

Abstract Submitted  
for the MAR10 Meeting of  
The American Physical Society

**Grassman-number tensor network states and its renormalization** ZHENGCHENG GU, Kavli Institute for Theoretical Physics, FRANK VERSTRAETE, University of Vienna, XIAOGANG WEN, Massachusetts Institute of Technology — Traditional condensed matter physics is based on two theories: symmetry breaking theory for phases and phase transitions, and Fermi liquid theory for metals. Mean-field theory is a powerful method to describe symmetry breaking phases and phase transitions by assuming the ground state wavefunctions for many-body systems can be approximately described by direct product states. The Fermi liquid theory is another powerful method to study electron systems by assuming that the ground state wavefunctions for the electrons can be approximately described by Slater determinants. In this paper, we propose a new class of states: Grassman-number tensor product states. These states only need polynomial amount of information to approximately encode many-body ground states. Many classes of states, such as matrix/tensor product states (M/TPS), Slater determinant states, etc., are subclasses of Grassman-number tensor product states. However, calculating the physical quantities for these state can be exponential hard in general. To solve this difficulty, we develop the Grassman-tensor-entanglement renormalization group (GTERG) method to efficiently calculate the physical quantities. We demonstrate our algorithm by studying several simple fermion/boson models.

Zhengcheng Gu  
Kavli Institute for Theoretical Physics

Date submitted: 22 Dec 2009

Electronic form version 1.4