# University of Miami, Physics Department Colloquium

**Date:** Wednesday, Feb 12, 2025
**Time:** 3:50 pm – 4:50 pm
**Location:** Wilder Auditorium – Rm 112, Knight Physics Building

# Long-range Entangled Quantum Matter in the Era of Quantum Devices

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**Abstract**

Long-range entangled quantum states of matter exhibit fascinating quantum phenomena and play a crucial role in reliably protecting and processing quantum information. Despite their importance, such states may be challenging to find in natural materials. Recent advancements in quantum devices offer a promising bottom-up approach to engineering quantum matter by implementing controllable quantum operations on qubits. This new approach also raises a key challenge: how to efficiently prepare long-range entangled states before qubits decohere due to the noise from environments?

In the first part of the talk, I will introduce a new paradigm for state preparation based on mid-circuit measurement, an emerging capability of quantum devices. Specifically, I will demonstrate how combining local measurements, entangling operations, and non-local classical communication enables the efficient preparation of long-range entangled quantum matter. I will also provide an overview of various ways in which measurement can be leveraged in this context. In the second part of the talk, I will discuss the stability of long-range entanglement in thermal environments, exploring how the robustness of quantum information storage can be understood through the lens of entanglement. Finally, I will highlight new directions for state preparation on quantum devices and discuss insights into quantum error correction from an entanglement-based perspective.

**Biography**

Tsung-Cheng 'Peter' Lu received his PhD in physics from the University of California San Diego in 2021 and was a postdoctoral researcher at the Perimeter Institute for Theoretical Physics from 2021 to 2024. He is currently an RQS (Robust Quantum Simulation) postdoctoral fellow at the University of Maryland - College Park, studying the interplay between quantum many-body physics and quantum information. His research focuses on leveraging quantum information theory to characterize quantum states of matter and explore their applications in quantum information processing. Outside of physics, he enjoys playing tennis and pickleball, as well as watching movies and TV series.