Sirui Lu

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EDUCATION

Tsinghua University (Beijing, China)   August 2015 - July 2019
Undergraduate Student
B.S. in Math and Physics, Dept. of Physics

Massachusetts Institute of Technology   August 2017 - May 2018
Undergraduate Special Student
Department of Physics

RESEARCH EXPERIENCE

Max-Planck Institute of Quantum Optics   October 2019 - present
Prof. Ignacio Cirac's group

· Proposed an efficient quantum algorithm for calculating observables at finite temperature that can be implemented on the analoge quantum simulators [1].

Tsinghua University   April 2017 - September 2019
Prof. Luming Duan's group (Tsinghua & Michigan)

· Bachelor thesis: Applications and Implementation of Quantum Random Unitaries.
· Derived neural network representations for many topologically-ordered states [4].
· Implemented a convolutional neural network based method for measuring the topological number for chiral topological insulators (with a solid-state quantum simulator) [5].

Harvard University   June 2018 - September 2018
Prof. Mikhail Lukin's Group

· Studied diabatic annealing and quantum approximate optimization algorithm in the random transverse Ising model and the hard core boson model.

Massachusetts Institute of Technology   September 2017 - June 2018
Prof. Isaac Chuang's Group

· Numerically and theoretically investigated the quantum approximate optimization algorithm for the state transfer problem [8].

Tsinghua University   August 2016 - December 2018
Prof. Bei Zeng's Group (University of Guelph & Institute for Quantum Computing)

· Wrote a program to search quantum codes that allow to transmit both quantum and classical information. The obtained codes can encode more information compared with hybrid codes obtained from the best-known stabilizer codes. Enhanced linear programming bounds with shadow enumerators [7].
· Conceived a convex hull approx. method and a machine learning algorithm to separability problem [6].
· Implemented the machine learning based method for local quantum state tomography [9].
· Performed numerical simulation for simulating quantum spin network – the fundamental building block of quantum spacetime at Planck scale [10].

CURRENT RESEARCH INTERESTS

- Quantum algorithms

- Quantum simulation on AMO platforms

- Many-body physics, tensor network and topological phases

- Quantum error correction & fault tolerance

PAPERS

[1] **Sirui Lu**, Mari Carmen Bañuls, J. Ignacio Cirac. Algorithms for quantum simulation at finite energies. `arXiv:quant-ph/2006.03032`, 2020.

[2] **Sirui Lu**, L.-M. Duan, Dong-Ling Deng. Quantum Adversarial Machine Learning. `arXiv:quant-ph/2001.00030`, 2020.

[3] Si Jiang*, **Sirui Lu***, Dong-Ling Deng. Vulnerability of Machine Learning Phases of Matter. `arXiv:quant-ph/1910.13453`, 2020.

[4] **Sirui Lu**, Xun Gao, L.-M. Duan. Efficient Representation of Topologically Ordered States with Restricted Boltzmann Machines. *Phys. Rev. B, 99:155136*, April 2019.

[5] W.-Q. Lian*, S.-T. Wang*, **S.-R. Lu**, Y.-Y. Huang, F. Wang, X.-X. Yuan, W.-G. Zhang, X.-L. Ouyang, X. Wang, X.-Z. Huang, L. He, X.-Y. Chang, D.-L. Deng, and L.-M. Duan. Machine learning topological phases with a solid-state quantum simulator. *Phys. Rev. Lett, 122,:210503*, May 2019.

[6] **Sirui Lu***, Shilin Huang*, Keren Li, Jun Li, Jianxin Chen, Dawei Lu, Zhengfeng Ji, Yi Shen, Duanlu Zhou, and Bei Zeng. Separability-entanglement classifier via machine learning. *Phys. Rev. A, 98:012315*, Jul 2018.

[7] Markus Grassl, **Sirui Lu**, and Bei Zeng. Codes for simultaneous transmission of quantum and classical information. IEEE International Symposium on *Information Theory Proceedings (ISIT), 2017* , pages 1718–1722. IEEE, 2017, doi.org/10.1109/ISIT.2017.8006823.

[8] Murphy Yuezhen Niu, **Sirui Lu**, Issac L. Chuang. Optimizing QAOA: Success Probability and Runtime Dependence on Circuit Depth. `arXiv:quant-ph/1905.12134`, 2019.

[9] Tao Xin*, **Sirui Lu***, Ningping Cao*, Galit Anikeeva, Dawei Lu, Jun Li, Guilu Long, Bei Zeng. Local-measurement-based quantum state tomography via neural networks. *npj Quantum Information 5.1 (2019): 1-8*.

[10] Keren Li*, Youning Li*, Muxin Han*, **Sirui Lu**, Jie Zhou, Dong Ruan, Guilu Long, Yidun Wan, Dawei Lu, Bei Zeng, Raymond Laflamme. Quantum Spacetime on a Quantum Simulator. *Communications Physics 2.1 (2019): 1-6*.

[11] Shi-Yao Hou, Ningping Cao, **Sirui Lu**, Yi Shen, Yiu-Tung Poon, Bei Zeng. Determining system Hamiltonian from eigenstate measurements without correlation functions. `arXiv:quant-ph/1903.06569`

TALKS

[1] **Sirui Lu**. Codes for simultaneous transmission of quantum and classical information. 2017 IEEE International Symposium on *Information Theory (ISIT)*, Aachen, Germany, June 25-30 2017.

[2] **Sirui Lu**. A separability-entanglement classifier via machine learning. The 2nd International Conference on *Quantum Information, Spacetime, and Topological Matter*, Zhangjiajie, China, July 3-7 2017.

[3] **Sirui Lu**. Quantum adversarial machine learning. Theory Group seminar, Max-Planck Institute of Quantum Optics, Garching, Germany, December 3, 2019.

RELEVANT GRADUATE COURSES

Harvard University, Fall 2017
Phys285b Modern Atomic and Optical Physics II, Prof. Mikhail Lukin: 5.0/5.0

MIT, Fall 2017
8.513 Many-Body Theory for Condensed Matter Systems, Prof. Xiao-Gang Wen: 5.0/5.0

MIT, Spring 2018
8.371 Quantum Information Science II, Prof. Aram Harrow & Isaac Chuang: 5.0/5.0
6.645 Phys. and engineering of superconducting qubits for QIP, Prof. William Oliver: 5.0/5.0
6.883 Science of Deep Learning: 5.0/5.0

Tsinghua University, 2015-2017
Quantum Information: Prof. Gui-lu Long, 4.0/4.0
Cold Atom Physics: Prof. Hui Zhai, 4.0/4.0
Quantum Entanglement and Quantum Error Correction, Prof. Bei Zeng

AWARDS & HONORS

2019 Chi-Sun Yeh Prize (highest honor for physics undergraduates at Tsinghua University)

Tsinghua Xuetang Talents Program

Qualcomm Scholarship

PROFESSIONAL ACTIVITIES

Referee for Physical Review Letters, Physical Review A, Physical Review B, The 2018 IEEE International Symposium on Information Theory, IEEE Journal on Selected Areas in Information Theory.

SKILLS

Computer Languages	Python, C/C++, Julia, Matlab, Mathematica
Softwares	LaTeX, Linux, TensorFlow, Tensor Networks (e.g., ITensor)
Quantum Tools	Qiskit, Project-Q, Yao.jl, CirQ, QuTiP, $\cdots$
Hobbies	Go (5d amateur)