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A Quantum Phase Transition in Hard-Core Bosons on an Optical Lattice in Three Dimensions[1] MATTHEW GAMMILL, Hendrix College, RICHARD SCALETTAR[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 potential – allow for excellent control of interaction strength and particle density. The Bose-Hubbard Model (BHM) describes interacting bosons confined to an optical lattice. 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 simulation in tandem with finite-size scaling methods, we locate precise values for the critical transition points.

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