Contribution ID: **100** Type: **not specified**

Entanglement area law in interacting bosons: from Bose-Hubbard, ϕ^4, and beyond

Wednesday, 27 August 2025 17:10 (20 minutes)

The entanglement area law is a fundamental principle that defines the informational structure of quantum many-body systems and serves as the backbone for tensor network algorithms. Traditionally, this law has been established under two key assumptions: the system must have bounded local energy and exhibit short-range interactions. However, extending the area law to scenarios with unbounded local energy and long-range interactions remains a significant challenge, particularly in bosonic systems where these standard assumptions do not hold. In this work [1], we rigorously prove the entanglement area law across a broad class of one-dimensional interacting bosonic systems, including models such as the Bose-Hubbard and ϕ^4 models, as well as systems exhibiting long-range interactions. Our approach overcomes the limitations of conventional assumptions by showing subexponential decay in the boson number distribution. Consequently, we establish that it is possible to approximate ground states using matrix product states with quasi-polynomial bond dimensions. These findings provide crucial insights for simulating bosonic systems with long-range interactions and advancing quantum simulation methodologies.

[1] Donghoon Kim and Tomotaka Kuwahara, arXiv:2411.02157

Primary author: KIM, Donghoon (RIKEN)

Co-author: Dr KUWAHARA, Tomotaka (RIKEN)

Presenter: KIM, Donghoon (RIKEN)

Session Classification: Contributed talks

Track Classification: Invited talk