

**Abstract for GR-TR Conference on Statistical Mechanics
and Dynamical Systems**

Talk Invited

Invited Talk

**Phase diagram of the hardcore Bose-Hubbard model on a
checkerboard superlattice**

Menderes Iskin^{1*}, M. Iskin¹, Itay Hen², M. Rigol²

¹ Department of Physics, Koç University, Rumelifeneri Yolu, 34450 Sariyer,
Istanbul, Turkey

² Department of Physics, Georgetown University, Washington, DC 20057, USA

* Electronic Address: miskin@ku.edu.tr

We obtain the complete phase diagram of the hardcore Bose-Hubbard model in the presence of a period-two superlattice in two and three dimensions. First we acquire the phase boundaries between the superfluid phase and the ‘trivial’ insulating phases of the model (the completely-empty and completely-filled lattices) analytically. Next, the boundary between the superfluid phase and the half-filled Mott-insulating phase is obtained numerically, using the stochastic series expansion (SSE) algorithm followed by finite-size scaling. We also compare our numerical results against the predictions of several approximation schemes, including two mean-field approaches and a fourth-order strong-coupling expansion (SCE), where we show that the latter method in particular is successful in producing an accurate picture of the phase diagram. Finally, we examine the extent to which several approximation schemes, such as the random phase approximation and the strong-coupling expansion, give an accurate description of the momentum distribution of the bosons inside the insulating phases.

[1] Itay Hen, M. Iskin, and M. Rigol, Phys. Rev. B **81**, 064503 (2010); see also arXiv:0911.0890.