MAR12-2011-003070

Abstract for an Invited Paper
for the MAR12 Meeting of
the American Physical Society

Computing Entanglement Entropy in Quantum Monte Carlo

ROGER MELKO, University of Waterloo

The scaling of entanglement entropy in quantum many-body wavefunctions is expected to be a fruitful resource for studying quantum phases and phase transitions in condensed matter. However, until the recent development of estimators for Renyi entropy in quantum Monte Carlo (QMC), we have been in the dark about the behaviour of entanglement in all but the simplest two-dimensional models. In this talk, I will outline the measurement techniques that allow access to the Renyi entropies in several different QMC methodologies. I will then discuss recent simulation results demonstrating the richness of entanglement scaling in 2D, including: the prevalence of the "area law"; topological entanglement entropy in a gapped spin liquid; anomalous subleading logarithmic terms due to Goldstone modes; universal scaling at critical points; and examples of emergent conformal-like scaling in several gapless wavefunctions. Finally, I will explore the idea that "long range entanglement" may complement the notion of "long range order" for quantum phases and phase transitions which lack a conventional order parameter description.