Quantum phase transitions of a boson Hubbard model in one and two dimensions: a modified Time-Evolving Block Decimation study\textsuperscript{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 ($\mu$) 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.

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Ji-Woo Lee
Myongji University

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