Abstract Submitted
for the DAMOP18 Meeting of
The American Physical Society

Complex Networks on Quantum States[1] LINCOLN D. CARR, MARC ANDREW VALDEZ, DANIEL JASCHKE, Colorado Sch of Mines, DAVID L. VARGAS, University of Maryland, BHUVANESH SUNDAR, KADEN HAZZARD, Rice University — We quantify the emergent complexity of quantum states near quantum critical points on regular 1D lattices, via complex network measures based on quantum mutual information as the adjacency matrix, in direct analogy to quantifying the complexity of EEG/fMRI measurements of the brain. Using matrix product state methods, we show that network density, clustering, disparity, and Pearson's correlation obtain the critical point for both quantum Ising and Bose-Hubbard models to a high degree of accuracy in finite-size scaling for three classes of quantum phase transitions, Z_2, mean field superfluid/Mott insulator, and a BKT crossover. Moreover, they uncover new kinds of structure in the quantum critical region not visible in correlation length and other established measures. For the Ising model we then analytically explore the effect of temperature on the complex network structure, covering mutual information, two-point correlations, and Renyi entropies, and find re-entrant behavior in the quantum critical fan.

[1]Funded by NSF, AFOSR, and the Welch Foundation.

Lincoln D. Car
Colorado Sch of Mines

Date submitted: 24 Jan 2018 Electronic form version 1.4