Fabio Franchini

Title: “Universal Quantum Simulator, Local Convertibility and Edge States in Many-body Systems”

Abstract:

In some many-body systems, certain ground state entanglement (Renyi) entropies increase even as the correlation length decreases. This entanglement non-monotonicity implies a stronger ``quantum nature" of the wave function and gives it a higher computational power, compared to classical manipulations. We will demonstrate that such a phenomenon, known as non-local convertibility, is due to the edge state (de)construction occurring in the system. To this end, we employ the example of the Ising chain, displaying an order-disorder quantum phase transitions. Employing both analytical and numerical methods, we compute entanglement entropies for various system's bipartitions (A|B) and consider ground states with and without Majorana edge states. We find that the thermal ground states, enjoying the Hamiltonian symmetries, show non-local convertibility if either A or B are smaller than, or of the order of, the correlation length. In contrast, the ordered (symmetry breaking) ground state is always locally convertible. The edge states behavior explains all these results and could disclose a paradigm to understand local convertibility in other quantum phases of matter. The connection we establish between convertibility and non-local, quantum correlations provides a clear criterion of which features a universal quantum simulator should possess to outperform a classical machine.

References:

-Fabio Franchini, Jian Cui, Luigi Amico, Heng Fan, Mile Gu, Vladimir E. Korepin, Leong Chuan Kwek, Vlatko Vedral. http://arxiv.org/abs/1306.6685