Joint CQSE & NCTS Seminar

2025
Dec. 5, Friday

Time: Dec. 5, 14:20 ~ 16:20
Title: Emergent Structure in Hilbert Space: Quantum Walks, Ergodicity Breaking, and Quantum-Inspired Algorithms—…and How They Shape Future Quantum Technology
Speaker: Yi-Ping Huang, Assistant Professor (Department of Physics, National Tsing Hua University)
Place: Rm. 104, Chin-Pao Yang Lecture Hall, Department of Physics/CCMS, NTU
Online Link:
https://nationaltaiwanuniversity-zbh.my.webex.com/nationaltaiwanuniversity-zbh.my/j.php?MTID=m35c57ceb3c91fd5af3ca30d927e989a1

Abstract:

Understanding how interference organizes the immense landscape of Hilbert space is central to modern quantum science. In this talk, I will explore three manifestations of this emergent structure, spanning single-, few-, and many-body regimes.

(1) Quantum walks reveal how interference converts simple dynamics into rich resources, from paradoxical game-theory behaviour to robust entanglement generation and recent understanding of quantum “magic".
(2) Quantum many-body scars expose weak ergodicity breaking: special subspaces where interference stabilizes coherent dynamics inside otherwise chaotic systems. I will present our group’s recent results on interference-caged scars and the use of dualities to classify their stability.
(3) Quantum-inspired classical algorithms leverage Hilbert-space geometry—via tensor networks and related structures—to accelerate hard problems in physics and data science, from nuclear few-body models to optimization.

Together, these topics illustrate how our team tackles frontier questions at the interface of quantum information, condensed matter, and algorithm design—and invite talented researchers to join this effort.

Biography:

Yi-Ping Huang is a theoretical physicist interested in developing frameworks to understand the mechanisms behind emergent patterns in interacting quantum

systems. He received his Ph.D. in Physics from the University of Colorado Boulder in 2017, where he worked on symmetries and topological order in strongly spin-orbit-coupled materials and introduced the concept of dipolar–octupolar doublets in frustrated magnets. As a visiting scholar at the Max Planck Institute for the Physics of Complex Systems (2017–2019), he identified dynamical quantum phase transitions in lattice gauge theories. During his PSI-FELLOW-II-3i Marie-Skłodowska-Curie Fellowship (2019–2021), he demonstrated disorder-free localization in gauge models. Since 2021, as faculty at National Tsing Hua University, he has launched several research directions: interference-caged quantum many-body scars, duality approaches to weak ergodicity breaking, and translation-symmetry
breaking effects in quantum walks.