北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Seminar

Challenges and opportunities for quantum computing in noisy intermediate-scale quantum era

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Time: 10:00am, July. 12, 2022 (Tuesday)

时间：2022年7月12日 （周二）上午10:00

腾讯会议链接: https://meeting.tencent.com/dm/WqyyHs2kmMVH

腾讯会议ID：286-965-447

Abstract

As we enter the noisy intermediate-scale quantum (NISQ) era, we face the near-term prospect of demonstrating non-trivial computations on quantum circuits consisting of 50 to a few hundred qubits without error correction. In this talk, I will discuss the challenges in quantum noise and opportunities in quantum simulation for quantum computing in NISQ era. Specifically, I will present our recent progress on non-Markovian noise on quantum processor [1,2]. We propose protocols based on transfer tensor maps and spectral transfer tensor map to capture non-Markovianity and reconstruct the noise spectral density beyond pure dephasing models. I will also introduce the AI-assisted quantum algorithm in accelerating quantum annealing process[3], in which we propose a Monte Carlo Tree Search (MCTS) algorithm and QuantumZero (QZero) to automate the design of annealing schedules. At last, I will describe a Lyapunov control-assisted quantum algorithm in accelerating quantum imaginary simulation and its realization on digital quantum computer [4].

References:

[1] Chen, Yu-Qin, et al. "Non-markovian noise characterization with the transfer tensor method." Physical Review Applied 13.3 (2020): 034045.

[2] Chen, Yu-Qin, et al. "Spectral-Transfer-Tensor Method for Characterizing Non-Markovian Noise." Physical Review Applied 17.6 (2022): 064007.

[3] Chen, Yu-Qin, et al. "Optimizing quantum annealing schedules with Monte Carlo tree search enhanced with neural networks." Nature Machine Intelligence 4.3 (2022): 269-278.

[4] Chen, Yu-Cheng, Chen, Yu-Qin et al. "Variational quantum simulation of the imaginary-time Lyapunov control for accelerating the ground-state preparation." arXiv preprint arXiv:2112.11782 (2021).

About the speaker

Dr. Yu-Qin Chen is a Senior Researcher in Tencent Quantum Laboratory, Tencent, China. She received her Ph.D in physics from International Center for Quantum Materials, School of Physics, Peking University in 2019 and then joined Tencent Quantum Laboratory. She is interested in quantum machine learning, artificial intelligence, quantum information science, quantum computation algorithm, quantum simulation in condensed matter physics and chemical systems.