

# Jin-Guo Liu (刘金国)

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Github: [GiggleLiu](#)

## 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, 100,000 RMB award), 2017

## Research interest & experience

I am a computational quantum physicist. 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](#). I list my research experiences as the following:

- 1 When I was a college student, I read a book "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 renormalization 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 conferences and summer schools.
- 4 My postdoc career is in Institute of Physics (IOP), Chinese Academy of Sciences. That time my research interest is automatic differentiation and quantum algorithms, this is a field that can incubate several killer Apps. I also developed the quantum simulation framework [Yao.jl](#) with a built in automatic differentiation engine together with a genuine Julia lover [Xiu-Zhe Luo](#).
- 5 I mentored a student for Julia on the [GSoC](#) project of differentiable tensor networks. It is a valuable experience for me to lead a project. The open source repository [OMEinsum](#) is listed below.
- 6 Now I am fully participated in reversible Turing machine, it can solve the

## 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  $\text{Sr}_2\text{IrO}_4$ : 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  $\text{BC}_3$ . [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. [Phys. Rev. A \*\*98\*\*](#) (2018).
- 7 Jin-Feng Zeng, Yu-Feng Wu, **Jin-Guo Liu\***, Lei Wang and JiangPing Hu, Learning and Inference on Generative Adversarial Quantum Circuits. [Phys. Rev. A \*\*99\*\*, 052306](#) (2018)
- 8 **Jin-Guo Liu**, Yi-Hong Zhang, Yuan Wan and Lei Wang, Variational Quantum Eigensolver with Fewer Qubits. [Phys. Rev. Research \*\*1\*\*, 023025](#) (2019)
- 9 Hai-Jun Liao, **Jin-Guo Liu**, Lei Wang, Tao Xiang, Differentiable Programming Tensor Networks [Phys. Rev. X \*\*9\*\*, 031041](#) (2019)
- 10 Xiu-Zhe Luo, **Jin-Guo Liu**, Pan Zhang and Lei Wang, Yao. jl: Extensible, efficient framework for quantum algorithm design. [arXiv:1912.10877](#) (2019)
- 11 **Jin-Guo Liu**, Liang Mao, Pan Zhang, Lei Wang, Solving Quantum Statistical Mechanics with Variational Autoregressive Networks and Quantum Circuits. [arXiv:1912.11381](#) (2019)
- 12 Hao Xie, **Jin-Guo Liu**, Lei Wang, Automatic differentiation of dominant eigensolver and its applications in quantum physics. [arXiv:2001.04121](#) (2020) Related articles

## A Selection of Github Repositories

- [NiLang.jl](#): An implementation of reversible Turing machine with instruction level autodiff.
- [OMEinsum.jl](#): one more einsum with generic element type, CUDA backend and automatic differentiation.
- [Yao.jl](#): high performance quantum circuit simulator aiming for quantum machine learning.
- [marbug](#): neural network for physicists tutorial code.
- [viznet](#): network (neural network, tensor networks and quantum circuit) visualization toolbox.

## 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"
- 8 March Meeting 2019 (Bostone), [Talk: "Differential Quantum Circuits and Generative Modeling"](#)
- 9 Juliacon 2019 (Baltimore), [Talk: "Differential Programming Tensor Networks"](#)
- 10 23rd Annual Conference on Quantum Information Processing (ShenZhen), Poster: "Yao - A differential quantum programming framework"