



TEXAS TECH™

Quantum Information and Computing (QIC)  
Seminar

Nai-Hui Chia (CS @ Rice)

10:30 AM, Tuesday, November 11, 2025  
Engineering Center 206

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**Computational Complexity for Problems in Quantum Physics**

In this talk, I will show how complexity theory can be used to characterize the computational limits of several fundamental problems in quantum physics. First, I will discuss the complexity of learning matrix product states (MPS). In particular, I will present an algorithm that improves on existing approaches, together with a tighter sample-complexity lower bound, even for the special case of product states. Second, I will turn to the problems of computing ground-state energies and quantum partition functions of local Hamiltonians. Under the quantum strong exponential time hypothesis (QSETH), we prove a new no-go theorem: any algorithm for these tasks must run in time  $2^{n/2}$ , even if we only seek a constant relative error approximation to the quantum partition function. Interestingly, we also give a quantum algorithm achieving  $1/2$ -relative error in time  $2^{n/2}$ , matching this lower bound. Finally, I will introduce a new complexity-theoretic framework for problems with quantum information inputs. This includes new complexity classes, complete problems, and structural results, and it yields applications to quantum property testing, quantum learning, quantum cryptography, and related areas.

**The speaker:** Nai-Hui Chia is an Assistant Professor in the Department of Computer Science at Rice University. He received his Ph.D. degree from Penn State University.

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