Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Quantum phase transitions of a boson Hubbard model in one and two dimensions: a modified Time-Evolving Block Decimation study[1] JI-WOO LEE, SUNG MOON KIM, HWAN BIN CHOI, Myongji University — We study quantum phase transitions of a boson Hubbard model in one and two dimensions at zero temperature. The model has a repulsive energy term (U) between the bosons located at the same site and a hopping energy term (t) to nearest neighboring sites. We construct matrix product states for one dimension and projected entangled pair states for two dimensions to represent ground states by a modified Time-Evolving Block Decimation. By exploring the energies and correlation functions, we obtain a phase diagram for this model as a function of chemical potential (μ) and hopping energy (t) as we fix $U = 1$. Our results are compared with other methods, such as strong-coupling perturbation results and Monte Carlo results. Our method can be useful in calculating ground-state properties since we can control the accuracy of the ground state and the number of parameters for quantum entanglement.

[1]This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (NRF-2012R1A1A2006113).

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Date submitted: 13 Nov 2014 Electronic form version 1.4