



高性能 EDA 算法
校企联合实验室

学术报告系列



报告人

刘锦鹏

清华大学

报告题目

Quantum for Science: Efficient Quantum Algorithms for Linear and Nonlinear Dynamics

报告时间

2025 年 1 月 6 日 上午 10:45 – 11:30

报告地点

光华楼东主楼 1801 室

报告摘要

Fault-tolerant quantum computers are expected to excel in simulating unitary dynamics, such as the dynamics of a quantum state under a Hamiltonian. Most applications in scientific and engineering computations involve non-unitary and/or nonlinear dynamics. Therefore, efficient quantum algorithms are the key for unlocking the full potential of quantum computers to achieve comparable speedup in these general tasks. First, we propose a simple method for simulating a general class of non-unitary dynamics as a linear combination of Hamiltonian simulation (LCHS) problems. The LCHS method can achieve optimal cost in terms of state preparation. Second, we give the first efficient (polynomial time) quantum algorithm for nonlinear differential equations with sufficiently strong dissipation. This is an exponential improvement over the best previous quantum algorithms, whose complexity is exponential in the evolution time. Our work shows that fault-tolerant quantum computing can potentially address complex non-unitary and nonlinear phenomena in natural and data sciences with provable efficiency.

报告人简介

刘锦鹏，清华大学数学科学中心助理教授，2022-2024 年在麻省理工和伯克利任博士后，2022 年博士毕业于马里兰大学，2017 年本科毕业于北航-中科院华罗庚班。研究方向为量子科学计算与量子科学智能，发表 PNAS、Nat. Commun.、PRL、CMP、JCP、Quantum 等期刊和 NeurIPS、QIP、TQC 等会议，受到 Quanta、SIAM News、MATH+ 等科技媒体报道，担任量子信息权威期刊 Quantum (JCR Q1, IF 6.4) 的编委 (中国高校仅 3 人)。

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