Massachusetts Institute of Technology
Department of Physics

Condensed Matter Theory Seminar

"Supercritical Entanglement: counter-examples to the area law for quantum matter"

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Abstract: In recent years, there has been a surge of activities in proposing exactly solvable quantum spin chains with the surprisingly high amount of ground state entanglement entropies-- beyond what one expects from critical systems describable by conformal field theories (i.e., super-logarithmic violations of the area law). We will introduce entanglement and discuss these models. We prove that the ground state entanglement entropy is $\sqrt{n}$ and in some cases even extensive (i.e., $\sim n$) despite the underlying Hamiltonian being: 1. Local 2. Having a unique ground state and 3. Being translationally invariant in the bulk. These models have rich connections with combinatorics, random walks, and universality of Brownian excursions. Lastly, we develop techniques that enable proving the gap of these models. As a consequence, the gap scaling of $1/n^c$ with $c>1$ that we prove rules out the possibility of these models having a relativistic conformal field theory description. Time permitting, we will discuss more recent developments in this direction.

References:

  . Movassagh, Farhi, Goldstone, Nagaj, Osborne, Shor, PRA (2010)
  . Bravyi, Caha, Movassagh, Nagaj and Shor, PRL (2012)
  . Movassagh and Shor, PNAS, doi:10.1073/pnas.1605716113 (2016)
    http://www.pnas.org/content/early/2016/11/02/1605716113.abstract
  . https://arxiv.org/abs/1609.09160
  . (with L. Levine) https://arxiv.org/abs/1611.03147

12:30pm
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Host: Liang Fu