February 13, 2023 – Speaker: Shenglong Xu

Time: 3:30-4:30 PM

Location: Marcus Nanotechnology 1116-1118

Title: Quantum information dynamics in many-body systems: a tale of encoding and decoding

Abstract: Recent advances in NISQ (Noisy Intermediate-Scale Quantum) technology and cross-disciplinary dialogues have significantly expanded the frontiers of out-of-equilibrium quantum many-body systems. In this talk, I will discuss quantum information dynamics, i.e., the fate of a quantum qubit thrown into a many-body system, as a general framework to study this new dynamical regime. I will show that local quantum information in a strongly interacting system spreads to non-local degrees of freedom in a universal manner, similar to the spread of an epidemic, and is encoded in the many-body Hilbert space in late time. This process, dubbed scrambling, has been observed in cold atoms, superconducting circuits, ion traps, and solid-state NMR experiments. The non-local nature of scrambled quantum information makes it more noise-resilient but challenging to decode. I will present our recent progress in decoding and teleporting quantum information in a prototypical many-body model, the 2D quantum XY model, using exact long-range entangled eigenstates and local measurements. Our protocol is ready to be carried out on current NISQ devices and may open new possibilities for quantum information processing.

Bio: Shenglong Xu is a research assistant professor at Texas A&M University. He obtained his Ph.D. in 2017 from the University of California, San Diego. Before joining TAMU in 2020, he worked as a postdoc in the condensed matter theory center at the University of Maryland. His current research interests include non-equilibrium phenomena in quantum many-body systems, quantum information and entanglement dynamics, and developing algorithms for classical and quantum