JIAQI CAI

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EDUCATION

Huazhong University of Science and Technology *2015 - Present*
Senior Undergraduate Overall GPA: 88/100, Rank: 10%
Major in Applied physics, from School of Physics.

AWARDS

China Undergraduate Physics Tournament, the Second Prize, 2015

Top Academic Student Award, Huazhong University of Science and Technology, 2016

National Scholarships, Ministry of Education, P.R.C, 2017

Pacemaker to Merit Student , Huazhong University of Science and Technology, 2017

INTERESTS

Experiment: Condensed matter & AMO physics, quantum information processing based on superconducting circuits or other promising platforms.

Theoretical interests:

- Geometric description in physics: topology, gauge field *etc*. Topological effects in electonic properties or photonics, tensor network state & geometry, *etc*.
- Interaction and correlation between the matter and the field: entanglement spreading in many body localization or chaotic system, quantum fluid of light, open quantum system *etc*.
- Control of the artificial system: quantum optimal control, self-learning control, *etc*(control methods), topological photonics, sonic crystal, ultracold atoms and other promising metamaterial or quantum simulation platform(artificial systems).

TECHNICAL STRENGTHS

Computer Languages Python, MATLAB, LaTeX
Software & Tools ED, DMRG, QuTiP, BLAS, Pytorch, *etc*

RESEARCH PAPERS AS FIRST AUTHOR OR FIRST CO-AUTHOR

1. Implementing universal nonadiabatic holonomic quantum gates with transmons, Zhuo-Ping Hong*, Bao-Jie Liu*, **Jia-Qi Cai***, Xin-Ding Zhang, Yong Hu, Z. D. Wang, Zheng-Yuan Xue arXiv:1710.03141, Phys. Rev. A, **97**, 022332
2. Out-of-time-order correlation functions as indicators of quantum phase transitions in the Rabi and Dicke model. Zheng-Hang Sun*, **Jia-Qi Cai***, Qi-Cheng Tang, Yong Hu, Heng Fan, arXiv:1811.11191, to be submitted to Phys. Rev. Lett.
3. Non-Hermitian topological microwave photonics with synthetic non-Abelian gauges. **Jia-Qi Cai**, Zheng-Yuan Xue, Ming Gong, Guang-Can Guo, Yong Hu arXiv:1812.02610, to be submitted to Phys. Rev. Lett.

*those authors contributed equally to this work

VISIT

1. CAS Key Laboratory of Quantum Information,
   University of Science and Technology of China, Prof. Ming Gong — Feb – Jan, 2018
2. Institute of Physics, Chinese Academy os Sciences, Prof. Heng Fan — Sep, 2018
3. Guangdong Provincial Key Laboratory of Quantum Engineering and Quantum Materials,
   South China Normal University, Prof. Zheng-Yuan Xue — Sep, 2017

RESEARCH EXPERIENCE

1. Quantum simulation of topological materials

   non-Hermitian condensed matter system in non- Abelian gauge field: Topological phases in photonic system with inevitable loss and gain are investigated. Moreover, we combine the synthetic non-Abelian gauge field with this non-Hermiticity, which gives rise to exotic phases of light and explicitly broken of bulk-edge correspondence. See cf. Publications 3.

2. Dynamical properties of quantum matters

   OTOC correlation in few body systems: Quantum phase transition in few body quantum system can broaden our horizon of exotic behavior of quantum matter. Here, we report a new experimentally feasible observables, OTOC, to detect QPT in those systems dynamically. See cf. Publications 2.

   Machine learning of dynamical quantum phase transition(DQPT): Coherent quantum real-time evolution gives rise to a new type of phase transition where physical quantities are non-analytic at critical time points. Lacking the notion of a free energy in this theory, whether there exists general principle of DQPT or not is still oan pen question. We wonder if machine learning can help to dig out the DQPT critical time.

   Quantum information spreading in many-body localization & quantum chaotic system: The eigenstate thermalization hypothesis states that the reduced density matrix of a subsystem corresponding to an excited state is thermal. We exam this hypothesis by the observing the flow of quantum information.

3. Quantum computation and information processing

   Non-Adiabatic holonomic quantum gate: To build a robust and fast quantum gate is challenging in quantum information science. We report that a very high-fidelity arbitrary one qubit or two qubit quantum gate can be achieved in transmon qubit, by our non-adiabatic holonomic manipulations. This scheme is now partially verified by experiments. see cf. Publications 1.

LEADERSHIP

- Chairman of Innovative Base of Physics Experiment(IBPE), Huazhong University of Science and Technology.
- Chairman of Academic Seminar for Seniors, School of Physics, Huazhong University of Science and Technology.
- Tutor of Classical Reading Seminar for Freshman, School of Physics, Huazhong University of Science and Technology.