

Title: Understanding Phases and Transitions under Decoherence

Abstract: With the rapid development of quantum simulator platforms, understanding the stability of quantum phases against coupling to the environment has become increasingly important. As a pure quantum state evolves into a mixed state under decoherence, traditional notions of quantum phases require a change of perspective.

In this talk, I will present recent progress in our understanding of mixed topological states from an information-theoretic standpoint, which contrasts sharply with conventional phase descriptions that rely on order parameters and fail to capture mixed state phases. The talk consists of three parts: (i) symmetry protected topological states under decoherence and extracting long range entangled states (ii) decohered topological orders and intrinsic error threshold (iii) faulty measurements and single-shot decodability. This understanding illustrates the deep connection between fault tolerance and the stability of phases in open quantum systems.