A Quantum Phase Transition in Hard-Core Bosons on an Opti-
cal Lattice in Three Dimensions\textsuperscript{1} MATTHEW GAMMILL, Hendrix College,
RICHARD SCALET TAR\textsuperscript{2}, UC Davis, VALY ROUSSEAU, LSU — In recent years,
ultracold atomic gases have provided new experimental realization of the superfluid
phase transition, and experiments where atoms are confined to an optical lattice
— a grid of counter-propagating lasers which generate a standing periodic poten-
tial — allow for excellent control of interaction strength and particle density. The
Bose-Hubbard Model (BHM) describes interacting bosons confined to an optical lat-
tice. Previous work on the hard-core three-dimensional Bose-Hubbard model with
periodic 'checkerboard' potential has demonstrated the existence of a superfluid-
insulator phase transition and established bounds on temperature and superlattice
potential within which these phase transitions may occur. However, a quantitative
phase diagram for this transition was heretofore unestablished. Using a QMC sim-
ulation in tandem with finite-size scaling methods, we locate precise values for the
critical transition points.

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\textsuperscript{2}primary research supervisor

Matthew Gammill
Hendrix College

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