

# Jiheng Duan

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## EDUCATION

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- **University of Rochester** NY, United State  
• **Doctor of Philosophy: Physics** Aug 2023 - Present
- **University of Macau** Macau, China  
• **Bachelor of Science: Applied Physics and Chemistry (GPA: 3.49/4.0)** Aug 2019 - June 2023
- **University of California, Berkeley** Online  
• **Summer Session: Summer Session Program (GPA: 3.7/4.0)** June 2022 - Aug 2022

## RESEARCH EXPERIENCES

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- **Research Assistant - Institute of Applied Physics & Materials Engineering** Macau, China  
14 hours per week Aug 2020 - Present
  - **Supervisor: [Pro. Hou IAN](#)**
  - **Topic 1 (Oct. 2021 - Oct. 2022): A Quantum Algorithm for Finding Collision-inducing Disturbance Vectors in SHA-1**
    - Systematically studied the differential analysis collision attack on the cryptographic hash function SHA-1.
    - Generalized the inversion and diffusion process in the Grover search in our quantum algorithm.
    - Simulated the algorithm using a quantum evolution simulation package in Python.
    - Reviewed methods of generating entangled quantum states and proposed a new one for this problem.
    - Proposed an optical implementation of the algorithm using the DOPO network, with a 3D experimental setup rendered by Blender.
    - Practicing scientific writing skills and description abilities. The corresponding paper is under revision.
  - **Topic 2 (May 2021 - Sept. 2021): 2000-Node Optimization: From the Ising Model to the MAX-CUT Problem Using the Simulated Annealing Algorithm**
    - Systematically study the MAX-CUT problem and other combinatorial optimization problems.
    - Reviewed and practiced the Metropolis and simulated annealing algorithms.
    - Implemented a simulated annealing Python program minimizing the Hamiltonian of an Ising model for solving a 2000-node MAX-CUT problem.
    - Compared the efficiency differences between homogeneous and inhomogeneous simulated annealing algorithms.
    - A brief review of the quantum annealing algorithm.
  - **Topic 3 (Oct. 2021 - Feb. 2022): On the Phase Controlled Qubit State Measurement Using Analog Microwave Phase Shifter**
    - Assistant with the experiment, learning control of the VNA, the dilution refrigerator, and sample installation.
    - Studied the theory of microwave phase shifter and qubit state measurement technique.
    - Cooperated with the author to report the project to the supervisor.
  - **Topic 4 (May. 2022 - present): Tuning 2-qubit on a superconducting qubits chip and the measurement of collective lamb shift**
    - Assistant with the experiment and data analysis, using VISA to control the VNA for measurement, and writing codes for fitting the lamb shift curve.
    - Studied the theory of copper-pair box.
    - Cooperated with the author to report the project to the supervisor.
  - **Topic 5 (Nov. 2021 - Jan. 2022): Strong Field Electromagnetically Induced Transparency Based on Coupled Flux Qubits**
    - Proposed a method using  $\sigma_z$  coupled flux qubits to realize a strong field electromagnetically induced transparency.
    - Studied the superconducting qubits and SQUID, including the theory of the AC/DC Josephson effects.
    - A method of diagonalizing this kind of Hamiltonian is proposed by introducing block diagonalization skills.
- **Research Assistant - Institute of Applied Physics & Materials Engineering** Macau, China  
7 hours per week Oct 2019 - Aug 2020
  - **Supervisor: [Pro. Li Zongjin](#)**
  - **Topic (Oct. 2019 - Dec. 2019): Magnesium Sulfate Concretes**
    - Finished the strength, ductility, and physical properties tests of improved magnesium sulfate concrete.

## HONORS AND AWARDS

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- Sir Run Run Shaw Scholarship Sept 2022
- 2022 Summer Programme Sponsorship July 2022
- Certification to Final, China Computer Federation Quantum Programming Competition May 2022
- Dean's Honor List Aug. 2022/March 2022/March 2020
- RC Foundation Scholarship Dec. 2020
- Third Prize, China Undergraduate Physics Tournament Oct. 2020
- Second Prize, National High School Mathematics League(Shandong, China) Sept. 2018

## PUBLICATIONS

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- **Duan, J.**, Li, M. and Ian, H., 2022. A quantum algorithm for finding collision-inducing disturbance vectors in SHA-1. arXiv preprint arXiv:2210.12762.
- You, Z., Chio, C., **Duan, J.**, Hoi, I., Tam, K. and Ian H., 2022. On the Phase Controlled Qubit State Measurement Using Analog Microwave Phase Shifter. (Submitted to QINP)

## SKILLS SUMMARY

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- **Technical Skills:** Python, C/C++, MATLAB, L<sup>A</sup>T<sub>E</sub>X, Shell Bash/Zsh
- **Often-used Library:** Qiskit, QuTiP, QPanda
- **Software Tools:** COMSOL, Illustrator, ANSYS Electronic Desktop, Blender, Premiere Pro, After Effects, SPSS
- **Soft Skills:** Self-learning, Leadership, Event Management, Writing, Public Speaking, Time Management

## EXPERIENCES

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- **Director - Seminar of Physics at the University of Macau, University of Macau** Macau, China  
5 hours per week March 2022 - Present
  - **About:** The Seminar of Physics at the University of Macau (SPUM) is a series of unofficial lectures organized by me and together with my classmate [Yichen Liu](#). We are willing to offer the contents of physics that the University of Macau's curriculum does not provide, such as classical mechanics, supplementing the theoretical basis of future research and studies in physics for the physics and chemistry students. Our site:[SPUM](#).
  - **Personal Works:** Teaching analytical mechanics and quantum mechanics, including basic Lagrange and Hamilton mechanics, quantum dynamics, quantization of fields, approximation methods, and scattering.
- **Residential Assistant - Moon Chun Memorial College** Macau, China  
7 hours per week Aug 2020 - May 2021
  - **Personal works:** Residential area management, leading the college community to participate in events and activities, proposing and organizing educational activities, and organizing the first-year orientation.
- **Monitor - Department of Physics and Chemistry, University of Macau** Macau, China  
6 hours per week Aug 2019 - Present
  - **Personal Works:** Associating students, helping the department to organize activities.
  - **Additional Works:** Organizing a team for attending the 2020 China Undergraduate Physics Tournament.
- **Technical Director - Physical and Chemical Society, University of Macau** Macau, China  
4 hours per week Aug 2022 - Present
  - **Personal Works:** Associating with other directors for technical works such as poster design, web design, and coding.
- **Member - University of Macau Swimming Team, University of Macau** Macau, China  
8 hours per week Sept 2019 - Sept 2020
  - **Personal Works:** Attending local swimming competitions and awards several awards.
- **Young Scientist Participant - Hong Kong Laureate Forum** Hong Kong, China  
1 hour per week Feb 2022 - Present
  - **Personal Works:** Participant in the forum on astronomy and mathematical science.