## 上海数学与交叉学科研究院



Shanghai Institute for Mathematics and Interdisciplinary Sciences

SIMIS Seminar series on Quantum computing, Quantum simulation and Strongly-correlated systems

## Mr. Muzhou Ma

Department of Electronic Engineering, Tsinghua University, Beijing, China

"Hamiltonian Learning through Quantum Dynamics"



Hamiltonian learning is a fundamental problem in quantum physics, essential for understanding and controlling quantum systems. Accurate Hamiltonian models are crucial for tasks ranging from quantum simulation to quantum error correction, where precise knowledge of interactions enables better optimization and control. This problem also has significant relevance in computer science, where the analogous task of learning undirected graphical models plays a central role in many machine learning frameworks. In this talk, I will review various methods for learning Hamiltonians under different structural assumptions, evaluating the performance of these protocols. I will then discuss approaches that achieve the gold-standard Heisenberg-limited scaling through quantum dynamics in two stages: learning k-body Hamiltonians and extending to arbitrary Hamiltonians. Additionally, I will present a lower bound for general Hamiltonian learning problems, showing a fundamental trade-off between total evolution time and digital quantum control for Hamiltonian learning tasks.

Muzhou is currently an undergraduate student in the Department of Electronic Engineering at Tsinghua University. His research focuses on quantum information theory.

Date and Place: March 21th, Friday, 2025, 14:00h-15:00h. Room: 1510. Send comments or questions to: Miguel Tierz (Seminar organizer) to tierz at simis.cn