Abstract Submitted
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Complex Networks and Quantum Phase Transitions[1] DAVID L. VARGAS, LINCOLN D. CARR, Colorado School of Mines — Complex quantum dynamics will benefit from a new set of complex network theory tools going beyond quantum averages and correlations. As a first step towards quantifying quantum complexity, we show that these tools reproduce known quantum phase diagrams in transverse Ising and Bose-Hubbard models. Such models are realized in ultracold atoms and molecules in optical lattices. We present a finite size scaling analysis of the quantum mutual information networks present in the transverse Ising and Bose-Hubbard Hamiltonians. In the transverse Ising model the first derivative of network density, average disparity, and clustering coefficient with respect to the transverse field (g) are maximized at $g = 1.002, 0.998,$ and 1.002 respectively as the number of sites in the lattice approaches infinity, and where the known critical point of the model occurs at $g_c = 1$. In the Bose-Hubbard model we find the superfluid phase is characterized by a vanishing disparity, non-zero network density, and non-zero clustering coefficient as we extrapolate to an infinite number of lattice sites. Our analysis thus provides evidence that complex network analysis of quantum mutual information is sufficient to identify critical points and phase boundaries of distinct quantum many body models.

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