomogeneous Mott phases of bosons in optical lattices COURT-
NEY LANNERT, Department of Physics, Wellesley College,106 Central Street,
Wellesley, MA 02481, BRIAN DEMARCO, SMITHA VISHVESHWARA, TZU-
CHIEH WEI, Department of Physics, University of Illinois at Urbana-Champaign,
1110 West Green Street, Urbana, IL 61801 — The feasibility of creating a spatially-
inhomogeneous phase of neutral bosonic atoms (such as Rubidium) in which multiple
Mott-insulating states coexist in a shell structure is discussed and analyzed. In the
set-up of trapped, tightly confined bosons in an optical lattice, we derive the con-
ditions on experimental parameters, such as number of bosons and the curvature of
the trapping potential, for creating an onion-like structure of any prescribed number
of Mott shells with different occupation numbers. We discuss the stability of such a
structure with an eye toward experimental conditions necessary for measuring the
structure with spectroscopic probes. The analyses ought to give a controlled means
of achieving the Mott groundstate observed in previous experiments, and give some
constraints for how successfully these states can be employed for quantum comput-
ing.

Tzu-Chieh Wei
University of Illinois at Urbana-Champaign