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Understanding Phases and Transitions in Mixed States

Thursday 3 October 2024 11:00 (1 hour)

With the rapid development of quantum simulator platforms, understanding the stability of quantum phases in the presence of environmental coupling has become increasingly important. As a pure quantum state evolves into a mixed state due to decoherence, traditional notions of quantum phases need to be reconsidered.

In this talk, I will present recent progress on mixed-state phases from an information-theoretic perspective, which contrasts sharply with conventional descriptions that rely on order parameters and fail to capture mixed-state phases. The presentation will be divided into three parts: (i) spontaneous symmetry breaking in mixed states, (ii) symmetry-protected topological states under decoherence and the extraction of long-range entangled states, and (iii) decohered topological orders and intrinsic error thresholds. If time permits, I will discuss how fault tolerance can be incorporated into this framework using a newly developed spacetime SPT (symmetry-protected topological) picture, highlighting the deep connection between fault tolerance and phase stability in open quantum systems.

Primary author: LEE, Jong Yeon (University of Illinois at Urbana-Champaign)

Presenter: LEE, Jong Yeon (University of Illinois at Urbana-Champaign)