Qiaochu Wan

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Objective

I am seeking a challenging position in the industry where I can apply my expertise in optics, machine learning, and condensed matter physics. I am passionate about contributing to innovative projects at the intersection of theoretical research and practical applications.

Education

- **Shanghaitech University** *September 2016 - August 2020*
  Bachelor of Science, Physics Shanghai, China
  - GPA: 3.68/4.0 in Physics major (Rank top 10 in Major)
  - Scholarship of Academic Excellence (for top 15% of students)
- **University of California, Berkeley** *August 2019 – August 2020*
  Undergraduate exchange CA, USA
  - Grade: 3.8/4.0 in Physics major
- **University of Pittsburgh** *August 2020 – expected November 2025*
  Doctor of Philosophy, Physics PA, USA
  - GPA: 3.9/4.0 in Physics major
  - Award of PQI fellowship

Projects

- **Project A: Machine learning algorithm for hBN thickness identification** *August 2024 - Present*
  Tools: microscope, AFM, Python, Matlab, SVM, Autoencoder, Mask R-CNN, PyTorch, scikit-learn
  - Implemented machine learning to accurately determine hBN flake thickness using only microscopic images, significantly reducing manual effort in exfoliation processes.
  - Created comprehensive training dataset by combining microscopic images with AFM scans.
  - Developing a computer vision algorithm based on Mask RCNN and Autoencoder to analyze the microscopic image of 2D material without doing an AFM scan, aiming to generalize the algorithm for a wide range of microscope illumination settings.
  - Took the tensor network courses and applied tensor network to accelerate the machine learning training process.
- **Project B: Discovery of a New Quasi-Particle - "Quaternion" for Novel Superconductors** *May 2021 - Present*
  Tools: Electron Beam Lithography, Photonic Lithography, Plassys E-Beam, dry etching, circuit design, optics
  - Discovered a new quasi-particle in a TMD bilayer system, identifying a unique, doubly-charged four-particle boson named "Quaternion."
  - Fabricated samples through mechanical exfoliation of 2D materials, dry transfer for 2D heterostructures, and photonic and electronic lithography for circuit development.
  - Measured its electronic and magnetic propriety in the National MagLab in Florida
  - Quaternion shows strong potential as an up-and-coming candidate for superconductors at room temperature and room pressure.
- **Project C: Ultra-Low Threshold Polariton Laser for On-Chip Optical Computation** *December 2022 - May 2024*
  Tools: PE-CVD, AFM, Fourier Optics, Cryogenic System, Femtosecond Laser, Fiber Optics, Optical simulation
  - Developed a high-efficiency nanolaser using TMD multi-quantum wells, achieving an ultra-low threshold with high efficiency.
  - Fabricated nanometer-scaled samples on pre-patterned chips incorporating a vertical-cavity surface-emitting laser (VCSEL) structure.
  - This nanolaser presents promising applications as a potential light source or optical switch for next-generation on-chip optical computation systems.
- **Project D: Weakly Coupled Polaritons in Wide-Area TMD Monolayers** *March 2022 - May 2023*
  Tools: ALD, AFM, VTE(vacuum thermal evaporation), Fourier Optics, Cryogenic System, XRD, Optical simulation
  - Collaborated with Professor Hui Deng to develop a method for transferring large-area TMD monolayers onto DBR surfaces with dodecane encapsulation.
  - Fabricated wide area cavity to encapsulate wide area Monolayer with transferable DBR grown by VTE.
  - Conducted photoluminescence measurements using a Fourier optics setup, identifying weakly coupled polaritons on a millimeter scale, marking a significant step toward next-generation optoelectronic devices based on TMDs.

EXPERIENCE

- **University of Pittsburgh** *August 2020 - Now*
  Research Assistant PA, USA
  - Fabricated a high-efficiency polariton laser(VCSEL) using TMD multi-quantum wells, achieving an ultra-low threshold with high efficiency on Silicon chips.
  - Developing a computer vision algorithm based on Mask RCNN and Autoencoder to analyze the microscopic image of 2D material without doing an AFM scan, aiming to generalize the algorithm for a wide range of microscopes illumination settings.
  - Discovered a new quasi-particle in a gated TMD bilayer system using Nanofabrication Process in the clean room, identifying a unique, doubly-charged four-particle boson named "Quaternion."
- **University of Pittsburgh** *August 2020 - August 2021*
  Teaching Assistant PA, USA
  - Assisting the instruction of modern physics experiment courses for undergraduates.
  - Led experimental physics classes twice weekly for a group of 40 students.
- **University of California, Berkeley** *August 2019 - August 2020*
  Research assistant CA, USA
  - Measuring the Valley Hall effect in WSe_2/WS_2 hetero-bilayer
  - Fabricated bilayer TMD devices using electron-beam lithography and plasma etching for ARPES at Lawrence Berkeley National Laboratory (LBNL).
- **University of Oxford, Clarendon Laboratory** *May 2019 - June 2019*
  Research Intern Oxford,UK
  - Synthesized heavy fermion material and Weyl semi-metal using Bridgman and Bi-flux method
  - Gained hands-on experience with XRD, magnetron sputtering, and XRR for ARPES at Diamond Light Source.
- **Shanghaitech University** *September 2018 - June 2019*
  Research Assistant Shanghai,China
  - Utilized Q# language to simulate the HHL algorithm for solving linear equations, contributing to foundational work in quantum computing for linear systems.
  - Successfully solved 2-by-2 Hermitian matrix equations in Q# and explored hybrid quantum-classical methods to enhance algorithm efficiency.
- **Shanghai Advanced Research Institute, Chinese Academy of Sciences** *September 2017 - Jan 2018*
  Research Assistant Shanghai, China
  - Simulated the propagation of leaser and interaction of two laser beams in the water using Matlab.
  - Applied the method for nonlinear fiber optics to solve the third-order nonlinear effect and water-photon interaction and achieved a well-matched result in a simplified water environment

SKILLS

- **Programming Languages:** Matlab, Python, Julia, Q#, JavaScript
- **Data Science & Machine Learning:** Data cleaning, Tensor Network for machine learning, Density matrix renormalization group, PyTorch, Sklearn, SVM, mask R-CNN, Autoencoder
- **Clean room Skills:** Spin coat, Electron Beam Lithography, Optical Lithography, Plasma Enhanced Chemical Vapor Deposition (PECVD), Hybrid Sputter/Evaporation System (Deposition System AJA), Plassys E-Beam Evaporation System, Plasma Enhanced Atomic Layer Deposition (PE-ALD), Dry Etching, Wire Bonding, Chemistry hoods
- **Characterization skills:** Atomic Force Microscope (AFM), Scanning Transmission Electron Microscope (STEM), Bruker X-Ray Diffractometer (XRD), Raman Microscope, Surface profiler
- **Optical Skills:** Fourier Optics, Fiber Optics, 4F system set-up, Photoluminescence measurement, Reflectivity measurement, Femtosecond laser and streak camera
- **Cryogenic skills:** low-temperature and high vacuum cryostat(4K), open circuit Helium cooling system, turbo pump, low temperature and high magnetic field measurement
- **Research Skills:** Condensed matter physics, Quantum field theory, Many-body physics, 2D material, excitonic state, polariton, photoelectric device, Boltzmann equation, data fitting, numerical solving of differential Partial equations, optical simulation with transfer matrix, Lab management
- **Other Tools & Skills:** Machine Tools, Lathe Machine, Drilling Machine, Milling Machine, Grinding, Computer Numerical Control, 3D modelling using Blender, PS, Illustrator, Office software, public speech.

Honors and Awards

- **PQI fellowship** *September 2024*
  Pittsburgh Quantum Institution
- **Honorable Mention** *February 2018*
  The Mathematical Contest in Modeling, Society for Industrial and Applied Mathematics

Publication list

A=Arixv, J=Journal, S=In Submission

[J.1] Charged bosons made of fermions in bilayer structures with strong metallic screening [J]*Nano Letters* (2021)21(18): 7669-7675.

[J.2] Bose condensation of upper-branch exciton-polaritons in a transferable microcavity. [J]*Nano Letters* (2023)23(20), 9538-9546.

[J.3] High Efficiency of Exciton-Polariton Lasing in a 2D Multilayer Structure. [J]*ACS Photonics* (2024) 11 (7),2722-2728.

[J.4] Bose-Einstein condensation of polaritons at room temperature in a GaAs/AlGaAs structure.[J]*ACS photonics* (2024)12(1),48-52

[A.1] Strong coupling of polaritons at room temperature in a GaAs/AlGaAs structure.*arXiv:*2502.12338

[S.1] Definitive evidence of asymmetric charged bosons in a bilayer system. Manuscript submitted for publication in *Science Advances*.

Public talks and presentation

- **Speaker** *March 2022*
  APS March meeting 2022, Chicago
  ◦ Charged Bosonic Excitonic State in Bilayer Structures with Strong Metallic Screening
- **Poster** *May 2022*
  Pittsburgh Quantum Institute Conference, Pittsburgh
  ◦ Charged Bosonic Excitonic State in Bilayer Structures with Strong Metallic Screening
- **Poster and Talk** *August 2022*
  ICSCE 11 Conference, Burlington
  ◦ Charged Bosonic Excitonic State in Bilayer Structures with Strong Metallic Screening
- **Speaker** *March 2023*
  APS March meeting 2023, Las Vegas
  ◦ Magneto-optic characterization of quaternion state in TMD bilayers with metallic screening
- **Poster and Speaker** *October 2023*
  MURI Meeting, Ann Arbor
  ◦ High Efficiency of Exciton-Polariton Lasing in a 2D Multilayer Structure
- **Author and submitter** *March 2024*
  APS March meeting 2024, Minneapolis
  ◦ High Efficiency of Exciton-Polariton Lasing in a 2D Multilayer Structure
- **Speaker** *March 2025*
  APS March meeting 2025, Anaheim
  ◦ Definitive Evidence of Excitonic Charged Bosons in a bilayer system

Volunteer Experience

- **Primary school teacher** *August 2017*
  Jinke Village First Primary School, near Five-hundred-meter Aperture Spherical Telescope(FAST)
  ◦ Introduced and taught introductory astronomy and physics to primary school students, bringing the first-ever physics class to this rural school.
  ◦ Engaged young students with hands-on activities and simplified physics concepts, fostering curiosity and foundational knowledge in science.
  ◦ Developed effective teaching skills tailored to young learners and adapted complex topics to an accessible level, enhancing science education in an underdeveloped community.

Additional Information

Languages: Chinese (Native), English(Fluent), Japanese (Beginner, near N3)