AO CHEN

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EDUCATION

ETH Zurich *Zurich, Switzerland*
MSc. Physics *Sept. 2019 – Feb. 2022 (expected)*
- Core GPA 5.61 / 6

Fudan University *Shanghai, China*
BSc. Physics *Sept. 2015 – Jun. 2019*
- Core GPA 3.75 / 4

University of California, Berkeley *California, U.S.*
Exchange Semester *Jan. – May 2018*
- Core GPA 4.00 / 4

RESEARCH EXPERIENCE

ETH Zurich *Zurich, Switzerland*
Semester Project & Master Thesis *Sept. 2019 – Sept. 2020*
- Title Neural network evolution strategy for solving quantum sign structures
- Supervisor Titus Neupert
- We used a sign network with discrete output values (± 1) to express the sign structure of variational wave functions. To train the sign network, the evolution strategy (ES) method was introduced to replace the traditional stochastic reconfiguration (SR) method which only applies to networks with continuous outputs. The sign network trained by ES learned the exact Marshall sign rule in the square-lattice Heisenberg model and improved the accuracy of variational states in the pyrochlore-lattice Heisenberg model. We also studied the properties of the pyrochlore Heisenberg model through the neural network and the many-variable variational Monte Carlo (mVMC) methods.
- This research was the main part of a paper in preparation [1] and contributed to a minor part of a preprint [2].

Fudan University *Shanghai, China*
Graduation Thesis *Feb. – Jun. 2019*
- Title Solving quantum many-body system based on transfer reinforcement learning
- Supervisor Yang Qi
- A single convolutional neural network (CNN) can be applied to systems with different sizes. Based on this property, we proposed a transfer learning scheme for the neural network quantum state in which the CNN was firstly trained by the exact diagonalization result in a small system, and then applied to the larger system for further variational optimization. This transfer learning scheme improved the accuracy and the stability in the 1D frustrated J_1–J_2 model compared with direct variational optimization. Furthermore, we also studied the autoregressive network and used it to obtain the ground state of the 1D transverse field Ising model successfully.

University of Tokyo *Tokyo, Japan*
University of Tokyo Summer Internship Program (UTSIP) *Jun. – Aug. 2018*
- Title Tissue homeostasis in a cellular automaton
- Supervisor Yu Chen
- We presented a multicellular homeostasis model in the form of a 2D stochastic cellular automaton with three cellular states – growth, death and arrest, which establishes a statistical non-equilibrium system under specific interaction rules. Through the mean field analysis and Monte Carlo simulations, we found that the system evolves into extinctive, proliferative and degenerative phases given different parameters. The study suggested that the collapse of homeostasis at the multicellular level may originate from the physics of some non-equilibrium processes.
- This research led to a published paper [3].

HONORS & SCHOLARSHIPS

ETH Scholarship for international students *Aug. 2021*
Chinese National Scholarship *Oct. 2017*

SKILLS

Language

- English
- Chinese

Programming

- Languages for scientific computing — Python, C++, MATLAB and Mathematica
- Packages for machine learning and GPU acceleration — PyTorch and JAX
- Quantum many-body methods — NQS, ED, QMC, MPS and mVMC

PUBLICATIONS

1. **Ao Chen**, Kenny Choo, Nikita Astrakhantsev, and Titus Neupert. Neural Network Evolution Strategy for Solving Quantum Sign Structures (in preparation).
2. Nikita Astrakhantsev, Tom Westerhout, Apoorv Tiwari, Kenny Choo, **Ao Chen**, Mark H. Fischer, Giuseppe Carleo, and Titus Neupert. Broken-Symmetry Ground States of the Heisenberg model on the Pyrochlore Lattice. arXiv:2101.08787 (2021).
3. Yuting Lou, **Ao Chen**, Erika Yoshida, and Yu Chen. Homeostasis and systematic ageing as non-equilibrium phase transitions in computational multicellular organizations. R. Soc. open sci. 6: 190012 (2019).

REFERENCES

Prof. Dr. Titus Neupert
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- Associate Professor at the Department of Physics, University of Zürich
- Master thesis supervisor

Dr. Yang Qi
qiyang@fudan.edu.cn

- Researcher at the Institute of Physics, Fudan University
- Bachelor thesis supervisor