Jin-Guo Liu (刘金国)

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Education

B.S. Software Engineering, Nanjing Institution of Science and Technology, 2008–2012.

Ph.D. Physics, Nanjing University, 2012–2017. (Advisor: Prof. Qiang-Hua Wang)

Skills

Quantum Software Engineering

Tensor Networks

Differentiable Programming

Julia/Python/Fortran language

Awards

First prize of Physics Olympiad, JiangSu Province, 2007

Academic Excellence Scholarship, Nanjing University, 2016

First prize of ZTE Fantastic Algorithm Challenge (out of 8000 teams, $15,000 award), 2017

Research interest & experience

I am a computational quantum physicsist. Armed with solid background of both quantum physics and computer science, I am able to solve some valuable problems in the cross discipline of quantum physics and computer sciences. I am also the maintainer of several open source projects (listed at the end of this CV), as well as an organizer of QuantumBFS and numeric club. I list my research experiences as the following:

1 When I was a college student, I read a book named "Quantum Computation and Quantum Information" by Michael A. Nielsen. I was deeply impressed by the beautiful computation framework in the book, and decided to learn more about quantum computing in Prof. Yang Yu's group in Nanjing University.

2 After one year, I was transferred to Prof. Qiang-Hua Wang's group since I was more interested in theories and numerical simulations rather than experiments. I mastered tensor networks algorithms and renormalizationing group theories, and became a geek in simulating quantum many body systems. Most of my works are about designing numeric algorithms to solve important problems in physics, like multi-channel Kondo problem and fractional topological excitation.

3 In the last year as a doctor candidate, I won the first prize in ZTE fantastic algorithm challenge, which is a good proof of my solid algorithmic background of matrix computation and combinatorial optimization. Then I became a postdoc of a young and charming guy Lei-Wang. Besides providing valuable suggestions in my research, Lei also creates a lot of opportunities for me, like encouraging me to give lectures and talks in international meetings and summer schools.

4 Now is the second year of my postdoc career in Institute of Physics (IOP), Chinese Academy of Sciences. My current research interest is quantum machine learning, this is a field that can incubate several killer Apps. I have not only published several sounding papers in this field, but also developed the quantum differentiable learning framework Yao.jl together with a genuine Julia lover Xiu-Zhe Luo.

5 Here, please allow me say something about the programming language. Since a lot of quantum software engineering positions require Python programming skill, being a 10 year old Python programmer, I am willing to use python if needed. But I strongly believe Julia language represents a trend for high performance device programming. Julia language supports introspection of each of its Intermediate Representations, making compiler level optimization to device codes possible, e.g. high performance GPU and TPU computation frameworks. I believe it can also provide an elegant solution to QPU programming, or QPU programming with CPU copressesor. This is why I switched my attention to Julia in the last year and developed Yao.jl.

Publications

1 **Jin-Guo Liu**, Da Wang and Qiang-Hua Wang, Quantum impurities in channel mixing baths. Phys. Rev. B **93**, 035102 (2016).

2 **Jin-Guo Liu**, Zhao-Long Gu, Jian-Xin Li and Qiang-Hua Wang, Sub-system fidelity for ground states in one dimensional interacting systems. N. J. Phys. 19(9), 093017 (2017).

3 Yang Yang, Wan-Sheng Wang, **Jin-Guo Liu**, Hua Chen, Jian-Hui Dai and Qiang-Hua Wang, Superconductivity in doped Sr_2IrO_4: A functional renormalization group study. Phys. Rev. B **89**, 094518 (2014).

4 Yao Wang, **Jin-Guo Liu**, Wan-Sheng Wang, and Qiang-Hua Wang, Electronic order near the type-II van Hove singularity in BC_3. Phys. Rev. B **97**, 174513 (2018)

5 Zi Cai, and **Jin-Guo Liu**, Approximating quantum many-body wave functions using artificial neural networks. Phys. Rev. B **97**, 035116 (2018).

6 **Jin-Guo Liu**, and Lei Wang, Differentiable learning of quantum circuit Born machine. arXiv:1804.04168 (2018).

7 JinFeng Zeng, YuFeng Wu, **JinGuo Liu***, Lei Wang and JiangPing Hu, Learning and Inference on Generative Adversarial Quantum Circuits. arXiv:1808.03425 (2018)

A Selection of Github Repositories

Yao.jl: high performance quantum circuit simulator aiming for quantum machine learning. Please also notice

CuYao.jl: its GPU extension with orders of performance improvement for batched input

QuAlgotithmZoo.jl, algorithm zoo based on Yao.jl, which includes Grover Search, HHL, QuGAN, QCBM, Hamiltonian Solver et. al.

LuxurySparse.jl: a high performance sparse matrix extension for Julia.

marbug: neural network for physicists tutorial code.

FunnyTN.jl: Tensor Network Library for Julia, derived from my old python project pymps.

viznet: network (neural network, tensor networks and quantum circuit) visualization toolbox.

Layers: computation graph framework with complex value support.

Conferences

1 Statistic Physics and Machine Learning (An Qing), talk: "Machine Learning in frustrated quantum spin system".

2 The FOR 1807 Winter School on Numerical Methods for Strongly Correlated Quantum Systems (Marburg), lecture: "Deep learning and quantum many body systems".

3 The 8th Workshop on Quantum Many-Body Computation (Hang Zhou), poster: "Differentiable learning of quantum circuit Born machine"

4 Computational Approaches for Quantum Many Body Systems 2016 (Bei Jing), talk: "Local indistinguishability and topological phase of matter"

5 The First International Conference on Machine Learning and Physics (Bei Jing), poster: "Differentiable learning of quantum circuit Born machine"

6 Julia Meetup in BeiJing 2018, talk: Tutorial for high performance matrix computations, in Julia

7 Quantum Information for Developers 2018 (Zurich), Hackathon: "Funny Tensor Networks"